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Work posture analysis using the rapid entire body assessment (REBA) method for musculoskeletal disorders (MSDs) complaints in laboratory workers

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Abstract

Purpose: This study aims to determine the risk level of work posture and musculoskeletal complaints among laboratory workers at the Faculty of Medicine, Public Health, and Nursing, Gadjah Mada University, Yogyakarta. **Methods:** This study employed an observational analytic design with a cross-sectional approach. The independent variable was work posture, while the dependent variable was musculoskeletal complaints among laboratory workers. Data were collected simultaneously during the study period. The research sample consisted of laboratory workers at the Faculty of Medicine, Public Health, and Nursing, Gadjah Mada University, Yogyakarta, who met the inclusion and exclusion criteria. This study used total sampling, including all 46 laboratory workers. **Results:** According to the Chi-square test results, one independent variable showed a significant relationship with musculo- skeletal complaints, namely the period of service ($p = 0.00$). Work posture was not significantly related to musculoskeletal complaints ($p = 0.50$). Similarly, age and musculoskeletal complaints were not significantly related ($p = 0.61$), nor was body mass index (BMI) ($p = 0.85$). **Conclusion:** Length of service is significantly related to musculoskeletal complaints among laboratory workers in the Faculty of Medicine, Public Health and Nursing, Gadjah Mada University, Yogyakarta.

Keywords: age; body posture; musculoskeletal; years of service

INTRODUCTION

Musculoskeletal disorders (MSDs) are complaints involving skeletal muscles, defined as muscles attached to the body's framework, experienced by individuals and ranging from mild to severe. These disorders are generally caused by excessive muscle strain and prolonged loading, which may result in damage to joints, ligaments, and tendons [1]. Musculoskeletal complaints include pain, aches, numbness, tingling, swelling, stiffness, tremors, sleep disturbances, and burning sensations, which may impair an individual's ability to move and coordinate limb movements, resulting in inefficiency, lost work time, and decreased work productivity [2].

MSDs affect muscles, joints, tendons, ligaments, and nerves. Most work-related MSDs develop gradually over time due to work activities or unfavorable work environments. These disorders commonly affect the back, neck, shoulders, and upper extremities, although the lower limbs may also be involved [3]. Awkward postures and heavy workloads are among the most common ergonomic risk factors associated with MSDs. In addition, manual material handling is recognized as a frequent work activity that increases ergonomic hazards and contributes to musculoskeletal complaints [4].

Work-related MSDs are among the most prevalent occupational health problems, affecting millions of workers each year. Construction workers, in particular, experience a higher incidence of work-related MSDs—approximately 16% higher than workers in other industries. The primary contributors to MSDs in the construction sector include high physical demands such as heavy lifting, repetitive tasks, and awkward working postures, including bending and twisting, kneeling, and working with the arms above shoulder height. Consequently, ergonomic interventions play a crucial role in reducing the risk of MSDs among construction workers. Ergonomists generally agree that implementing ergonomic measures to reduce physical workload in the construction industry should be actively promoted. In line with this, the Netherlands Sectoral Health and Safety Institute in the Construction Industry has implemented the national Lighter Work campaign to raise awareness among workers and employers about ergonomic practices [5].

The International Labour Organization (ILO), through its occupational disease prevention program, reported that MSDs, including carpal tunnel syndrome, accounted for 59% of all recorded occupational diseases in European countries in 2005 [6]. Furthermore, a report by the European Monitoring Commission estimated that MSDs were responsible for 49.9% of work absences lasting more than three days and 60% of permanent work-related disabilities [7]. In Argentina, 22,013 cases of occupational diseases were reported in 2010, with MSDs representing the most frequently occurring condition [8]. Similarly, in the Republic of Korea, cases of MSDs increased markedly from 1,634 in 2001 to 5,502 in 2010 [9]. This study aims to determine the risk level of work posture and musculoskeletal complaints among laboratory workers at the Faculty of Medicine, Public Health, and Nursing, Gadjah Mada University, Yogyakarta.

METHODS

This study is an observational, cross-sectional study aimed at examining the strength of the relationship between the independent variable, working posture, and the dependent variable, musculoskeletal complaints, among laboratory workers. The research was conducted in February 2019, with a total of 46 laboratory workers as the study population. Bivariate analysis was performed to assess the association between working posture and musculoskeletal complaints, and to evaluate the relationships between potential confounding variables (age, length of service, and body mass index) and musculoskeletal complaints. For categorical data involving the dependent, independent, and confounding variables, the chi-square test was applied, with a significance level of $p < 0.05$ and a 95% confidence interval.

