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RESEARCH ARTICLES

Peran Faktor Gizi dan Gaya Hidup dalam Musculoskeletal Disorders pada Porter

The Role of Nutritional and Lifestyle Factors in Musculoskeletal Disorders among Porters

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Abstract

Musculoskeletal disorders (MSDs) represent a frequent occupational health issue arising from mechanical stress, particularly repetitive lifting and long periods of standing. These conditions are especially prevalent among workers performing strenuous manual tasks, such as porters. Initial observations at Bandung Railway Station revealed recurring shoulder and calf discomfort reported by porters, suggesting the need to investigate whether nutritional intake, nutritional status, and lifestyle behaviors contribute to these complaints. This research sought to determine the association between nutrient consumption, nutritional status, lifestyle factors, and musculoskeletal disorder (MSDs) symptoms among porters at Bandung Railway Station. The study utilized a quantitative design with a cross-sectional framework. All 67 porters at the station were included through total sampling. Data were gathered through structured interviews using validated tools: the Nordic Body Map to identify MSD symptoms; a 24-hour dietary recall to quantify macro and micronutrient intake; the Pittsburgh Sleep Quality Index (PSQI) to assess sleep patterns; and anthropometric measurements to determine body mass index (BMI). Data analysis showed that sleep quality was the dominant factor (p-value = 0,002), with a 59,6% MSDs prevalence in poor sleepers versus 5% in good sleepers. Carbohydrate intake was also significant (p-value = 0,033), where adequate intake surprisingly recorded higher MSDs (59,3%) than deficient intake (32,5%); thus, MSDs in this study are primarily driven by poor sleep and suboptimal carbohydrate intake.

Keywords: *musculoskeletal disorders, nutrient intake, porter*

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Abstrak

Gangguan muskuloskeletal (MSDs) sering terjadi akibat beban mekanis dari pengangkatan berulang dan berdiri lama, dengan prevalensi tinggi pada pekerja fisik berat seperti *porter*. Informasi awal dari Stasiun Kereta Api Bandung menunjukkan bahwa *porter* sering mengalami nyeri pada bahu dan betis, sehingga perlu diteliti bagaimana asupan gizi, status gizi, dan faktor gaya hidup berhubungan dengan keluhan MSDs pada kelompok ini. Penelitian ini bertujuan untuk menganalisis hubungan antara asupan zat gizi, status gizi, dan gaya hidup dengan keluhan *musculoskeletal disorders* (MSDs) pada *porter* di Stasiun Kereta Api Bandung. Penelitian ini menggunakan desain penelitian kuantitatif dengan pendekatan *cross-sectional*. Populasi penelitian terdiri dari keseluruhan 67 *porter* yang bekerja di Stasiun Kereta Api Bandung, yang dipilih melalui total sampling. Data dikumpulkan melalui wawancara langsung menggunakan instrumen yang telah divalidasi, meliputi kuesioner *Nordic Body Map* untuk menilai keluhan MSDs, *food recall* 24 jam untuk mengevaluasi asupan makronutrien dan mikronutrien, Pittsburgh Sleep Quality Index (PSQI) untuk menilai kualitas tidur, dan pengukuran antropometri untuk menentukan indeks massa tubuh (IMT). Analisis data menunjukkan bahwa kualitas tidur menjadi faktor dominan (*p-value* = 0,002) dengan prevalensi MSDs 59,6% pada tidur yang buruk versus 5% pada tidur yang baik. Asupan karbohidrat juga signifikan (*p-value* = 0,033), asupan cukup justru mencatat MSDs lebih tinggi (59,3%) dibanding asupan kurang (32,5%). Masalah MSDs pada penelitian ini utamanya disebabkan oleh tidur yang buruk dan asupan karbohidrat yang tidak ideal.

