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An Overview of Musculoskeletal Disorders (MSDs) Complaints Among First-Semester Students of the Biology Department FST Pattimura University, 2024

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Abstract

Aims: The leading causes of MSDs complaints in first-year students are often related to poor body positioning habits while studying, use of non-ergonomic technological devices, and high academic stress.

Study design: The research design used in this study is a correlational design with a cross-sectional approach.

Place and Duration of Study: This research was conducted at Pattimura University Ambon from 23 December 2024 to 3 February 2025

Methodology: The sample consists of 76 respondents. Data was collected using a questionnaire distributed through a Google Form, which was shared online and filled out by the respondents. The data from the study were analyzed using the SPSS program.

Results: The results indicate that there is no relationship between gender, age, smoking habits, and exercise habits with MSD complaints. However, a relationship was found between Body Mass Index (BMI) and MSD complaints.

Conclusion: The most common MSD complaints among students are pain in the upper neck, left shoulder, waist, buttocks, left and right ankle, and wrists.

Keywords: Musculoskeletal Disorders (MSDs), Smoking habits, Exercise habits, Body Mass Index (BMI).

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Introduction

Musculoskeletal disorders (MSDs) represent a major public health concern in occupational environments, accounting for approximately 42% to 58% of all work-related illnesses reported in 2019 [1]. These disorders are characterized by discomfort or pain in the skeletal muscles and typically result from repetitive static loads that progressively affect muscle tissues. MSDs may range from mild discomfort to severe, disabling pain [2]. The musculoskeletal system comprises tendons, tendon sheaths, ligaments, bursae, blood vessels, joints, bones,

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muscles, and nerves [3–5]. Notably, MSDs usually do not manifest suddenly; rather, they result from cumulative microtraumas sustained over time [6].

According to the Global Burden of Disease (GBD) study conducted in 2019, approximately 1.71 billion individuals worldwide experience MSDs, including conditions such as neck pain, low back pain, fractures, osteoarthritis, and related injuries [7]. The World Health Organization (WHO) reports the highest prevalence in high-income countries, accounting for 441 million cases, followed by countries in the Western Pacific region (427 million) and South Asia (369 million). In Indonesia, the Central Statistics Agency (BPS) documented 365,580 MSD-related cases, commonly linked to fatigue or injuries caused by lifting heavy loads [8].

Muscle fatigue, which increases the risk of injury, can be evaluated based on work intensity, the duration of sustained physical effort, and the frequency of such activity [9]. Complaints associated with muscle fatigue are typically categorized as either temporary—subsiding after the removal of a static load—or persistent, with symptoms continuing beyond the cessation of physical effort [10].

Among students transitioning from secondary to higher education, MSDs are increasingly prevalent and detrimental to quality of life. First-year students, in particular, are exposed to elevated academic demands that necessitate extended sitting, limited physical activity, and intensive study hours, all of which heighten the risk of musculoskeletal complaints [11, 12]. These challenges are compounded by lifestyle behaviors commonly observed in student populations, including sedentary routines, poor posture, and insufficient physical exercise [13]. One study emphasizes that reduced physical activity contributes to diminished muscular strength and joint flexibility, exacerbating the risk of MSDs [14].

Moreover, chronic academic stress is linked to adverse physical health outcomes, as sustained stress can negatively impact musculoskeletal resilience and recovery [15–17]. Often, a decline in physical functioning may go unnoticed initially, only to manifest later in impaired performance and reduced well-being. The widespread use of digital technologies—computers, laptops, and smartphones—has further exacerbated this issue. Although these devices are integral to academic and social engagement [18–20], their prolonged use in ergonomically unsound postures contributes significantly to muscle tension and strain, especially in the cervical, thoracic, and lumbar regions.

Long-term exposure to these conditions may precipitate chronic pain or injury if not mitigated through proper posture and rest. It has been suggested that the absence of ergonomic awareness among students can intensify the severity and frequency of MSDs, particularly in individuals spending prolonged hours at screens [21]. Findings by Bachtiar et al. underscore the importance of maintaining correct sitting posture and incorporating sufficient rest to reduce the impact of digital technology use on musculoskeletal health [22].

The development of MSDs is influenced by a multifactorial interplay of personal and environmental variables. Several studies emphasize that age, gender, physical activity levels, and occupational history are significant determinants of MSD risk [23]. In addition, an elevated body mass index (BMI) has been associated with increased biomechanical stress on joints—especially the knees and lower back—thereby raising the likelihood of musculoskeletal issues [24]. Lifestyle factors such as smoking may also impair musculoskeletal health by compromising blood flow and impeding the recovery of muscle and bone tissues [25, 26].

While prior research by Manery et al. (2024) has demonstrated that body posture during sitting does not significantly correlate with lower back pain (LBP), the duration of sitting does show a strong relationship with LBP symptoms in biology students. However, their study did not identify the specific complaints most frequently experienced by students or the full range of contributing factors involved.

Research Problem

The problem that is the focus of this study is the high prevalence of Musculoskeletal Disorders (MSDs) complaints in first-semester students, which is thought to be related to their lifestyle and academic habits. Students who have just entered the world of lectures often face new challenges, such as changes in physical activity patterns, increased academic load, and lousy posture habits when studying or using electronic devices for a long time. These conditions can trigger musculoskeletal disorders like back, neck, or joint pain. Therefore, this study seeks to explore the types of MSDs complaints experienced by students and the factors that influence them to provide practical prevention recommendations.

Research Focus

The focus of this study aims to provide an overview of complaints of Musculoskeletal Disorders (MSDs) in first-semester students of the Department of Biology FST Pattimura University in 2024 and analyze the relationship between gender, age, body mass index, smoking habits, and exercise habits with the occurrence of these complaints.

Research Aim and Research Questions

This study aimed to describe the types of Musculoskeletal Disorders (MSDs) complaints experienced by first-semester students of the Department of Biology FST Pattimura University in 2024 and identify factors associated with these complaints.

