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Association of Nutritional Status, Activity Behavior, and Dietary Behavior with Musculoskeletal Complaints in Undergraduate Students

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Abstract

Background: Musculoskeletal complaints are widespread among undergraduate students and are influenced by a number of modifiable lifestyle factors. While it has been shown that physical activity and sedentary behavior influence musculoskeletal health, the joint impacts of nutritional status and dietary behavior are not well established.

Objectives: The purpose of this study was to determine the association between nutritional status, exercise behavior, dietary behavior and musculoskeletal complaints in undergraduate students.

Methods: This quantitative cross-sectional study was performed on 80 undergraduate students recruited by using purposive sampling. Body weight and height were assessed and BMI was calculated. Activity behavior (physical activity level and sitting duration), dietary behavior, healthy food choices and musculoskeletal complaints were assessed by validated questionnaires. Data were examined using descriptive statistics and Spearman's rank correlation with $p < 0.05$ as a level of significance.

Results: A majority of participants reported normal nutritional status (76.3%), low physical activity (52.5%), moderate sitting duration (51.3%), bad eating behavior (58.8%), and good healthy food choices (48.8%). Physical activity was adversely correlated with musculoskeletal complaints ($r_s = -0.560$, $p < 0.001$) while sitting duration was positively correlated ($r_s = 0.440$, $p < 0.001$). Gender, nutritional status, dietary behavior, and selection of healthy food were not significantly associated with musculoskeletal problems ($p > 0.05$).

Conclusion: Musculoskeletal complaints among undergraduate students are strongly associated with physical activity levels and sitting duration. Encouraging regular physical activity and minimizing prolonged sitting could enhance musculoskeletal health within this population.

Keywords: nutritional status, activity behavior, dietary behavior, musculoskeletal complaints, health

INTRODUCTION

Musculoskeletal complaints are unspecific signs of the musculoskeletal system and usually occur as pain or discomfort in one or more body locations, especially in the lumbar back, neck, shoulder and knee (Haas et al., 2023). Musculoskeletal complaints are prevalent among university students worldwide. A study on musculoskeletal disorders (MSDs) among undergraduate health sciences students in Malaysia found that 86.6% of respondents experienced MSDs (Adilah et al., 2023). A cross-sectional survey in Brazil showed that 90.5% of university students had musculoskeletal disorders in at least one area of the body (Oliveira et al., 2022). Recently, musculoskeletal pain has been recorded in 73.6% of undergraduate students of health sciences in the last 12 months in India (Kishwanth et al., 2026). Evidence of a large burden of musculoskeletal problems from Indonesia has also been found. A cross-sectional survey in medical clinical students showed that 57.7 % of respondents had considerable musculoskeletal discomfort, indicating that musculoskeletal problems also occurred among Indonesian university students (Indra Harianto Rante et al., 2025). These complaints could have detrimental consequences on students' daily activities, physical functioning, academic functioning and health related quality of life. This highlights the need of identifying modifiable risk variables to assist in the development of effective preventive strategies (Wohlmuth-Cohen & León-Avila, 2021).

The nutritional status and dietary habits are important factors influencing the musculoskeletal health and may cause the development of musculoskeletal issues. Body mass index (BMI) is a widely used index of nutritional status that reflects the balance between calorie intake and physiological requirements. Both undernutrition and obesity have adverse effects on the musculoskeletal system. An increased BMI increases biomechanical load on weight bearing joints, affects gait and movement patterns and promotes chronic low grade inflammation through cytokines

released by adipose tissue . In addition, bad dietary habits, such as the excess of ultra-processed foods, refined carbohydrates and energy-dense foods, could induce oxidative stress, systemic inflammation, and adiposity, thus favoring the development and persistence of musculoskeletal disorders (Mohan et al., 2025; Seels & Field, 2024). Conversely, good eating habits are essential for the health of bones and muscles, tissue regeneration, and the preservation of musculoskeletal function, such as balanced intake of high-protein, calcium, vitamin D, and plant foods while limiting processed foods (Dominguez et al., 2025). Studies have shown that higher overall ¹² diet quality is associated with lower musculoskeletal pain, regardless of weight reduction, suggesting that nutritional status and choice of nutritious foods are important modifiable variables in reducing musculoskeletal problems (Ward SJ et al., 2025).