RESULTS

The results of the univariate analysis showed that respondents aged ≤45 years accounted for 24 (52.17%), while those aged >45 years accounted for 22 (47.83%). The frequency distribution of length of service indicated that 11 respondents (23.91%) had ≤5 years of service, whereas 35 respondents (76.09%) had>5 years of service (Table 1).

Table 1. Characteristics of respondents (n = 46)

Characteristic	n	%
Age		
≤ 45 years	24	52.17
> 45 years	22	47.83
Length of service		
≤ 5 years	11	23.91
> 5 years	35	76.09
Body Mass Index (BMI)		
BMI < 25.0	22	47.83
BMI > 25.1	24	52.17
Working posture		
Low	17	36.96
Moderate	29	63.04
High	0	0
Very high	0	0
Musculoskeletal complaints		
Low	35	76.09
Moderate	11	23.91
High	0	0
Very high	0	0
Gender		
Male	19	41.30
Female	27	58.70
Level of education		
Senior high school	21	45.65
Associate degree	11	23.91
Bachelor's and master's degree	14	30.43

The frequency distribution of body mass index (BMI) showed that 22 respondents (47.83%) had a BMI <25.0, while 24 respondents (52.17%) had a BMI >25.1. The frequency distribution of working posture indicated that 17 respondents (36.96%) were in the low-risk (non-risk) category, while 29 respondents (63.04%) were in the moderate-risk category. The frequency distribution of musculoskeletal complaints showed that 35 respondents (76.09%) were in the low category, while 11 respondents (23.91%) were in the moderate category. By gender, 19 respondents (41.30%) were male, and 27 (58.70%) were female. The frequency distribution of educational level showed that 21 respondents (45.65%) had completed senior high school, 11 respondents (23.91%) held an associate degree, and 14 respondents (30.43%) had a bachelor's or master's degree (Table 1).

The results of the bivariate analysis using the Chi-square test with a 95% confidence interval (CI) and a significance level of $p < 0.05$ are presented in Table 2. The results of the bivariate analysis showed that among laboratory workers aged ≤ 45 years, 19 respondents (54.29%) reported low musculoskeletal complaints, while 5 respondents (45.45%) reported moderate musculoskeletal complaints. Among laboratory workers aged > 45 years, 16 respondents (45.71%) reported low musculoskeletal complaints, and 6 respondents (54.55%) reported moderate musculoskeletal complaints. The chi-square test yielded a p-value of 0.61, indicating no statistically significant association between age and musculoskeletal complaints (Table 2).

Table 2. Bivariate analysis

Variable	Musculoskeletal complaints				OR	p-value
	Low		Moderate			
	n	%	n	%		
Age						
≤ 45 years	19	54.29	5	45.45	1.42	0.61
>45 years	16	45.71	6	54.55		
Length of service						
≤ 5 years	5	14.29	6	54.55	0.13	0.00*
>5 years	30	85.71	5	45.45		
Work posture						
Low	12	34.29	5	45.45	0.62	0.50
Moderate	23	65.55	6	54.55		
BMI						
< 25.0	17	48.57	5	45.45	1.13	0.85
> 25.1	18	51.43	6	54.55		

Notes: n: number of respondents, *significant ($p<0.05$), OR: Odds Ratio, p: Probability, performed using the chi-square test.

Regarding length of service, laboratory workers with ≤ 5 years of service who reported low musculoskeletal complaints numbered 5 respondents (14.29%), while 6 respondents (54.55%) reported moderate musculoskeletal complaints. Among laboratory workers with a length of service > 5 years, 30 respondents (85.71%) reported low musculoskeletal complaints, and 5 respondents (45.45%) reported moderate musculoskeletal complaints. The chi-square test showed a p-value of 0.00, indicating a statistically significant association between length of service and musculoskeletal complaints (Table 2).