The research questions asked were:

1. What are the types of MSD complaints experienced by first-semester students?
2. What is the relationship between age, gender, BMI, smoking habits, and exercise habits with Musculoskeletal Disorders (MSDs) complaints?

Research Methodology

General Background

This study uses a correlational research design with a cross-sectional approach to describe the relationship between phenomena that occur simultaneously or within a certain period. This study's population included all Department of Biology FST Pattimura University students. The sample used in this study were students of Class 2024 of the Department of Biology FST Pattimura University, with as many as 126 students. The determination of the sample size in this study was carried out using the analytical formula for unpaired categorical data. The dependent variable to be studied in this study is Musculoskeletal Disorders (MSDs). The independent variables to be studied in this study are individual risk factors, including age, gender, BMI, smoking, and exercise habits.

This study used the following restriction criteria:

Inclusion criteria:

1. Students majoring in biology class 2024
2. Willing to be a respondent

The exclusion criteria in this study are:

1. Respondents did not fill out the questionnaire completely.
2. Respondents who did not return the questionnaire.

This study used a simple random sampling technique, namely, randomly sampling population members without regard to the strata in the population.

Sample / Participants / Group

The sample in this study totaled 76 respondents. This study's sample size was determined using the analytical formula for unpaired categorical data.

$$n1=n2=\left(\frac{Z\alpha\sqrt{2PQ}+Z\beta\sqrt{P1Q1+P2Q2}}{P1-P2}\right)^2$$

Description:
Zα = Derivat baku alfa = 1.282
Zβ = Derivat baku beta = 0.84
P2 = Proportion in the group whose value is already known (0.7)
Q2 = 1-P2
P1 = Proportion in the group whose value is the judgement of the researcher (P2 + 0.2)
Q1 = 1-P1
P = Total proportion (P1+P2)/2
Q = 1-P
Since there were no previous studies, the value of P2 was set based on a rational estimate = 0.7.47,48 Thus:
P2 = 0,7
P1 = P2 + 0.2 = 0.7 + 0.2 = 0.9
P = P1+P2/2 = 0.9+0.7/2 = 0.8
Q1 = 1 - P1 = 1 - 0.9 = 0.1
Q2 = 1 - P2 = 1 - 0.7 = 0.3

Q = 1 - P = 1 - 0.8 = 0.2

Furthermore, it is entered into the formula for calculating unpaired categorical analytical samples with a standard alpha derivative of 95% and a standard beta derivative of 20%, becoming:

$$\frac{\frac{Za\sqrt{2PQ}+Z\beta\sqrt{P1Q1+P2Q2}}{P1-P2}}{\frac{1{,}282\sqrt{2(0{,}8)(0{,}2)}+0{,}84\sqrt{(09{,}9)(0{,}1)+(0{,}7)(0{,}3)}}{0{,}9-0{,}7}} \quad n = 35$$

So, according to the formula above, the sample size is ± 35 samples. The number of samples is increased by 10% to avoid missing observations. In this study, are 38 samples in each sample group, and the total minimum sample is 76.

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Instrument and Procedures

The Nordic Body Map questionnaire [27] has been tested for validity and reliability. The validity test showed that all statements were valid. The reliability test, measured using Cronbach's alpha, yielded a value of 0.704 for the Musculoskeletal Disorders (MSDs) questionnaire, indicating high reliability (reliability value of more than 0.60) [28].

The data collection steps in this study began with researchers preparing the necessary equipment and needs. Next, the researcher used Microsoft Excel to select respondents randomly based on predetermined inclusion criteria. After that, the researcher went to the research location and explained the purpose and objectives of the study to the respondents. After obtaining permission, respondents were asked to give consent by filling out an informed consent sheet, which was then followed by filling out a questionnaire. The data was collected after the respondents completed the questionnaire and then processed and analyzed to draw research conclusions.

Data Analysis

Univariate analysis was used to obtain a description of the characteristics of the single data or variables, including gender, age, BMI, smoking habits, exercise habits, and MSD complaints. The results of this analysis will be presented in the form of frequency distribution tables and percentages. To examine the relationship between age, gender, BMI, smoking habits, exercise habits, and Musculoskeletal Disorders (MSDs) complaints, a chi-square test was applied using the Statistical Package for the Social Sciences (SPSS) version 25.

Some things that need to be considered in using the chi-square test include:

1. No cells should have an observed frequency value and an expected frequency value of less than 5 contained in more than 20% of the total number of cells.
2. The number of samples is >30.
3. To see whether there is an association between two variables.36

Conditions that apply to the chi-square test:

1. If the table is 2 x 2 and there is no Expected value <5, then the test is 'Continuity Correlation.'
2. If the table is 2 x 2 and there is an E value < 5, then the test used is 'Fisher's Exact Test.'
3. If the table is more than 2 x 2, for example, 2 x 3, 3 x 3, and no E value < 5, the 'Person Chi-Square test' is used.
4. If the table is other than 2 x 2 and 2 x K and there is an E value < 5, then merge the cells.
5. If the table is 2 x 3 and there is an E < 5 value after combining the cells (not eligible for the chi-square test), then the alternative test uses the Kolmogorov-Smirnov test.

In the chi-square test, if the p-value <0.05, Ha is accepted and Ho is rejected, it means that there is a relationship between age, gender, BMI, smoking habits, and exercise habits with complaints of Musculoskeletal Disorders (MSDs) in students and if the p value> 0.05, Ha is rejected. Ho is accepted; it means that there is no relationship between age, gender, BMI, smoking habits, or exercise habits with complaints of Musculoskeletal Disorders (MSDs).

Research Results

Respondent Characteristics

Table 1 shows the frequency distribution of variables such as age, gender, BMI, smoking habits, exercise habits, and complaints of Musculoskeletal Disorders (MSDs).