University students are subject to sedentary lifestyle because of intense academic activities that involve prolonged sitting hours during lectures, studies, and usage of laptops or other digital devices. University students are sedentary for around 7–8 hours per day, and this lifestyle is associated with long periods of sitting and lack of movement (Edelmann et al., 2022; Khalil et al., 2024). Sedentary behavior is not the same as physical inactivity. Sedentary behaviour ⁴ is defined as awake activities in sitting, reclining or laying position with an energy expenditure of ≤ 1.5 metabolic equivalents (METs). Physical inactivity ¹³ is described as not achieving the necessary levels of moderate-to-vigorous physical activity . Both are established modifiable risk factors for bad health outcomes. Musculoskeletal complaints may be associated with lengthy hours of sitting and low levels of physical activity caused by static muscle loading, decreased muscle activation, decreased blood circulation, increased muscle fatigue and prolonged mechanical stress on the spine and surrounding soft tissues. Consistent with these mechanisms, ³¹ previous studies have shown that longer sitting time and sedentary behavior are

associated with a higher risk of musculoskeletal complaints, while regular physical activity may reduce musculoskeletal symptoms by enhancing muscle strength, joint mobility, circulation, and postural stability (Dzakpasu et al., 2021; Zhang & Li, 2025).

Although previous studies have demonstrated that nutritional status, dietary behavior, physical activity, and sedentary behavior are associated with musculoskeletal complaints, these modifiable lifestyle factors have predominantly been investigated independently. Limited evidence has comprehensively examined the combined associations of nutritional status, activity behavior, and dietary behavior with musculoskeletal complaints among undergraduate students, particularly in Indonesia. A better understanding of these interrelated factors may provide a stronger scientific basis for developing integrated health promotion and preventive strategies to reduce the burden of musculoskeletal complaints in university students. Therefore, this study aimed to examine the associations between nutritional status, activity behavior, and dietary behavior with musculoskeletal complaints among undergraduate students.

METHODS

Study Design and Participants

The present study was a quantitative cross-sectional study. This study was designed to investigate the connections between nutritional status, exercise behavior, dietary behavior and musculoskeletal complaints in undergraduate physiotherapy students. This research was conducted at Physiotherapy Study Program, State University of Surabaya, Indonesia in February-April 2026. Participants were recruited by purposive sampling based on pre-defined inclusion criteria. The study included a total of 80 undergraduate physiotherapy students. Participants were undergraduate physiotherapy students who were at least 18 years old, were active students, agreed to participate in the study willingly, provided written informed consent, and completed all the study questionnaires. Those students whose

questionnaires were not completed were eliminated from the analysis. Data were obtained by self-administered questionnaires at the time of the study.

Research Instruments

Anthropometric measures and structured questionnaires were used for data collection with sufficient validity and reliability. Body weight was measured using a calibrated digital weighing scale, and height was measured using a stadiometer. Measurements were utilized to determine Body Mass Index (BMI) as a measure of nutritional status. Physical activity and sitting time were assessed by use of a structured questionnaire on activity behavior. Dietary behavior was measured via structured questionnaire for dietary behavior and healthy food selection behavior. Musculoskeletal problems were evaluated by a structured questionnaire pertaining to symptoms in various parts of the body. All the questionnaires were conducted in Indonesian and were filled independently by the participants during the data collecting period.

Data Analysis

The data collected were coded, entered and analyzed by Statistical Package for the Social Sciences (SPSS) version 25.0. Descriptive statistics were performed to describe the characteristics of participants and research variables. To analyze the link between nutritional status, exercise behavior, dietary behavior and musculoskeletal complaints, the Spearman's rank correlation test was used for bivariate analysis. The direction and intensity of the relationships were determined using Spearman's correlation coefficient (r_s). A p-value of < 0.05 was judged statistically significant.