Kata Kunci: gangguan muskuloskeletal, asupan nutrisi, porter

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Highlight:

- Sleep quality is the primary factor strongly associated with Musculoskeletal Disorders (MSDs) (*p-value* = 0,002). MSDs prevalence reached 59,6% in the poor sleep group compared to only 5% in the good sleep group.
- Carbohydrate intake has a significant relationship with MSDs (*p-value* = 0,033). Suboptimal intake triggers muscle fatigue due to lactic acid accumulation and low glycogen reserves during strenuous physical activity.
- The study involved 67 porters at Bandung Station, with the majority aged 40–59 years. Other variables such as age, years of work, nutritional status (BMI), and smoking habits were not significantly associated with the incidence of MSDs.

INTRODUCTION

Musculoskeletal disorders (MSDs) refer to a group of conditions marked by discomfort or pain affecting various body regions such as the neck, shoulders, back, hands, and feet. The intensity of these symptoms may vary widely, ranging from mild irritation to more debilitating pain (Dutta, 2024). These problems commonly arise from extended exposure to static postures, which place continuous mechanical stress on the body and may contribute to injuries involving muscles, ligaments, or joint structures.

A variety of factors can contribute to the development of MSDs, encompassing

occupational, individual, environmental, and psychosocial elements. Work-related determinants include the intensity of tasks, duration of work shifts, body posture during activities, and the frequency of repetitive movements (Raraswati et al., 2020). From the individual standpoint, characteristics such as nutritional status, age, exercise routines, smoking behavior, prior musculoskeletal issues, and overall physical fitness substantially influence one's susceptibility to MSDs (Alhashim et al., 2025).

Porters represent an occupational group with a notably high vulnerability to MSDs. Their routine responsibilities require them to lift and transport heavy loads repeatedly, creating substantial mechanical pressure on the musculoskeletal system and markedly elevating their risk of injury (Devi et al., 2017). Such strain can undermine concentration and productivity, diminish overall work performance, and heighten the likelihood of workplace accidents, ultimately contributing to increased healthcare expenditures (Harahap and Susilawati, 2023). The Global Burden of Disease (GBD) Study 2019 reports that musculoskeletal disorders affect an estimated 1,71 billion individuals worldwide. The highest concentration of cases is found in high-income countries, accounting for roughly 441 million people, followed by the Western Pacific Region with 427 million cases and Southeast Asia with 369 million. Among the various forms of MSDs, low back pain emerges as the most frequently documented condition.

In Indonesia, musculoskeletal disorder symptoms are estimated to affect 7,30% of individuals aged 15 years and older. West Java ranks sixth at the national level with a prevalence of 8,86%. Among labor groups in the province, including workers, bus drivers, and domestic helpers, the prevalence reaches approximately 7,61%. In Bandung City, the rate is higher at 9,35% (Kemenkes, 2018). Evidence from previous research supports this pattern. At Surabaya Gubeng Railway Station, 86,7% of the 60 porters surveyed reported symptoms of MSDs (Puspitasari, 2017). A similar finding was observed at Surakarta Railway Station, where 93,75% of porters stated they experienced musculoskeletal complaints (Dwileksmanawati, 2019).

Individual determinants such as dietary intake, nutritional status, and lifestyle behaviors contribute substantially to the development of MSDs. Adequate and balanced nutrition is essential for maintaining musculoskeletal function, whereas insufficient nutrient consumption can impair the performance of muscles and joints (Artaza-Artabe et al., 2016). Nutrient intake strongly influences overall nutritional status, and individuals classified as overweight or obese have a greater likelihood of reporting musculoskeletal problems than those with a normal weight profile (Muliani et al., 2023; Sattar et al., 2025). Excess body mass places additional mechanical pressure on the musculoskeletal system, which can trigger fatigue and increase the risk of injury (Rusman et al., 2023). Unhealthy lifestyle behaviors, such as smoking and inadequate sleep quality, have been associated with an increased likelihood of developing MSDs (Arifin and Darmawan, 2023). Smoking impairs respiratory function by reducing lung capacity and limiting oxygen transport to body tissues, which can promote muscle fatigue and discomfort through elevated lactic acid accumulation (Afro and Paskarini, 2022). Sleep disturbances, particularly interruptions in the NREM and REM stages, can disrupt muscle tone and neuromuscular regulation, including mechanisms along the spinal cord (Vetrivelan and Bandaru, 2023).