Table 1. Frequency Distribution of Research Variables

Variable	n	%
Gender		
Male	16	21.1
Female	60	78.9
Age		
<18 years	5	6.6
18-20 years	71	93.4
21-23 years	0	0.0
Body Mass Index (BMI)		
Underweight	26	34.2
Normal	44	57.9
Overweight	6	7.9
Smoking Habit		
Smoker	4	5.3
Non-smoker	72	94.7
Exercise Habit		
Exercising	34	44.7
Not exercising	42	55.3
MSDs Complaints		
Mild complaints	29	38.2
Moderate complaints	47	61.8

The results in Table 1 indicate that, based on gender, most respondents are female (78.9%), while males comprise only 21.1%. Most respondents are aged 18-20 (93.4%), with only 6.6% under 18 years, and none fall into the 21-23 years category. Regarding BMI, most respondents have a normal BMI (57.9%), followed by underweight (34.2%), and a small percentage in the overweight category (7.9%). Concerning smoking habits, most respondents do not smoke (94.7%), with only 5.3% being smokers. Regarding exercise habits, the majority exercise (44.7%), while 55.3% do not. Lastly, regarding MSD complaints, more respondents reported moderate complaints (61.8%) than mild complaints (38.2%).

Relationship Between Gender, Age, BMI, Smoking Habits, and Exercise Habits with Musculoskeletal Disorders (MSDs) Complaints

A Chi-square test was performed to assess whether there is a relationship between gender, age, BMI, smoking habits, exercise habits and MSD complaints. The results of the Chi-square test are shown in Table 2.

Table 2. Chi-square Test Results

Variable	MSDs Complaints				Total		P-value
	Mild Complaints		Moderate Complaints				
	n	%	n	%	n	%	
Gender							
Male	7	43.8	9	56.2	16	100	*0,773*
Female	22	36.7	38	63.3	60	100	
Age							
<18 years	1	20.0	4	80.0	5	100	*0,664*
18-20 years	28	39.4	43	60.6	71	100	
BMI							
Underweight	13	50.0	13	50.0	26	100	*0,008*
Normal	14	31.8	30	68.2	44	100	
Overweight	2	33.3	4	66.7	6	100	
Smoking Habit							
Smoker	1	25.0	3	75.0	4	100	*1,000*
Non-smoker	28	38.9	44	61.1	72	100	
Exercise Habit							
Exercising	12	35.3	22	64.7	34	100	*0,150*
Not exercising	17	40.5	25	59.5	42	100	

Based on the results in Table 2, the p-values for gender (0.773), age (0.664), smoking habits (1.000), and exercise habits (0.150) indicate that there is no significant relationship between gender, age, smoking habits, and exercise

habits and MSD complaints. However, the p-value for BMI (0.008) indicates a significant relationship between BMI and MSD complaints.

Table 2 also shows that among males, the percentage of mild complaints is 43.8%, while moderate complaints account for 56.2%. In contrast, among females, 36.7% report mild complaints, and 63.3% report moderate complaints. This suggests that females more frequently report heavier MSDs complaints compared to males, both in mild and moderate complaints.

MSDs complaints are less common among those under 18 years, with only 20% reporting mild complaints and 39.4% reporting moderate complaints. On the other hand, those aged 18-20 years report significantly higher MSDs complaints, with 80% reporting mild complaints and 60.6% reporting moderate complaints. This indicates that the 18-20-year age group is more prone to both mild and moderate MSDs complaints.

In the underweight BMI category, 50% of respondents report mild complaints, and the other 50% report moderate complaints. In the normal BMI category, 31.8% report mild complaints, and 68.2% report moderate complaints. In the overweight category, 33.3% report mild complaints, and 66.7% report moderate complaints. This suggests that the majority of MSDs complaints, both mild and moderate, are more often reported by individuals with a normal BMI. However, the comparison between mild and moderate complaints is nearly even.

Among smokers, 25% report mild complaints, and 75% report moderate complaints. In contrast, among non-smokers, 38.9% report mild complaints, and 61.1% report moderate complaints. Although more non-smokers are present, the smoking group tends to report more severe complaints (moderate complaints).

For respondents who exercise, 35.3% report mild complaints, and 64.7% report moderate complaints. Among those who do not exercise, 40.5% report mild complaints, and 59.5% report moderate complaints. This suggests that although exercise does not eliminate MSDs complaints, the group that does not exercise tends to report slightly more mild and moderate complaints than those who exercise regularly.

Discussion

Musculoskeletal Disorders (MSDs) Complaints in Students

The results of the study in Table 1 show that 47 respondents (61.8%) experienced moderate Musculoskeletal Disorders (MSDs) complaints, while 29 respondents (38.2%) had mild complaints. These findings are similar to the study by 29], which found that moderate musculoskeletal complaints were most frequently experienced by students of the 2020 cohort, at a rate of 2.8%. This condition may occur because first-year students often engage in practical sessions that require them to lean forward or adopt a bent posture, leading to muscle strain in the back and resulting in musculoskeletal complaints in the back area.

In addition, the students' generally inactive lifestyle also plays a role in the increase of MSDs complaints. Many students spend more time in front of computer or laptop screens for studying, writing assignments, or socializing online. The static posture and lack of physical movement for hours can affect the balance of body muscles, especially in the back, neck, and shoulder areas. Without adequate exercise or movement, muscles that remain under prolonged pressure in certain positions become more susceptible to strain and fatigue, leading to MSDs complaints.