The bivariate analysis showed that among laboratory workers with a non-hazardous working posture, 12 respondents (34.29%) reported low musculoskeletal complaints, while 5 respondents (45.45%) reported moderate musculoskeletal complaints. Among laboratory workers with a hazardous working posture, 23 respondents (65.71%) reported low musculoskeletal complaints, and 6 respondents (54.55%) reported moderate musculoskeletal complaints. The chi-square test yielded a p-value of 0.50, indicating no statistically significant association between working posture and musculoskeletal complaints (Table 2).

Regarding BMI, 17 respondents (48.57%) with a BMI < 25.0 reported low musculoskeletal complaints, while 5 respondents (45.45%) reported moderate musculoskeletal complaints. Among respondents with a BMI > 25.1, 18 respondents (51.43%) reported low musculoskeletal complaints, and 6 respondents (54.55%) reported moderate musculoskeletal complaints. The chi-square test yielded a p-value of 0.85, indicating no statistically significant association between body mass index and musculoskeletal complaints (Table 2).

DISCUSSION

The prevalence of musculoskeletal complaints among respondents was relatively high. Based on the study results, 11 out of 46 respondents reported experiencing musculoskeletal complaints. Although the types of complaints varied by work type, the most frequently reported complaint was back pain. Laboratory workers commonly reported pain in the right shoulder, back, and waist, as well as in both legs. These complaints arise because laboratory work in the Biochemistry, Anatomy, Pharmacology, Microbiology, Physiology, and Skills Laboratories requires workers to perform seated tasks for approximately 8 hours per day. Such work processes can lead to muscle tension, which may be further exacerbated when tasks are performed using non-ergonomic working postures. Among laboratory workers, musculoskeletal complaints are often perceived as common occupational issues; therefore, workers tend not to report them to workplace medical personnel unless the symptoms can be alleviated by rest or sleep.

Among laboratory department workers, the most common musculoskeletal complaints were reported in the upper arms and waist. These complaints are associated with work processes that require workers to lift nickel soil samples and then grind them. The weight of the load lifted is approximately 25 kg. During lifting, workers bend forward and use the spine as a fulcrum, placing excessive pressure on the lower back. In addition, workers are required to carry nickel soil samples to the storage area by pushing them with a manual pushing tool. The grinding process itself is repetitive and takes approximately 15–20 minutes, depending on the amount of nickel soil processed. This task is performed in a standing position with the back inclined forward, which contributes to musculoskeletal complaints in the waist region.

Association between work posture and musculoskeletal complaints

The human body is designed to perform daily work activities. Muscle mass, which accounts for nearly half of total body weight, enables humans to move and carry out work-related tasks. On the one hand, work is essential for development and performance improvement, enabling individuals to achieve productivity as a life goal. However, performing work also subjects the body to external loads. In other words, every job constitutes a burden for the individual, which may be physical or mental [10]. According to Anies (2014), body posture and certain tool-related work activities can cause health problems, including illness. Improper work postures can lead to health issues, including pain, fatigue, and work-related injuries. In addition, static postures, whether sitting or standing, for prolonged periods, may lead to musculoskeletal complaints. These negative effects can occur in both the short and long term.

Work posture in this study was assessed using the Rapid Entire Body Assessment (REBA) method. The results showed that the majority of respondents had risky working postures (29, 63.04%). The Chi-square test results in Table 8 indicate that respondents with risky working postures had a higher proportion of moderate musculoskeletal complaints (6 respondents, 54.55%) than those with non-risky working postures (5 respondents, 45.45%). The p-value of 0.50 indicates that the research hypothesis was rejected, indicating no statistically significant association between working posture and musculoskeletal complaints. The odds ratio (OR) of 0.62 indicates that respondents with risky working postures had 0.62 times the odds of experiencing moderate musculoskeletal complaints compared with those with non-risky working postures.

This study indicates that working posture is not associated with musculoskeletal complaints at a statistically significant level. Laboratory workers across several laboratory units exhibited varying working postures and ergonomic risk levels. Based on the assessment of working postures in the Pharmacology Laboratory using the REBA method, several tasks were performed in awkward or non-neutral postures; however, the overall ergonomic risk level was classified as low. The lowest REBA score observed was 2 among Skill Laboratory workers, while the highest REBA score was 8.