Preliminary interviews conducted with the Porter Coordinator at Bandung Railway Station showed that all porters reported experiencing pain, especially in the shoulders and calves. The interviews also confirmed that no previous studies had explored MSDs among porters at this location. This lack of existing evidence formed

the basis for the current study, which seeks to examine the relationship between nutrient intake, nutritional status, lifestyle behaviors, and musculoskeletal disorder complaints among porters at Bandung Railway Station.

METHODS

This research applied a quantitative method with a cross-sectional design to investigate the association between musculoskeletal disorder (MSDs) complaints as the dependent variable and several independent variables. The independent variables included age, duration of employment, intake of energy, protein, fat, carbohydrates, calcium, iron, body mass index (BMI), smoking behavior, and sleep quality. The study was carried out at Bandung Railway Station, the busiest station within Operational Area II Bandung. Between January and October 2024, the station recorded 1,268,243 passenger departures and 1,292,396 arrivals. Data collection and all phases of the research process, from preparation to the final report, were conducted between February 2024 and April 2025.

The study population consisted of all active porters working at Bandung Station in 2025 with a total of 67 individuals. Since the population was relatively small, a total sampling approach was used. Participants were included if they were registered as active porters during data collection, were present at the station during data gathering, and provided informed consent. Porters who were not available at the time of data collection were excluded. Validated and reliable tools were used for data collection. MSD complaints were identified through the Nordic Body Map questionnaire, which divides the body into specific numbered regions to pinpoint areas of pain. Respondents scored pain intensity from 1 to 4 for each region, and the cumulative score reflected the overall severity of MSD complaints.

Macronutrient and micronutrient intakes were measured using a single 24-hour dietary recall. Although repeated recalls are generally preferred to reduce individual variation, operational limitations and the highly mobile duties of porters prevented multiple recall sessions. Participants described all foods and beverages consumed during the previous 24 hours, including portion sizes and ingredients of processed foods to ensure accurate nutrient assessment. To limit recall errors, trained interviewers used probing techniques, portion estimation aids, and food photographs. The single 24 hour recall was considered an acceptable approximation of recent intake within the practical boundaries of the study.

BMI was calculated from direct anthropometric measurements using a digital scale and a microtoise. Smoking status was self-reported based on the number of cigarettes consumed per day. Sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI), which comprises seven components related to sleep patterns during the past month. PSQI scores range from 0 to 21, with scores of 5 or below classified as good sleep quality and scores above 5 categorized as poor sleep quality.

Data analysis included three stages. First, univariate analysis was used to summarize each variable. Second, bivariate analysis was performed using chi-square. Ethical approval for this research was granted by the Research Ethics Committee of Universitas Negeri Malang (Approval No. 19.02.09/UN32.14.2.8/LT/2025, issued February 19, 2025). The study followed core ethical principles, including respect for persons, beneficence, non-maleficence, and justice. All procedures adhered to these principles to ensure scientific integrity and protect participants throughout the study.

RESULTS AND DISCUSSIONS

Subject characteristics

Table 1 summarizes the demographic characteristics, prevalence of musculoskeletal disorders (MSDs), nutrient intake, nutritional status, smoking behavior, and sleep quality of porters working at Bandung Station in 2025. Most porters were adults aged 40 to 59 years, totaling 45 individuals (67,2%). For employment duration, the majority had been working for more than five years, amounting to 59 individuals (88,1%). Regarding MSD complaints, almost half of the porters, specifically 29 individuals (43,3%), reported experiencing symptoms related to musculoskeletal disorders.