The analysis of the results shows that the most common MSDs complaints among students are pain in the upper neck, left shoulder, lower back, buttocks, left and right ankles, and left and right wrists. Pain in the upper neck is usually associated with poor posture, especially when students spend long hours bending or hunching over while reading, writing, or using electronic devices [30, 31]. This posture causes tension in the neck muscles, leading to discomfort and pain [32]. Additionally, pain in the left shoulder and lower back can be caused by uneven load distribution or poor posture while carrying heavy bags or sitting too long in uncomfortable positions. Limited movement and a lack of muscle stretching over long periods can cause the accumulation of tension in these areas [33]. Pain in the buttocks, ankles, and wrists suggests muscle strain or fatigue in areas frequently exposed to load during activities [34]. Especially for students with a habit of sitting for long periods, complaints in the wrists and ankles can result from muscle and joint tension as they support the body in a static position. Repeated use of the wrists for typing or using a computer mouse also makes them vulnerable to injury from repetitive motion. Similarly, the ankles may experience pain from maintaining a fixed posture for prolonged periods or muscle strain while sitting.

Muscle complaints can be classified into temporary (reversible) and persistent [35]. Temporary complaints occur when muscles bear static loads but will subside once the load is removed. Persistent complaints, however, continue even after the heavy load has ceased. According to [29], neck, shoulders, back, lower back, and buttocks, complaints arise from students adopting forced and incorrect sitting postures for prolonged periods, resulting in muscle tension in these areas, which causes pain.

The Relationship Between Gender and Musculoskeletal Disorders (MSDs) Complaints

Based on the data presented in Table 2, the p-value for the gender variable is 0.773, indicating no statistically significant association between gender and the prevalence of musculoskeletal disorder (MSD) complaints. Despite the absence of statistical significance, a noteworthy trend is observed: women exhibit a higher prevalence of MSDs compared to men. Specifically, 43.8% of male participants reported mild complaints, while 56.2% experienced moderate complaints. In contrast, 36.7% of female participants reported mild complaints, and 63.3% experienced moderate complaints.

This observed disparity may be partially attributed to physiological differences between sexes, which influence susceptibility to musculoskeletal injuries. Prior research suggests that variations in physical attributes such as muscle mass, skeletal structure, body mass index, height, and joint mechanics contribute to the differing prevalence rates across genders [36, 37]. These structural differences are considered key biological factors predisposing women to higher MSD vulnerability. Muscle strength, in particular, has been identified as a critical factor. Research has shown that men typically possess greater muscle strength than women, enabling them to manage physical workloads more efficiently [38, 39]. This advantage may reduce the likelihood of injury during tasks requiring prolonged or intensive physical effort. In contrast, due to relatively lower muscle mass and physical strength, women may be more prone to experiencing strain or injury, particularly in activities involving repetitive exertion or heavy lifting [40]. Further analysis highlights that muscular endurance and load-bearing capacity are often less developed in women, which may increase their physical burden during high-demand activities. As emphasized in studies by Barik and Sofiana [41], these physiological limitations can pose challenges for women in occupations or daily routines that require sustained physical performance or strength-intensive tasks.

The Relationship Between Age and Musculoskeletal Disorders (MSDs) Complaints

The statistical results in Table 2 show no significant relationship between age and MSDs complaints ($p>0.05$). No significant relationship exists because all respondents in this study are still in the non-risk age category (<30 years old). In this age group, physical changes that occur usually have not reached a significant stage to affect the incidence of MSDs directly. MSDs complaints experienced by respondents are more likely to be caused by other factors, such as poor posture habits or inadequate physical activity, rather than aging or decreased physical function that usually occurs at an older age.

At a younger age, the body is generally still in optimal physical condition, with faster recovery ability and capacity to withstand greater loads or tension [42]. Bones, muscles, and joints are still relatively strong and elastic, so musculoskeletal disorders tend to be milder and heal quickly [43]. The body's ability to repair itself is better in younger individuals, allowing them to recover from minor injuries more efficiently. Therefore, younger individuals typically have higher physical endurance, enabling them to recover more quickly from muscle strain or injuries caused by daily activities or poor posture [44].

Moreover, younger individuals are often more active and maintain physical fitness. However, their physical activity may be limited to light sports or social interactions that do not place heavy loads on the body. Many young people engage in enjoyable physical activities such as light sports, walking, or other social activities that do not require heavy physical exertion. These activities help maintain flexibility, muscle strength, and joint health [45]. However, such physical activity may not always be sufficient to reduce the potential for musculoskeletal injuries, especially if poor posture habits or long periods of sitting are not corrected.

The Relationship Between BMI and Musculoskeletal Disorders (MSDs) Complaints

The study results in Table 2 show the p-value for BMI of 0.008, which means a relationship exists between BMI and MSD complaints ($p<0.05$). This significant relationship indicates that a person's BMI status can affect the severity of MSD complaints they experience. BMI, which measures the balance between body weight and height, can affect posture, weight distribution, and muscle and joint health.

The underweight category showed that 50% of respondents experienced mild complaints, while the other 50% had moderate complaints. This may occur because individuals with low BMI often have less muscle mass, which makes their bodies less capable of bearing physical loads, especially in areas such as the back, waist, and joints [46]. This condition makes them more vulnerable to muscle tension and musculoskeletal disorders. Additionally, the body with a low BMI may be less able to distribute the load evenly, leading to quicker muscle fatigue and the potential for musculoskeletal injuries.

In the normal BMI category, 31.8% of respondents experienced mild complaints, while 68.2% experienced moderate complaints. Respondents with a normal BMI tend to have better body weight balance and preserved

muscle mass, which allows them to bear physical loads more efficiently. However, despite being within the normal range, other factors such as poor posture, sitting for extended periods, or lack of physical activity may still cause musculoskeletal disorders. The variation in complaints within this group shows that, although the BMI is within the normal range, environmental and behavioral factors still play an essential role in muscle and joint health.