RESULTS

Characteristics of Respondents

A total of 80 undergraduate students were included in the study. As can be seen in Table 1, the majority of respondents were female (61.3%) and had normal nutritional status based on Body Mass Index (BMI) (76.3%). In

terms of their activity behavior, more than half of the respondents (52.5%) reported low levels of physical activity, whereas most of the respondents were classified as having moderate sitting duration (51.3%). In terms of dietary behavior, the majority of respondents had poor dietary patterns (58.8%), whereas healthy food selection behavior was predominantly categorized as good (48.8%). Regarding musculoskeletal complaints, nearly half of the respondents reported experiencing complaints occasionally (46.3%), followed by often (28.8%), while only 12.5% reported never experiencing musculoskeletal complaints.

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Table 1. Characteristics of Respondents

Variable	Frequency (n)	Percentage (%)
Gender		
Male	31	38,8
Female	49	61,3
Nutritional Status		
Underweight	11	13,8
Normal	61	76,3
Overweight	8	10
Physical Activity		
Low	42	52,5
Moderate	7	8,8
High	31	38,8
Sitting Duration		
Low	13	16,3
Moderate	41	51,3
High	26	32,5
Dietary Pattern		
Poor	47	58,5
Moderate	23	28,8
Good	10	12,5

Variable	Frequency (n)	Percentage (%)
Healthy Food Selection Behavior		
Poor	29	36,3
Moderate	39	48,8
Good	12	15,0
Musculoskeletal Complaints		
Never	10	12,5
Sometimes	37	46,3
Often	23	28,8
Very Often	10	12,5

Association between Respondent Characteristics and Musculoskeletal Complaints

The association between gender, nutritional status, and musculoskeletal complaints is presented in Table 2. Nutritional status (BMI) was not significantly correlated with musculoskeletal complaints ($r_s = 0.078$, $p = 0.492$). Likewise, gender ($r_s = -0.034$, $p = 0.765$) were not significantly associated with musculoskeletal complaints.

Table 2. Association between Gender, Nutritional Status, and Musculoskeletal

Category	Spearman's rho (r_s)	p-value
Gender	-0,034	0,765
Nutritional Status (BMI)	0.078	0,492

Association between Activity Behavior, Dietary Behavior and Musculoskeletal Complaints

The associations between activity behavior, dietary behavior, and musculoskeletal complaints are presented in Table 3. Physical activity showed a statistically significant negative correlation with musculoskeletal complaints ($r_s = -0.560$, $p < 0.001$), indicating that participants with higher levels of physical activity tended to report lower levels of musculoskeletal complaints. In contrast, sitting duration demonstrated a statistically significant moderate positive correlation with musculoskeletal complaints ($r_s = 0.440$, $p < 0.001$), suggesting that longer

Table 3. Association between Activity Behavior, Dietary Behavior, and Musculoskeletal Complaints

Category	Spearman's rho (r_s)	p-value
Activity Behavior		
Physical Activity	-0,560	<0.001*
Sitting Duration	0,440	<0.001*
Dietary Behavior		
Dietary Pattern	-0,058	0,611
Healthy Food Selection Behavior	-0,217	0,053

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Table 3 also presents the results of the Spearman's rank correlation analysis between dietary pattern, healthy food selection behavior and musculoskeletal complaints. Dietary pattern ($r_s = -0.058$, $p = 0.611$) and healthy food selection behavior was not significantly correlated with musculoskeletal complaints.

DISCUSSION

Characteristics of Respondents

Several studies have demonstrated that female students experience musculoskeletal problems more frequently than male students. Meghna et al., (2024) reported a higher incidence of musculoskeletal problems among female physiotherapy students, while Kishwanth et al., (2026) similarly found a higher prevalence of musculoskeletal pain among female undergraduate health science students. In the present study, female students also represented the majority of participants, which may have influenced the overall distribution of musculoskeletal complaints.

Most participants in the present study had normal nutritional status. This finding indicates that the majority of undergraduate physiotherapy students maintained a BMI within the recommended range despite being exposed to various academic and lifestyle demands. However, nutritional status alone may not be sufficient to indicate musculoskeletal health as musculoskeletal complaints are complicated disorders impacted by

dietary, behavioral, occupational and environmental factors. Recent data has stressed the importance to consider the nutritional status coupled with lifestyle-related factors such as dietary consumption, physical activity, sleep quality and other health behaviors in the assessment of musculoskeletal disorders risk (Cuomo & Parascandolo, 2024; Rivaldy et al., 2025).