Table 1. Profile of musculoskeletal disorders, nutritional intake, and lifestyle characteristics of porters at Bandung Station, 2025

Variable	n	%
Age		
Elderly (≥60 years)	8	11,9
Adults (40-59 years)	45	67,2
Young adults (19-39 years)	14	20,9
Working time		
Long working time (>5 years)	59	88,1
New working period (≤5 years)	8	11,9
Musculoskeletal disorders		
MSDs	29	43,3
Not experiencing MSDs	38	56,7
Energy intake		
Less	35	52,2
Enough	32	47,8
Protein intake		
Less	21	31,3
Enough	46	68,7
Fat intake		
Less	35	52,2
Enough	32	47,8
Carbohydrate intake		
Less	40	59,7
Enough	27	40,3
Calcium intake		
Less	51	76,1
Enough	16	23,9
Iron intake		
Less	11	16,4
Enough	56	83,6
Nutritional status		
Abnormal	16	23,9
Normal	51	76,1
Smoking habit		
Heavy smoker	16	23,9
Moderate smoker	35	52,2

Variable	n	%
Light smoker	5	7,5
Not a smoker	11	16,4
Sleep quality		
Less	47	70,1
Good	20	29,9
Total	**67**	**100**

Source: Primary data, 2025

Regarding nutrient intake, more than half of the porters, specifically 35 individuals (52,2%), consumed energy below the recommended dietary allowance. In contrast, most porters met their protein needs, with 46 individuals (68,7%) reporting sufficient intake. Deficiencies were identified in fat and carbohydrate consumption, affecting 35 individuals (52,2%) and 40 individuals (59,7%) respectively. Among the micronutrients examined, calcium showed the highest deficiency rate, with 51 porters (76,1%) not achieving the recommended intake. Iron intake, on the other hand, was adequate for most porters, with 56 individuals (83,6%) reporting sufficient consumption.

With respect to nutritional status, the majority of porters were classified within the normal weight range, totaling 51 individuals (76,1%). For smoking behavior, more than half of the respondents, or 35 individuals (52,2%), fell into the moderate smoker category. Meanwhile, most porters, amounting to 47 individuals (70,1%), reported having poor sleep quality.

The relationship between nutritional intake, lifestyle factors, and musculoskeletal disorders among porters at Bandung Station

Statistical analysis in Table 2 reveals that sleep quality is the most dominant factor strongly associated with the incidence of Musculoskeletal Disorders (MSDs) (p-value = 0,002). Subjects with poor sleep quality showed a significantly higher tendency to experience MSDs (59,6%) compared to those with good sleep quality, the majority of whom reported no complaints (9,0%).

Table 2. Bivariate analysis of the relationship between nutritional intake, lifestyle factors, and musculoskeletal disorders among porters at Bandung Station, 2025

Variable	MSDs		Not experiencing MSDs		Total		*p-value*
	n	%	n	%	n	%	
Age							
Elderly (≥60 years)	3	37,5	5	62,5	8	100	0,933
Adults (40-59 years)	21	46,7	24	53,3	45	100	0,473
Young adults (19-39 years)	5	35,7	9	64,3	14	100	*Baseline*
Working time							
Long working time (>5 years)	25	42,4	34	57,6	59	100	0,684
New working period (≤5 years)	4	50,0	4	50,0	8	100	*Baseline*
Energy intake							
Less	13	37,1	22	62,9	35	100	0,290

Variable	MSDs		Not experiencing MSDs		Total		*p-value*
	n	%	n	%	n	%	
Enough	16	50,0	16	50,0	32	100	*Baseline*
Protein intake							
Less	9	42,9	12	57,1	21	100	0,962
Enough	20	43,5	26	56,5	46	100	*Baseline*
Fat intake							
Less	14	40,0	21	60,0	35	100	0,571
Enough	15	46,9	17	53,1	32	100	*Baseline*
Carbohydrate intake							
Less	13	32,5	27	67,5	40	100	0,033*
Enough	16	59,3	11	40,7	27	100	*Baseline*
Calcium intake							
Less	21	41,2	30	58,8	51	100	0,535
Enough	8	50,0	8	50,0	16	100	*Baseline*
Iron intake							
Less	6	54,5	5	45,5	11	100	0,413
Enough	23	41,1	33	58,9	56	100	*Baseline*
Nutritional status							
Abnormal	8	50,0	8	50,0	16	100	0,740
Normal	21	41,2	30	58,8	51	100	*Baseline*
Smoking habit							
Heavy smoker	5	31,3	11	68,8	16	100	0,782
Moderate smoker	17	48,6	18	51,4	35	100	0,481
Light smoker	3	60,0	2	40,0	5	100	0,383
Not a smoker	4	36,4	7	63,6	11	100	*Baseline*
Sleep quality							
Less	28	59,6	19	40,4	47	100	0,002*
Good	1	5,0	19	95,0	20	100	*Baseline*