In the overweight BMI category, 33.3% of respondents experienced mild complaints, and 66.7% experienced moderate complaints. The more frequent MSDs complaints experienced by individuals with an overweight BMI can be explained by the increased load the body has to bear due to excess weight. Being overweight puts additional pressure on joints and muscles, especially in areas such as the knees, waist, and lower back, which are more prone to injury or muscle tension [47, 48]. Furthermore, the uneven body mass distribution resulting from excess weight can cause postural imbalances, increasing the risk of MSDs. According to [49], the higher an individual's BMI, the more likely they are to experience musculoskeletal disorders (MSDs). This is because an overweight individual will support their body weight by contracting lower back muscles, which places pressure on spinal nerve discs, increasing the risk of MSD complaints [50]. If left unchecked, musculoskeletal complaints can lead to serious consequences, including material losses and permanent disability for workers [51].

The Relationship Between Smoking Habits and Musculoskeletal Disorders (MSDs) Complaints

Based on the statistical test results, no significant relationship between smoking habits and MSDs complaints was found ($p > 0.05$). This could be because most of the respondents in this study were female. According to Rosemillen & Dwiyanti [52], smoking habits are closely related to increased MSDs complaints, such as muscle pain, injury, and body tension. The more prolonged and more frequent someone smokes, the greater the risk of musculoskeletal disorders.

Smoking directly impacts lung capacity, which plays a significant role in physical endurance and an individual's overall physical ability [53, 54]. A decreased lung capacity due to harmful substances in cigarettes makes it harder for the body to obtain adequate oxygen [55, 56]. Oxygen is crucial in various metabolic processes, including carbohydrate burning and energy processing for physical activity [57]. In this context, reduced lung capacity due to smoking indirectly affects an individual's physical performance and worsens muscle conditions.

When the body cannot obtain sufficient oxygen, metabolic processes are disrupted, leading to the formation of lactic acid in the muscles. Lactic acid is a byproduct of anaerobic metabolism that occurs when the body lacks oxygen, and its accumulation can cause sharp muscle pain and tension in muscle tissue [58]. Smokers often experience this condition, which is one of the main contributors to musculoskeletal complaints [59]. The buildup of lactic acid not only affects physical comfort but also reduces the body's ability to recover effectively from physical activities.

The Relationship Between Exercise Habits and Musculoskeletal Disorders (MSDs) Complaints

Based on the research results (Table 2), there was no significant relationship between exercise habits and MSDs complaints ($p > 0.05$). Table 2 also shows that respondents who exercised reported 35.3% mild complaints and 64.7% moderate complaints, while those who did not exercise reported 40.5% mild complaints and 59.5% moderate complaints. Although, in theory, regular and appropriate exercise can help maintain muscle and joint health and reduce the risk of musculoskeletal disorders, this finding suggests that the exercise habits of respondents in this study may not be sufficient to prevent or alleviate MSDs complaints.

Several factors may explain this result. First, although respondents in this study were involved in exercise, the type of exercise they performed might not have been intense enough or suitable to address the musculoskeletal issues they were experiencing. Exercise that does not involve muscle strength or flexibility or exercise that is not done regularly may not provide enough benefits to prevent muscle tension or joint injuries, which are the primary causes of MSD complaints.

Additionally, despite the role of exercise in maintaining overall body health, other factors such as poor posture habits, prolonged sitting, or daily activities may significantly influence the emergence of MSDs complaints. For instance, respondents who exercised might still have poor habits, such as sitting for extended periods in front of a computer or using a mobile phone with non-ergonomic posture, which can cause muscle and joint tension. In this case, despite exercising, other more frequent daily habits may diminish the effectiveness of exercise in preventing MSDs.

Conclusions and Implications

The statistical analysis shows a p-value of 0.773 for gender, 0.664 for age, 1.000 for smoking habits, and 0.150 for exercise habits, meaning no significant relationship exists between gender, age, smoking habits, and exercise habits with MSD complaints. On the other hand, the p-value for BMI was 0.008, indicating a significant relationship between BMI and MSD complaints. The most common MSD complaints among students are pain in the upper neck, left shoulder, waist, buttocks, left and right ankle, and wrists.

Considering that BMI is significantly associated with MSDs complaints, managing a healthy body weight may serve as an effective preventive measure to reduce MSDs complaints among students. The most frequently reported complaints, particularly in the neck, shoulders, lower back, and wrists, suggest that poor posture and prolonged sitting (e.g., sitting at a desk or computer for extended periods) may contribute to these complaints. Campaigns focusing on proper posture and ergonomic improvements during study or work activities could be a valuable intervention.

Suggestions for Future Research

Building on the current study's findings, several directions for future research are suggested. Firstly, longitudinal studies are needed to monitor the progression of musculoskeletal disorders (MSDs) among students over time, particularly as they advance in their academic journey. Such studies can help identify whether musculoskeletal complaints increase with cumulative exposure to academic stress and poor posture or whether they diminish due to adaptation and ergonomic awareness. Secondly, future research should explore the impact of psychosocial factors such as academic stress, sleep quality, anxiety, and time management skills, which may influence the onset and intensity of MSDs. Including psychological and behavioral variables will provide a more holistic understanding of the risk profile for MSDs in university students. Thirdly, interventional studies implementing posture correction, ergonomic education, and physical activity programs would be valuable in evaluating the effectiveness of such strategies in reducing the prevalence and severity of MSD complaints. These interventions can also be tailored to specific subgroups based on BMI, gender, or lifestyle habits to assess targeted outcomes. Furthermore, more precise measurement tools, such as motion-tracking devices or musculoskeletal imaging, could complement self-reported questionnaires to improve the accuracy of symptom documentation. It is also essential to examine environmental and technological factors such as furniture ergonomics, classroom design, and screen time.

Finally, multi-institutional comparative studies involving students from different faculties or universities may help to generalize findings and provide broader preventive recommendations across academic settings.

Declarations

Author Contributions

F.M.T. contributed to designing, conducting, and writing the manuscript. M. R. R., A.R.S.K, and Y.A.E contributed to conducting, analyzing data, and writing the manuscript. A.M.U contributed to reviewing the manuscript content.

