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Factors Associated With Subjective Musculoskeletal Disorder (MSD) Complaints Among Fitness Instructors In Semarang City, 2025

Vimelani Afiska Mayratnaprima[1*], Ratih Pramitasari[2]

1,2 Public Health Study Program, Universitas Dian Nuswantoro
Jl. Imam Bonjol No. 207, Pendrikan Kidul, Central Semarang District, Semarang City, Central Java 50131
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*Corresponding Author: 411202203467@mhs.dinus.ac.id

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ABSTRACT
Musculoskeletal Disorders (MSDs) are common among fitness instructors due to repetitive movements, high physical load, and prolonged teaching duration. This study aimed to analyze factors associated with subjective MSD complaints among fitness instructors in Semarang City in 2025. A quantitative cross-sectional study was conducted with 110 instructors selected by accidental sampling. Data were collected using the Standardized Nordic Questionnaire (SNQ) and Rapid Entire Body Assessment (REBA). Bivariate analysis used Spearman Rank, Chi-square, and Fisher Exact tests (α=0.05). The prevalence of MSD complaints was 98.2% in the last 12 months and 97.3% in the last 7 days. There was no association between working period and MSD complaints (p=0.914; p=0.060). Working duration (p<0.001; p=0.017) and working posture (p<0.001; p<0.001) were significantly associated with MSD complaints, while exercise type was not (p=0.281; p=1.000). Strong correlations were observed for working duration (r=0.686) and working posture (r=0.763). Managing teaching duration and improving ergonomic posture are recommended to reduce MSD risk.

Introduction

Musculoskeletal Disorder (MSD) refers to disorders of the musculoskeletal system, including muscles, tendons, ligaments, joints, and nerves, which can impair movement function and reduce an individual's work capacity (1). This condition generally develops due to exposure to ergonomic risk factors such as repetitive movements, non-ergonomic working postures, and prolonged activity duration (1)(2). Globally, MSD is one of the leading causes of disability, with more than 1.7 billion cases worldwide, and low back pain as the largest contributor to the global burden of disability (3). The International Labour Organization (ILO) also reports that MSD accounts for approximately 40% of the total compensation burden due to occupational injuries and diseases worldwide (4). Its impact is not limited to individual health but also includes decreased productivity, increased work absenteeism, and significant economic burden.

In Indonesia, the 2018 Basic Health Research (Riskesdas) reported a musculoskeletal disorder prevalence of 7.9%, with several provinces showing rates higher than the national average (5). In addition, data from BPJS Ketenagakerjaan indicate an increase in occupational disease cases from 210,989 cases in 2019 to 234,370 cases in 2021, suggesting that occupational health problems remain relatively high (6). In Central Java, approximately 9.3% of the population has experienced injuries, with 9.21% occurring in the workplace, particularly among the productive-age group (7). From an ergonomic perspective, MSD is understood as the result of interaction between individual capacity and job demands, where factors such as work duration, activity frequency, working posture, and workload intensity play important roles, especially in physically demanding occupations (8).

Fitness instructors are one of the worker groups exposed to these risks due to the physically demanding, repetitive nature of their work, often performed over long durations. In Semarang City, there are more than 50 fitness studios with around 150 active instructors teaching in various settings, including fitness centers, communities, schools, and government programs. Instructors typically teach at least two sessions per day, each lasting about 1–1.5 hours, resulting in repeated exposure to physical workload and potential accumulation of muscle fatigue. This phenomenon is supported by the increasing trend in fitness activities, where the Sports Development Index shows that community participation rose from 25.4% in 2023 to 26.3% in 2024, with aerobic exercise being one of the most popular activities (9) This trend directly increases both the workload and demand for fitness instructors in the field.