Note: *Chi-square, significant if p-value< 0,05

Additionally, carbohydrate intake shows a significant relationship (p-value = 0,033), although an anomaly was found where the group with adequate intake recorded a higher MSDs prevalence (59,3%) than the deficient group (32,5%), suggesting the need for further analysis regarding workload or physical activity. Conversely, other variables such as demographic factors (age and years of work), nutritional status (BMI), intake of energy, protein, fat, calcium, and iron, as well as lifestyle habits (smoking) showed no statistically significant correlation (p-value > 0,05) with MSDs in this study. Overall, MSDs in this sample are primarily driven by poor sleep quality and suboptimal carbohydrate intake.

The relationship between carbohydrate intake and musculoskeletal disorders

The results of this study show that low carbohydrate intake is significantly associated with a higher likelihood of musculoskeletal disorder (MSDs) complaints among porters at Bandung Railway Station. These findings are consistent with prior research indicating that inadequate carbohydrate consumption increases vulnerability to

fatigue and muscle discomfort following physical effort. Carbohydrates are stored primarily in the form of glycogen, which is essential for sustaining muscle function. Reduced glycogen availability weakens muscular performance and promotes early fatigue as well as musculoskeletal pain (Lucia et al., 2021).

Observational data from the present study show that many porters typically consume only two meals per day, which contributes to insufficient carbohydrate intake. This eating pattern does not meet the energy demands of porters whose daily tasks involve strenuous activities such as transporting and lifting heavy loads. Carbohydrates serve as the principal energy source during high intensity work. When dietary intake does not supply adequate energy, the body relies on muscle glycogen reserves.

Continuous use of glycogen without sufficient replenishment depletes these reserves. When this happens, the body increases lipid oxidation to maintain energy production. However, fat metabolism operates more slowly and is not efficient during intense physical activity (Tamas et al., 2024). As a result, the body shifts toward anaerobic metabolic pathways, generating lactic acid during the production of adenosine triphosphate for muscle contraction. Lactic acid accumulation stimulates nociceptors in the peripheral nervous system, producing sensations of muscle pain (Namma-Motonaga et al., 2022; Zulaini et al., 2021).

This physiological mechanism aligns closely with the working conditions of porters. Continuous physical exertion lowers muscle glycogen, and without enough carbohydrate intake, fatigue intensifies and MSD complaints become more frequent. Irregular eating patterns and limited knowledge of proper nutrition, particularly with regard to carbohydrates, compound this problem. When lipid oxidation becomes the main energy pathway, inefficient energy production leads to greater lactic acid buildup, which increases fatigue and muscular discomfort after physical work.

Chronic carbohydrate insufficiency poses serious health concerns for porters given the heavy physical demands of their occupation. Low carbohydrate intake may lead to muscle catabolism when the body breaks down muscle protein to meet its energy requirements. This process slows recovery and increases the likelihood of injury and persistent fatigue (Wiguna et al., 2022). Under more prolonged and severe deficiency, carbohydrate inadequacy may contribute to metabolic shifts toward fat oxidation, elevating the potential development of ketosis as a future risk rather than an immediate consequence. This condition may result in dehydration and disturbances in electrolyte balance, which are particularly hazardous for individuals engaged in physically demanding work (Sanjaya and Setiawan, 2024).

Incorporating low glycemic index carbohydrate sources can serve as a preventive implication, rather than a direct statistical conclusion, for reducing MSD risk (Adinda et al., 2025). Foods such as whole grains, vegetables, and fresh fruits provide a sustained release of energy and help maintain stable blood glucose levels. Preventive actions should therefore include ensuring better access to nutritious foods as well as targeted nutrition education for porters. These measures are essential for stabilizing glycogen levels during physical activity and reducing the likelihood of fatigue and muscle discomfort arising from inadequate energy intake.