Data Availability Statement

The data used in this study are available and accessible under a legitimate request.

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Informed Consent Statement

All respondents were given precise information regarding the purpose, procedures, and potential risks. Respondents were also allowed to ask questions and confirm their understanding before providing informed consent to participate in the study.

Conflicts of Interest

This study declares that the authors have no conflicts of interest related to this study.

References

1. Jacquier-Bret J, Gorce P. Prevalence of body area work-related musculoskeletal disorders among healthcare professionals: A systematic review. Int J Environ Res Public Health [Internet]. 2023;20(1):841. Available from: http://dx.doi.org/10.3390/ijerph20010841

2. Sani NT, Widajati N. Factors affecting risk of Musculoskeletal Disorders (MSDs) complaints in spring production workers. Indian J Forensic Med Toxicol [Internet]. 2021;15(2):3152–61. Available from: http://dx.doi.org/10.37506/ijfmt.v15i2.14854
3. Goolsby MJ, Grubbs L. Advanced Assessment: Interpreting Findings and Formulating Differential Diagnoses. 2018.
4. Gilliland KO, Kernick ET. Musculoskeletal Tissues and Anatomy. In: Clinical Foundations of Musculoskeletal Medicine. Cham: Springer International Publishing; 2021. p. 11–21. Available from https://doi.org/10.1007/978-3-030-42894-5_2
5. Hughes SH. The musculoskeletal system. St. Louis: Elsevier Health Sciences; 2022.
6. Gallagher S, Schall MC. Musculoskeletal disorders as a fatigue failure process: evidence, implications and research needs. In: Thatcher A, Yeow P, Chee D, editors. New paradigms in ergonomics. Abingdon: Routledge; 2020. p. 105–19. Available from: https://doi.org/10.4324/9781351208956-9
7. Cieza A, Causey K, Kamenov K, Hanson SW, Chatterji S, Vos T. Global estimates of the need for rehabilitation based on the Global Burden of Disease study 2019: a systematic analysis for the Global Burden of Disease Study 2019. Lancet [Internet]. 2020;396(10267):2006–17. Available from: https://doi.org/10.1016/S0140-6736(20)32340-0
8. Hales TR. Ergonomics and upper extremity musculoskeletal disorders. In: Physical and biological hazards of the workplace. Hoboken: Wiley; 2016. p. 13–32. Available from: https://doi.org/10.1002/9781119276531.ch2
9. Ma L, Chablat D, Bennis F, Zhang W. A new simple dynamic muscle fatigue model and its validation. Int J Ind Ergon [Internet]. 2009;39(1):211–20. Available from: https://doi.org/10.1016/j.ergon.2008.04.004
10. Wang TV, Song PC. Neurological voice disorders: a review. Int J Head Neck Surg [Internet]. 2022;13(1):32–40. Available from: https://doi.org/10.5005/jp-journals-10001-1521
11. Yoon S, An S, Noh DH, Tuan LT, Lee J. Effects of health education on adolescents' non-cognitive skills, life satisfaction and aspirations, and health-related quality of life: a cluster-randomized controlled trial in Vietnam. PLoS One [Internet]. 2021;16(12):e0259000. Available from: https://doi.org/10.1371/journal.pone.0259000
12. Fahmy VF, Momen MA, Mostafa NS, Elawady MY. Prevalence, risk factors and quality of life impact of work-related musculoskeletal disorders among school teachers in Cairo, Egypt. BMC Public Health [Internet]. 2022;22(1):2257. Available from: https://doi.org/10.1186/s12889-022-14712-6
13. Manery DE, Zuneldi T, Embisa YA, Ukratalo AM, Pattimura N. Gambaran tingkat stres akademik pada mahasiswa keperawatan STIKes Pasapua Ambon tahun 2024. J Anestesi [Internet]. 2024;2(3):193–206. Available from: https://doi.org/10.59680/anestesi.v2i3.1228
14. Lewis R, Gómez Álvarez CB, Rayman M, Lanham-New S, Woolf A, Mobasheri A. Strategies for optimising musculoskeletal health in the 21st century. BMC Musculoskelet Disord [Internet]. 2019;20(1):164. Available from: http://dx.doi.org/10.1186/s12891-019-2510-7
15. Pascoe MC, Hetrick SE, Parker AG. The impact of stress on students in secondary school and higher education. Int J Adolesc Youth [Internet]. 2020;25(1):104–12. Available from: http://dx.doi.org/10.1080/02673843.2019.1596823
16. Pangemanan VO, Manery DE, Ukratalo AM, Nanere BE, Embisa YA, Assagaf AR. Hubungan Self-Efficacy Dengan Stres Akademik Pada Mahasiswa S1 Biologi FMIPA Universitas Pattimura Dalam Proses Penyusunan Skripsi. Anestesi [Internet]. 2024;2(3):31–8. Available from: http://dx.doi.org/10.59680/anestesi.v2i3.1103
17. Deng Y, Cherian J, Khan NUN, Kumari K, Sial MS, Comite U, et al. Family and academic stress and their impact on students' depression level and academic performance. Front Psychiatry [Internet]. 2022;13:869337. Available from: http://dx.doi.org/10.3389/fpsyt.2022.869337
18. Can S, Karaca A. Determination of musculoskeletal system pain, physical activity intensity, and prolonged sitting of university students using smartphone. Biomed Hum Kinet [Internet]. 2019;11(1):28–35. Available from: http://dx.doi.org/10.2478/bhk-2019-0004
19. Brink Y, Louw Q, Grimmer K. Do changes in psychosocial factors, lifestyle factors and sitting posture influence the likelihood of musculoskeletal pain in high school computer users? Physiother Res Int [Internet]. 2020;25(4):e1865. Available from: http://dx.doi.org/10.1002/pri.1865
20. Rafiq K, Mehboob S, Khalid A, Nesar S, Khan Z, Saad SM, Arain AA, Ghafoor BA, Iftikhar J, Laiq S, Bhutto M. The Ignorance of Ergonomics: Digital Lifestyle During the COVID-19 Pandemic among University Students in Pakistan. Pak-Euro Journal of Medical and Life Sciences. 2024 Jun 30;7(2):299-306.
21. Filkova S, Usheva N. Ergonomic requirements for learning environment for prevention of spinal deformities. In: 2020 International Conference on Biomedical Innovations and Applications (BIA) [Internet]; 2020 Sep 24-27; Varna, Bulgaria. [place unknown]: IEEE; 2020 [cited 2025 Mar 31]. Available from: https://doi.org/10.1109/bia50171.2020.9244504
22. Bachtiar F, Fithri NK, Amalia R, Herbawani CK, Ismiyasa SW, Purnamadyawati P. Edukasi mengenai dampak penggunaan smartphone sebagai upaya pencegahan gangguan muskuloskeletal pada remaja. Abdimas unwahas [Internet]. 2020 Apr 26 [cited 2025 Mar 31];5(1). Available from: https://doi.org/10.31942/abd.v5i1.3332
23. Krishnan KS, Raju G, Shawkataly O. Prevalence of work-related musculoskeletal disorders: psychological and physical risk factors. Int J Environ Res Public Health [Internet]. 2021;18(17):9361. Available from: https://doi.org/10.3390/ijerph18179361