Preliminary survey results among fitness instructors in Semarang City show a variety of exercise types such as aerobics, zumba, yoga, piloxing, line dance, and belly dance, with teaching experience ranging from 1.5 to 25 years. With a frequency of 1–14 classes per week, common complaints include soreness, cramps, pain, tingling, and muscle or joint stiffness, particularly in the back, knees, waist, shoulders, and legs. These complaints often recur due to a combination of tight schedules, specific working postures, and repetitive movements such as squats, jumps, backbends, and high-impact cardio movements. Several previous studies support these findings. For instance, a study by Merati et al. involving 435 subjects found that the prevalence of MSD among fitness instructors was higher compared to swimming instructors (10). Nery et al. reported an injury prevalence of 85% among 120 Brazilian Jiu-Jitsu athletes, with the highest distribution in the knees (35%) and shoulders (28%) (11). In the gym setting, Misal et al. noted that 78% of 147 instructors experienced shoulder pain due to repetitive activities (12). Shinde and Sahasrabuddhe found that 82% of 108 gym instructors experienced similar complaints associated with non-ergonomic postures (13). A literature review by George and Abraham of 10 studies confirmed the high prevalence of MSD-related pain in the shoulders and lower back, triggered by heavy workloads and repetitive movements (14).

Although many studies have examined Musculoskeletal Disorder (MSD) among fitness workers, most focus on gym instructors or athletes, while research on community-based fitness instructors remains very limited. In addition, previous studies generally assess risk factors separately and have not integrated subjective complaint measurements with objective ergonomic assessments. To date, no study has simultaneously used the Standardized Nordic Questionnaire (SNQ) and Rapid Entire Body Assessment (REBA) to examine the relationship between subjective complaints and biomechanical risk among fitness instructors. Furthermore, analyses combining work duration and working posture as key risk factors are still rarely conducted. Therefore, this study offers a novel contribution by integrating subjective and observational approaches to assess MSD risk among fitness instructors in Semarang City.

Methods

This study employed a quantitative design with an analytical observational approach using a cross-sectional method. All independent variables, including years of service, work duration, working posture, and type of exercise, as well as the dependent variable in the form of subjective complaints of Musculoskeletal Disorder (MSD), were measured simultaneously to analyze the relationships between variables. The study population consisted of all fitness instructors in Semarang City in 2025, totaling 150 individuals. Using the Slovin formula ($\alpha = 0.05$), a sample size of 110 respondents was obtained. Sampling was conducted using an accidental sampling technique with inclusion criteria: active instructors for at least one year, teaching at least once per week, and willing to participate as research respondents.

The main instruments used for data collection were the Standardized Nordic Questionnaire (SNQ) and the Rapid Entire Body Assessment (REBA) method. MSD complaints were measured using the SNQ for both the past 12 months and the last 7 days through guided interviews. Meanwhile, working posture was assessed using the REBA method through direct observation while instructors were teaching. Supporting data such as age, gender, years of service, work duration (total teaching hours per week), and type of exercise were collected through a respondent characteristics questionnaire. Both instruments have been scientifically validated, with the SNQ showing item correlation values ranging from 0.501 to 0.823 and a Cronbach's alpha reliability of 0.726, while the REBA method demonstrates strong inter-rater reliability with Cronbach's alpha values ranging from 0.75 to 0.90.

Data analysis was carried out using software through several stages of statistical testing. Univariate analysis was used to describe the frequency distribution of each research variable. Furthermore, bivariate analysis was performed to examine relationships between variables with a significance level of $p < 0.05$. The Spearman Rank test was used for ordinal-scale variables such as

years of service, work duration, and working posture. For the exercise type variable, the Chi-Square test was used for 12-month data, and Fisher's Exact test was applied for 7-day data to accommodate the frequency distribution. This study focused on partial relationships between variables; therefore, multivariate analysis was not conducted.

Result

Characteristics of Respondents

The characteristics of respondents in this study include gender, age, years of service, work duration, work posture based on the REBA assessment, and the types of exercise taught. An overview of these respondent characteristics is essential to understanding the distribution of research subjects before conducting the analysis of relationships between variables.