Based on the above description, the dominant working positions and postures among respondents in the laboratories of the Faculty of Medicine, Public Health, and Nursing at Universitas Gadjah Mada, Yogyakarta, include standing, squatting, bending, and stooping. The most frequently performed activities were lifting, carrying, and pushing work equipment, as well as repetitive hand movements. Most of these working postures and activities pose ergonomic risks and involve awkward joint angles, influenced by working methods, work tools, workstation design, and the physical demands of the tasks performed.

The findings of this study are consistent with those of Ulfah (2014), who reported no significant association between musculoskeletal complaints and work posture in the weighing and washing sections of laundry workers, with p-values of 0.77 and 0.257, respectively [11]. Similarly, a study by Maghfiroh (2014) found no significant relationship between work posture and musculoskeletal complaints ($p = 0.330$). In addition, Icsal (2016) reported no significant association between work posture and musculoskeletal complaints (p-value = 0.108) [10].

Association between age and musculoskeletal complaints

In general, musculoskeletal complaints are most commonly experienced between the ages of 35 and 65 [12]. Initial complaints typically begin around the age of 35 and tend to increase with advancing age. This occurs because, during middle age, muscle strength and endurance begin to decline, thereby increasing the risk of musculoskeletal complaints.

The aging process contributes to a decline in physical work capacity due to changes in organs and the cardiovascular and hormonal systems, which, in turn, increases the risk of musculoskeletal complaints [10]. Age is also closely associated with degenerative processes in muscles, bones, and joints. Muscle tissue gradually loses elasticity, and joints experience a reduction in synovial fluid, both of which are linked to the development of musculoskeletal complaints [13].

The results of this study show that the majority of respondents were aged ≤ 45 years, totaling 24 respondents (52.17%). The Chi-square analysis presented in Table 2 indicates that among respondents aged ≤ 45 years, 5 experienced moderate musculoskeletal complaints, whereas among respondents aged > 45 years, 6 did. The p-value of 0.61 indicates that the research hypothesis was rejected, suggesting no statistically significant association between age and musculoskeletal complaints. The odds ratio (OR) of 1.42 indicates that respondents aged 45+ had 1.42 times the odds of experiencing musculoskeletal complaints compared to respondents aged ≤45.

The absence of a significant association between age and musculoskeletal complaints among laboratory workers may be attributed to work allocation practices. Observations indicated that several laboratory workers

aged 45 or older were often assigned to work areas with lower physical workloads. Although the standard daily working duration for laboratory workers is 8 hours, the intensity of laboratory activities varies. On high-volume days, workers typically spend the full 8 hours in the laboratory. However, when laboratory activities are limited, workers spend approximately 4 hours performing laboratory tasks, with the remaining time allocated to administrative duties. As a result, laboratory workers aged 45 or older tend to experience lower physical strain, which may reduce their risk of musculoskeletal complaints.

The results of this study are consistent with the findings of Balaputra (2017), who studied nurses at dr. H. Koesnandi Bondowoso. That study found no significant positive relationship between age and musculoskeletal complaints among nurses (p-value = 0.451) [14]. Similarly, Ratna (2017) examined female masseuses at Badung Market in Denpasar and reported no significant positive relationship between age and musculoskeletal complaints (p-value = 0.7258) [15].

Association between length of service and musculoskeletal complaints

The risk of musculoskeletal complaints is influenced by the intensity, frequency, and duration of exposure, all of which are closely related to length of service. An increase in musculoskeletal disorders is associated with prolonged exposure of the musculoskeletal system to work-related physical demands, particularly those related to working hours. The longer an individual performs a job, the greater the cumulative exposure to occupational risk factors, which may increase the likelihood of work-related health problems, including musculoskeletal complaints. At the same time, longer working hours may contribute to increased work experience and productivity [16]. However, a higher workload is generally associated with an increased risk of musculoskeletal complaints due to sustained physical strain.

The average length of service for the respondents was 12 years, ranging from 1 to 38 years. The majority of respondents had a length of service of > 5 years, totaling 25 respondents (76.09%), while those with a length of service of ≤ 5 years accounted for 11 respondents (23.91%). The results of the Chi-square test presented in Table 2 indicate that respondents with a length of service of > 5 years experienced moderate musculoskeletal complaints in 5 respondents (45.45%), compared to 6 respondents (54.55%) among those with a length of service of ≤ 5 years. The p-value of 0.00 indicates that the research hypothesis is accepted, demonstrating a statistically significant relationship between length of service and musculoskeletal complaints. The OR value of 0.13 suggests that respondents with a length of service of > 5 years had 0.13 times lower odds of experiencing moderate musculoskeletal complaints compared to those with a length of service of ≤ 5 years.