24. Laal F, Madvari RF, Balarak D, Mohammadi M, Dortaj E, Khammar A, et al. Relationship between musculoskeletal disorders and anthropometric indices among bus drivers in Zahedan city. Int J Occup Saf Ergon [Internet]. 2018;24(3):431–7. Available from: https://doi.org/10.1080/10803548.2017.1334335
25. Abate M, Vanni D, Pantalone A, Salini V. Cigarette smoking and musculoskeletal disorders. Muscles Ligaments Tendons J [Internet]. 2013;3(2):63. Available from: https://doi.org/10.11138/mltj/2013.3.2.063
26. Tarantino U, Cariati I, Greggi C, Gasbarra E, Belluati A, Ciolli L, et al. Skeletal system biology and smoke damage: from basic science to medical clinic. Int J Mol Sci [Internet]. 2021;22(12):6629. Available from: https://doi.org/10.3390/ijms22126629
27. Sofyan DK. Determination of musculoskeletal disorders (MSDs) complaints level with Nordic Body Map (NBM). IOP Conf Ser Mater Sci Eng [Internet]. 2019;505(1):012033. Available from: https://doi.org/10.1088/1757-899X/505/1/012033
28. Ammarwati Q. Faktor-faktor yang berhubungan dengan keluhan musculoskeletal disorders (MSDs) pengguna komputer pada pegawai kantor Dinas Ketahanan Pangan Kota Tangerang tahun 2022 [thesis]. Jakarta: UIN Syarif Hidayatullah Jakarta, Fakultas Ilmu Kesehatan; 2022.
29. Yuwono AE, Goalbertus G. Keluhan gangguan muskuloskeletal mahasiswa FKG Usakti pada masa pembelajaran hybrid. Prepotif J Kesehat Masyarakat. 2023;7(1):799–806.
30. Susilowati IH, Kurniawidjaja LM, Nugraha S, Nasri SM, Pujiriani I, Hasiholan BP. The prevalence of bad posture and musculoskeletal symptoms originating from the use of gadgets as an impact of the work from home program of the university community. Heliyon [Internet]. 2022;8(10):e11059. Available from: https://doi.org/10.1016/j.heliyon.2022.e11059
31. Wang R, Yin Y, Zhang H, Pan L, Zhu Y, Wang M, et al. Risk factors associated with the prevalence of neck and shoulder pain among high school students: a cross-sectional survey in China. BMC Musculoskelet Disord [Internet]. 2023;24(1):641. Available from: https://doi.org/10.1186/s12891-023-06656-8
32. Harvey R, Peper E, Booiman A, Cedillo AH, Villagomez E. The effect of head and neck position on head rotation, cervical muscle tension, and symptoms. Biofeedback [Internet]. 2018;46(3):65–71. Available from: https://doi.org/10.5298/1081-5937-46.3.04
33. Nelson AG, Kokkonen J. Stretching anatomy. Champaign: Human Kinetics Publishers; 2021. Available from: https://doi.org/10.5040/9781718225633
34. Vila Pouca MC, Parente MP, Jorge RM, Ashton-Miller JA. Injuries in muscle-tendon-bone units: a systematic review considering the role of passive tissue fatigue. Orthop J Sports Med [Internet]. 2021;9(8):23259671211020731. Available from: https://doi.org/10.1177/23259671211020731
35. Janssen L, Allard NA, Saris CG, Keijer J, Hopman MT, Timmers S. Muscle toxicity of drugs: when drugs turn physiology into pathophysiology. Physiol Rev [Internet]. 2020;100(2):633–72. Available from: https://doi.org/10.1152/physrev.00002.2019
36. To KE, Berek NC, Setyobudi A. Hubungan Masa Kerja, Jenis Kelamin dan Sikap Kerja dengan Keluhan Muskuloskeletal pada Operator SPBU di Kota Kupang. Media Kesehatan Masyarakat. 2020;2(2):42–9. Available from: https://doi.org/10.35508/mkm.v2i2.2853
37. Rahayu PT, Setiyawati ME, Arbitera C, Amrullah AA. Relationship of Individual and Occupational Factors to Complaints of Musculoskeletal Disorders among Employees. Jurnal Kesehatan. 2020;11(3):450–5. Available from: https://doi.org/10.26630/jk.v11i3.2221
38. Tosi LL, Boyan BD, Boskey AL. Does sex matter in musculoskeletal health?: The influence of sex and gender on musculoskeletal health. JBJS. 2005;87(7):1631–47. Available from: https://doi.org/10.2106/00004623-200507000-00030
39. Stevens-Lapsley JE, Kohrt WM. Osteoarthritis in women: effects of estrogen, obesity and physical activity. Women's Health. 2010;6(4):601–15. Available from: https://doi.org/10.2217/WHE.10.38
40. Ogunlana MO, Govender P, Oyewole OO. Prevalence and patterns of musculoskeletal pain among undergraduate students of occupational therapy and physiotherapy in a South African university. Hong Kong Physiotherapy Journal. 2021;41(1):35–43. Available from: https://doi.org/10.1142/S1013702521500037
41. Barik CZ, Sofiana L. The Risk Analysis of Musculoskeletal Disorders in Pottery Making Workers in Kasongan, Bantul. STRADA Jurnal Ilmiah Kesehatan. 2020;9(2):605–11. Available from: https://doi.org/10.30994/sjik.v9i2.321
42. Bompa TO, Carrera M. Conditioning young athletes. Champaign: Human Kinetics; 2015.
43. Li G, Niu W. Challenges toward musculoskeletal injuries and diseases. In: Nanoengineering in musculoskeletal regeneration. London: Academic Press; 2020. p. 1–41. Available from: https://doi.org/10.1016/B978-0-12-820262-3.00001-3
44. Kenny GP, Yardley JE, Martineau L, Jay O. Physical work capacity in older adults: implications for the aging worker. Am J Ind Med. 2008;51(8):610–25. Available from: https://doi.org/10.1002/ajim.20600
45. Micheo W, Baerga L, Miranda G. Basic principles regarding strength, flexibility, and stability exercises. PM R. 2012;4(11):805–11. Available from: https://doi.org/10.1016/j.pmrj.2012.09.583
46. Parietti F, Chan K, Asada HH. Bracing the human body with supernumerary robotic limbs for physical assistance and load reduction. In: Proceedings of the 2014 IEEE International Conference on Robotics and Automation. 2014. p. 141–8. Available from: https://doi.org/10.1109/ICRA.2014.6906601
47. Arif M, Gaur DK, Gemini N, Iqbal ZA, Alghadir AH. Correlation of percentage body fat, waist circumference and waist-to-hip ratio with abdominal muscle strength. Healthcare. 2022;10(12):2467. Available from: https://doi.org/10.3390/healthcare10122467
48. Manery DE, Ramadhany MR, Ukratalo AM, Pangemanan VO. Hubungan Posisi Dan Lama Duduk Dengan Keluhan Low Back