Table 1. Characteristics of Respondents

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	9	8.2
	Female	101	91.8
Age	Early Adult (26–35 years)	54	49.1
	Late Adult (36–45 years)	47	42.7
	Early Elderly (46–55 years)	9	8.2
Years of Service	Short (0–6 years)	13	11.8
	Moderate (6–10 years)	33	30.0
	Long (> 10 years)	64	58.2
Work Duration	Low (≤ 14 hours/week)	57	51.8
	High (> 14 hours/week)	53	48.2
Work Posture	Negligible Risk (1)	8	7.3
	Low Risk (2–3)	26	23.6
	Medium Risk (4–7)	36	32.7
	High Risk (8–10)	31	28.2
	Very High Risk (11–15)	9	8.2
Type of Exercise	High impact	80	72.7
	Low impact	30	27.3

Based on age group, the majority of respondents were in the early adulthood category (26–35 years), totaling 54 individuals (49.1%), followed by late adulthood (36–45 years) with 47 individuals (42.7%), and early elderly (46–55 years) with 9 individuals (8.2%). In terms of gender, most fitness instructors were female, accounting for 101 individuals (91.8%), while male respondents totaled 9 individuals (8.2%). These findings indicate that the study population was predominantly composed of women within the productive age range.

In terms of work experience, most respondents had long working periods (>10 years), with 64 individuals (58.2%), followed by moderate working periods (6–10 years) with 33 individuals (30.0%), and shorter working periods (0–6 years) with 13 individuals (11.8%). Regarding weekly work duration,

respondents with lower teaching intensity (≤14 hours/week) accounted for 57 individuals (51.8%), while those with higher work duration (>14 hours/week) totaled 53 individuals (48.2%).

Based on working posture assessment using the REBA method, the majority of respondents were categorized as having moderate risk (score 4–7), with 36 individuals (32.7%), followed by high risk (score 8–10) with 31 individuals (28.2%), low risk (score 2–3) with 26 individuals (23.6%), very high risk (score 11–15) with 9 individuals (8.2%), and negligible risk (score 1) with 8 individuals (7.3%). Finally, based on the type of exercise taught, most respondents instructed high-impact exercise, accounting for 80 individuals (72.7%), while low-impact exercise was taught by 30 individuals (27.3%).

Overview of Musculoskeletal Disorder (MSD) Complaints

In this study, MSD complaints were measured using the Standardized Nordic Questionnaire (SNQ), which is divided into two distinct timeframes: the last 12 months and the last 7 days.

Table 2. Overview of MSD Complaints Among Respondents

Variable	Category	Frequency (n)	Percentage (%)
MSD Complaints (Last 12 Months)	Low (0–20)	40	36.4
	Moderate (21–41)	56	50.9
	High (42–62)	14	12.7
MSD Complaints (Last 7 Days)	Low (0–20)	105	95.5
	Moderate (21–41)	5	4.5

Table 2 presents the distribution of respondents' MSD complaints across two time periods: the past 12 months and the last 7 days. Based on the data, MSD complaints over the past 12 months were predominantly in the moderate category (score 21–41), accounting for 56 individuals (50.9%), followed by the low category (score 0–20) with 40 individuals (36.4%), and the high category (score 42–62) with 14 individuals (12.7%). The relatively high proportion in the moderate to high categories over the past year indicates that musculoskeletal disorders among fitness instructors tend to be chronic or recurrent over time.

In contrast, findings from the short-term period (last 7 days) show a much lower distribution of MSD complaints. The majority of respondents were in the low category (score 0–20), totaling 105 individuals (95.5%), while only 5 individuals (4.5%) fell into the moderate category (score 21–41), and none were in the high category. This comparison suggests that although long-term cumulative complaints are quite substantial, acute complaints within a short period (the past week) are relatively mild, which may be influenced by daily recovery processes or fluctuations in teaching schedules.

Relationship Between Independent Variables and MSD Complaints

Bivariate analysis was conducted to determine the relationship between years of service, work duration, work posture (REBA), and the type of exercise with MSD complaints across two timeframes (the last 12 months and the last 7 days) using the Spearman Rank, Chi-square, and Fisher's Exact tests.