The relationship between sleep quality and musculoskeletal disorders

This study also observed that most porters reported musculoskeletal disorder (MSDs) complaints. These findings align with earlier studies that identified a meaningful relationship between sleep quality and the occurrence of musculoskeletal symptoms (Tam

et al., 2021). Poor sleep has consistently been linked to a greater incidence of MSDs.

A review of existing literature supports this outcome, noting that individuals who sleep less than eight hours per night have an elevated risk of developing musculoskeletal problems (Maulana et al., 2021). This is particularly relevant for porters at Bandung Station, whose work requires intense physical activity and whose sleep patterns are frequently disrupted. Because porters must adapt their rest periods to irregular train schedules, many experience fragmented sleep and limited recovery. This pattern interferes with the nightly restoration of muscles and connective tissues.

Nighttime sleep plays an essential role in facilitating muscle repair through protein synthesis, growth hormone regulation, and the release of regenerative biomarkers. One key factor is insulin-like Growth Factor 1 (IGF-1), which contributes to the repair and regeneration of muscles, bones, and ligaments (Chennaoui et al., 2021). Insufficient sleep reduces the production of IGF 1 and other anabolic hormones, ultimately impairing the body's ability to recover from physically demanding work.

Beyond the physical workload, psychological stress also influences sleep quality among porters. The uncertainty of daily income often encourages porters to prolong their working hours, reducing time available for rest. Persistent stress elevates cortisol, epinephrine, and norepinephrine levels, which disrupt sleep regulation by interfering with the Reticular Activating System. These disturbances impair both REM and non-REM sleep phases, causing frequent awakenings and symptoms such as nightmares (Cerro et al., 2022).

The effects of poor sleep extend beyond delayed tissue recovery. Sleep deprivation induced fatigue can reduce productivity and increase the likelihood of workplace injuries. Over the long term, chronic insufficient sleep has been associated with serious health outcomes including hypertension, type 2 diabetes, and cardiovascular disease. Insufficient sleep is also strongly linked to mental health issues such as anxiety and depression (Khan and Aouad, 2017).

The results of this study emphasize the critical role of sleep quality in maintaining musculoskeletal health. Poor sleep contributes substantially to the high prevalence of MSDs among porters. Interventions targeting sleep quality improvement are therefore essential. One possible initiative for PT KAI Persero is the provision of designated rest facilities with proper lighting, ventilation, and comfort to support quality sleep. Implementing sleep hygiene education, including guidance on consistent sleep routines and limiting stimulant use such as caffeine, may further support porter well being. These interventions are particularly needed since many porters currently rest in public areas such as prayer rooms or waiting lounges, which may not provide an environment conducive to restorative sleep.

CONCLUSIONS

This study identified a significant relationship between carbohydrate intake and sleep quality with the occurrence of musculoskeletal disorders (MSDs) among porters. These findings emphasize the importance of adequate nutrition and sufficient rest in preventing MSDs among workers who perform physically intensive tasks. Preventive efforts may include improving access to nutritious foods, offering targeted health education, and providing appropriate rest facilities. Despite the strengths of these findings, several limitations should be acknowledged. MSD complaints were measured using the Nordic Body Map questionnaire, and carbohydrate intake was estimated from a single 24 hour dietary recall. Although these tools are validated and widely applied, the

use of self-reported data introduces possible bias, particularly related to inaccuracies in recalling food intake or physical symptoms. Beyond measurement concerns, broader contextual influences on MSDs and sleep quality were not captured in this study.

This study also did not include various psychosocial or environmental factors, such as noise exposure or occupational stressors, that may influence sleep quality. Furthermore, sleep quality was evaluated using the Pittsburgh Sleep Quality Index, which is validated but remains a subjective self report measure. Although widely utilized, self-reported sleep assessments are susceptible to recall errors and response bias. Future investigations should integrate objective methods such as actigraphy or polysomnography and examine additional contributors to sleep disturbances that may play a role in the development or exacerbation of musculoskeletal disorders.

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CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest related to the content of this manuscript.

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