Pain (LBP) Selama Kuliah Pada Mahasiswa Semester Pertama Jurusan Biologi Universitas Pattimura Tahun 2023. JHN J Health Nurs. 2023;1(2):61–9. Available from: https://doi.org/10.58738/jhn.v1i2.537
49. Viester L, Verhagen EA, Hengel KM, Koppes LL, van der Beek AJ, Bongers PM. The relation between body mass index and musculoskeletal symptoms in the working population. BMC Musculoskelet Disord. 2013;14:1–9. Available from: https://doi.org/10.1186/1471-2474-14-238
50. Putsa B, Jalayondeja W, Mekhora K, Bhuanantanondh P, Jalayondeja C. Factors associated with reduced risk of musculoskeletal disorders among office workers: a cross-sectional study 2017 to 2020. BMC Public Health. 2022;22(1):1503. Available from: https://doi.org/10.1186/s12889-022-13940-0
51. Malik KM, Beckerly R, Imani F. Musculoskeletal disorders a universal source of pain and disability misunderstood and mismanaged: a critical analysis based on the US model of care. Anesthesiol Pain Med. 2018;8(6):e85532. Available from: https://doi.org/10.5812/aapm.85532
52. Rosemillen W, Dwiyanti E. Correlation between age and smoking habit with musculoskeletal disorders among gantry luffing crane operators. Media Gizi Kesmas. 2023;12(1):160–4. Available from: https://doi.org/10.20473/mgk.v12i1.2023.160-164
53. Kaczynski AT, Manske SR, Mannell RC, Grewal K. Smoking and physical activity: a systematic review. Am J Health Behav. 2008;32(1):93–110. Available from: https://doi.org/10.5993/AJHB.32.1.9
54. Vancampfort D, Probst M, Scheewe T, De Herdt A, Sweers K, Knapen J, et al. Relationships between physical fitness, physical activity, smoking and metabolic and mental health parameters in people with schizophrenia. Psychiatry Res. 2013;207(1–2):25–32. Available from: https://doi.org/10.1016/j.psychres.2012.09.026
55. Demling RH. Smoke inhalation lung injury: an update. Eplasty. 2008;8:e27.
56. Bals R, Boyd J, Esposito S, Foronjy R, Hiemstra PS, Jiménez-Ruiz CA, et al. Electronic cigarettes: a task force report from the European Respiratory Society. Eur Respir J. 2019;53(2). Available from: https://doi.org/10.1183/13993003.01151-2018
57. Ferretti G, Fagoni N, Taboni A, Vinetti G, di Prampero PE. A century of exercise physiology: key concepts on coupling respiratory oxygen flow to muscle energy demand during exercise. Eur J Appl Physiol. 2022;122(6):1317–65. Available from: https://doi.org/10.1007/s00421-022-04901-x
58. Li X, Yang Y, Zhang B, Lin X, Fu X, An Y, et al. Lactate metabolism in human health and disease. Signal Transduct Target Ther. 2022;7(1):305. Available from: https://doi.org/10.1038/s41392-022-01151-3
59. Dean E, Söderlund A. What is the role of lifestyle behaviour change associated with non-communicable disease risk in managing musculoskeletal health conditions with special reference to chronic pain?. BMC Musculoskelet Disord. 2015;16:1–7. Available from: https://doi.org/10.1186/s12891-015-0545-y