There is a statistically significant relationship between length of service and musculoskeletal complaints among laboratory workers at the Faculty of Medicine, Public Health, and Nursing, Universitas Gadjah Mada, Yogyakarta. This finding may be attributed to the placement of long-serving workers in work areas with higher ergonomic risks, such as prolonged sitting and the use of non-ergonomic workstations, including chairs without adequate back support that do not meet workers' ergonomic needs. Prolonged engagement in high-risk activities, such as lifting heavy loads and working in awkward postures, increases cumulative exposure to musculoskeletal strain, thereby elevating the risk of musculoskeletal complaints. This result is consistent with previous studies indicating a higher prevalence of musculoskeletal complaints among respondents with a length of service exceeding five years.

The results of this study are consistent with those of Hazarin (2016), who reported a significant relationship between length of stay and musculoskeletal complaints among workers in the Production Unit of the "SP" Aluminum Metal Casting Factory in Yogyakarta, particularly among workers with a length of stay of more than 10 years (p = 0.049) [17]. Similarly, Maghfiroh (2014) found a significant association between a length of stay exceeding five years and musculoskeletal complaints (p = 0.012). Furthermore, Hastuti (2018) also demonstrated a significant relationship between a length of stay of more than five years and musculoskeletal complaints, with a p-value of 0.027.

Association between BMI and musculoskeletal complaints

Body mass index (BMI), or body size, is one factor associated with musculoskeletal complaints. BMI reflects the relationship between an individual's body weight and height and influences the ability of the musculoskeletal system to maintain balance when bearing loads, whether from body weight itself or from additional external loads [11]. An elevated BMI is commonly used as an indicator of obesity, defined as a BMI value exceeding 25 kg/m², according to the Ministry of Health of the Republic of Indonesia. BMI is also widely used to assess and monitor nutritional status and is calculated by dividing body weight (kg) by height (m²).

The results of the study indicate that 11 respondents (23.91%) had a BMI < 25.0, while 24 respondents (52.17%) had a BMI> 25.0. The Chi-square test results presented in Table 8 show that moderate musculoskeletal complaints were reported by 6 respondents (54.55%) with a BMI of > 25.0, compared to 5 respondents (45.45%) with a BMI of < 25.0. The p-value of 0.85 indicates that the research hypothesis is rejected, suggesting that there is no statistically significant association between BMI and musculoskeletal complaints. The OR of 1.13 suggests that respondents with a BMI> 25.0 had slightly higher odds of experiencing moderate musculoskeletal complaints than those with a BMI < 25.0; however, this difference was not statistically significant.

The findings of this study are consistent with those of Ratna (2017), who reported no significant association between body mass index and musculoskeletal complaints among female su'un noodle workers at Badung Market, Denpasar (p = 0.611) [15]. Similarly, Ningrum (2017) found no significant relationship between body mass index (BMI) and leg muscle strength among porters at Pasar Senen Railway Station (p-value = 0.470). Furthermore, Rossa (2017) also demonstrated no significant association between body mass index and musculoskeletal complaints among nurses at RSD Idaman Banjarbaru (p = 0.321).

CONCLUSION

The findings indicate that there was no statistically significant relationship between working posture, age, and body mass index with musculoskeletal complaints among laboratory workers. In contrast, a significant association was found between length of service and musculoskeletal complaints. Laboratory workers experienced mild to moderate musculoskeletal complaints, with the most frequently affected body regions being the upper neck, right shoulder, waist, back, and both legs.

Based on these findings, the Faculty of Medicine, Public Health, and Nursing, Universitas Gadjah Mada, Yogyakarta, is encouraged to implement an occupational safety and health (OSH) management system, including job placement and task assignment based on workers' age and length of service, as well as periodic job rotation. Collaboration with relevant institutions to provide regular occupational safety and health training, particularly on safe manual material handling, is also recommended. In addition, laboratory workers are encouraged to improve their occupational safety and health awareness and maintain physical fitness. Future studies are recommended to involve larger sample sizes and to include additional factors, such as physical environmental and psychosocial variables, that may influence musculoskeletal complaints.

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