Table 3. Relationship Between Independent Variables and MSD Complaints

Independent Variable	Statistical Test	Dependent Variable		Status
		MSD Complaints (12 Months) (p-value)	MSD Complaints (7 days) (p-value)	
Years of Service	Spearman Rank	0.914	0.060	Not Significant
Work Duration	Spearman Rank	<0,001	0.017	Significant
Work Posture	Spearman Rank	<0,001	<0,001	Significant
Type of Exercise	Chi-Square & Fisher's Exact	0.281	1.000	Not Significant

Table 3 demonstrates the statistical analysis of factors associated with musculoskeletal complaints:

1. Years of Service: Analyzed using the Spearman Rank test, years of service shows no significant relationship with MSD complaints in either the last 12 months ($p = 0.914$) or the last 7 days ($p = 0.060$). This indicates that the duration of an instructor's career does not necessarily dictate the severity of musculoskeletal issues.
2. Work Duration: Using the Spearman Rank test, a significant relationship was found between work duration and MSD complaints in both the 12-month period ($p < 0.001$) and the 7-day period ($p = 0.017$). This suggests that higher weekly teaching hours directly increase the physical burden and the risk of musculoskeletal disorders.
3. Work Posture: Also analyzed through the Spearman Rank test, work posture (REBA) shows a highly significant correlation with both long-term ($p < 0.001$) and short-term ($p < 0.001$) MSD complaints. This reinforces the premise that ergonomic factors are critical drivers of MSDs in this profession.
4. Type of Exercise: Analyzed via Chi-Square for 12-month data ($p = 0.281$) and Fisher's Exact test for 7-day data ($p = 1.000$), the type of exercise does not show a significant relationship with MSD complaints. This implies that both low-impact and high-impact activities impose similar repetitive strains on the musculoskeletal system.

Discussion

The results of this study show that most respondents were in the productive age group (early and late adulthood). At this stage, physical capacities such as muscle strength, flexibility, and coordination remain relatively optimal to support activities with high physical demands. However, the aging process

still leads to a gradual decline in physiological function, where muscle mass and bone density decrease by approximately 1% per year after the age of 30 (15). Muscle flexibility can also decline by about 20–30% between the ages of 30 and 70 (16). This condition increases the risk of injury, considering that peak physical performance occurs between the ages of 20–40, while the risk of musculoskeletal complaints is higher in the 41–50 age group (16). Increasing age is directly correlated with declining physical capacity, which exacerbates the risk of MSD complaints (17).

Most respondents were female, who physiologically tend to have lower muscle mass and strength compared to males, making them more susceptible to muscle fatigue during repetitive activities (18). In addition to mechanical factors, hormonal influences such as estrogen also affect musculoskeletal function. Hormonal fluctuations may contribute to increased muscle fatigue thresholds and pain sensitivity, ultimately raising the risk of musculoskeletal complaints among female workers compared to males (18).

The distribution of years of service shows that the majority of respondents had long working experience, reflecting accumulated skills and expertise over time (19). However, the findings indicate that years of service were not associated with MSD complaints. This may be explained by physiological adaptation processes and increased work efficiency with greater experience (20). A study by Ahmed et al. found that workers with less experience had a higher risk of musculoskeletal complaints compared to more experienced workers (21). Similarly, Erna et al. reported no association between years of service and MSD complaints, as ergonomic factors and actual workload were more dominant determinants (22).

Work duration in this study showed a significant relationship with MSD complaints. Biomechanically, prolonged work duration increases cumulative mechanical load on muscles and joints due to repetitive movements that generate joint stress and continuous muscle contraction. This exposure triggers cumulative trauma in the form of microtrauma accumulation when the load exceeds tissue adaptation capacity. In addition, an imbalance between workload and recovery time (fatigue–recovery cycle) leads to persistent muscle fatigue. Bratland-Sanda et al. found that teaching more than 5 hours per week increases injury risk by 3.9 times (23). Merati et al. stated that prolonged duration leads to continuous muscle fatigue (10). George and Abraham categorized instructors as high-risk workers due to repetitive intensive activities (14). Physiologically, Kalangi explained that excessive activity reduces muscle contraction capacity (24). Reza et al. emphasized that musculoskeletal strain arises from insufficient recovery (25). This is further supported by MF. Yusuf et al., who showed that long working duration consistently increases subjective complaints (2), and by Hulshof et al., who concluded that long-term cumulative effects impair movement function (26).(23)(10)(14)(24)(25)(2)(26).

Working posture also showed a significant relationship with MSD complaints. Based on REBA assessment standards, most fitness instructors were categorized as having moderate (32.7%) to high risk (28.2%), with even very high risk (8.2%) requiring immediate intervention. These risks are triggered by deviations from neutral posture (awkward posture), such as trunk flexion greater than 60°, single-leg support causing load imbalance, and upper arm flexion exceeding 90°, which increases shoulder load. A study by Tatik and Eko found that workers with high-risk postures were 5.4 times more likely to experience MSD complaints (p=0.033), particularly in the back, neck, and shoulders due to continuous muscle strain (27). This condition is worsened by prolonged bending or static positions, which, according to Andriani et al., lead to uneven load distribution in the musculoskeletal system (1). These findings are supported by MF. Yusuf and Hulshof et al., who reported that poor ergonomic exposure significantly contributes to joint pain (2)(26). Santos et al. further emphasized that without ergonomic intervention, repetitive activities will worsen musculoskeletal conditions over time (28).

Most respondents were high-impact exercise instructors (72.7%) compared to low-impact (27.3%), reflecting the dominance of high-intensity, high-impact physical activity. Alex et al. explained that jumping movements in high-impact exercise increase joint load because both feet do not simultaneously contact the ground (29). Hartini stated that high-impact training imposes greater physical stress on the lower extremities, increasing the potential for muscle fatigue (30). Despite differences in physical load, the study found no association between exercise type and MSD complaints, likely due to the combination of various exercise types in instructors' teaching activities. Kalsina and Kudrya noted that both static and strength-based exercises still increase cardiovascular and musculoskeletal workload (31). Low-impact exercise also requires endurance and muscle strength performed in a controlled manner (32). Furthermore, low-impact exercise may still cause complaints as it often involves sustained stretching and static postures over certain durations (33). Overall, both high and low intensity activities can trigger muscle fatigue if done repeatedly without sufficient recovery.

Overall, this study confirms that the factors most strongly associated with MSD complaints are work duration and working posture, while years of service and type of exercise do not show significant relationships. These findings are consistent with existing literature emphasizing that ergonomic factors and actual workload play a more critical role in determining musculoskeletal disorder risk than individual background characteristics alone.

Conclusion

The study conducted on exercise instructors in Semarang City in 2025 reveals that there is no significant relationship between years of service and MSD complaints, for both the 12-month and 7-

day periods. This indicates that a longer tenure does not necessarily increase MSD risk, likely due to professional adaptation and accumulated experience.

In contrast, work duration and work posture show a significant correlation with MSD complaints. Higher teaching hours and non-ergonomic postures lead to increased physical load, muscle fatigue, and insufficient recovery time, thereby raising the risk of disorders. Meanwhile, the type of exercise (high-impact vs. low-impact) was not associated with MSDs, as both involve repetitive movements and significant musculoskeletal loading. Complaints most frequently occurred in the neck, shoulders, back, waist, knees, and feet due to a combination of repetitive movements and poor ergonomics over long periods.

Recommendations

1. For Instructors: Prioritize ergonomic work postures, manage teaching time effectively, ensure adequate rest periods, and consistently stretch before and after activities.
2. For Studio Managers and Fitness Centers: Management is advised to implement a more balanced scheduling system, provide facilities that support ergonomic safety, and conduct regular health monitoring and education regarding musculoskeletal health.
3. For Health and Academic Institutions: These institutions play a crucial role by providing preventive education on MSDs, ergonomic training, and facilitating regular health screenings for instructors.
4. For Future Researchers: It is recommended that future research explore additional variables such as age, gender, BMI, psychological stress, and recovery habits using a multivariate research design.

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