Physical activity is often low and sitting is prolonged among university students. Can & Karaca, (2019) observed that almost three quarters of university students were not achieving the required level of moderate-to-vigorous physical activity, and almost two thirds spent more than four hours per day sitting. Mashhadi et al., (2022) also stated that 69.4% of medical students sat for more than two hours at a time and most students did less than one hour of exercise each day. The results indicate that the university students are often subjected to a sedentary lifestyle because of protracted academic work, excessive computer use, and reliance on digital devices that restrict their ability to engage in regular physical activity. The present study also showed that most participants had low levels of physical activity and considerable sitting time, indicating that sedentary behavior is frequent among undergraduate physiotherapy students.

Most participants demonstrated moderate dietary behavior and healthy food selection behavior, showing that although students generally displayed some healthy eating behaviors, their dietary behavior was not yet at optimal level. Similar findings have been observed in university students when factors affecting food choice include convenience, time limits, academic workload, food availability and personal preferences . According to Feraco et al., (2024), the eating patterns and food preferences of young people are dramatically different due to the influence of biological, behavioral and environmental factors that are ultimately responsible for the quality of the foods they consume. Similarly, Borba et

al., (2022) emphasized the high association of healthy eating behaviors with food selection procedures and ability to prepare meals. They recommended that offering healthier food choices could enhance the overall dietary quality of university students.

Association between Respondent Characteristics and Musculoskeletal Complaints

In the present study ³⁵ no significant association was found between gender and musculoskeletal complaints among undergraduate students. This was ¹⁷ contrary to the study by ¹⁷ Meghna et al., (2024), who reported higher prevalence of musculoskeletal problems among female physiotherapy students. Similarly, Overstreet et al., (2023)) found that women consistently had higher prevalence of chronic musculoskeletal pain compared to men across a range of musculoskeletal disorders. These sex differences have been attributed to multiple biological and physiological mechanisms, including hormonal influences, differences in muscle mass and connective tissue composition, immune responses, and pain processing pathways, all of which may contribute to greater susceptibility to musculoskeletal symptoms among women (Hart, 2023). But the present study did not find such differences, possibly because the male and female participants had similar academic demands, learning environments and daily ergonomic exposures, hence decreasing the impact of gender on musculoskeletal complaints.

The study did not find any significant relationship between food status and musculoskeletal disorders. This observation is comparable with the results of Kurniawan et al., (2024), who did not identify a significant ¹¹ association between body mass index and musculoskeletal disorders among mobile esports athletes. Likewise, Kandasamy et al., (2024) reported that the musculoskeletal problems of university students were more linked with behavioral and ergonomic characteristics (e.g., usage of electronic devices, posture, and physical activity) rather than body mass index .

However, Nugraha et al., (2024) found a slight ¹¹ positive correlation between body mass index and musculoskeletal disorders, indicating that excess body weight could be a factor in musculoskeletal symptoms in some populations. Inconsistencies in findings across study may be explained by participant characteristics, occupational or academic exposures, and outcome measurements. The participants of the present study were mostly young college students with normal nutritional status, hence the range in body mass index was limited. Thus, changeable lifestyle choices of this population may effect musculoskeletal symptoms more than dietary status alone.

Association between Activity Behavior, Dietary Behavior and Musculoskeletal Complaints

²⁶ The correlation between exercise behavior and musculoskeletal symptoms was substantial in college students. In particular, physical activity was adversely connected with musculoskeletal symptoms, and sitting time was positively correlated. This is consistent with other research that have found that less physically active students and those who sit for lengthy periods are more prone to musculoskeletal complaints. Eloi et al., (2022) found that sedentary medical students had higher impairment related to low back pain compared to physically active students. ¹⁶ Students who sat for more than seven hours per day had significantly higher disability ratings. Similarly, Mashhadi et al., (2022) observed that long sitting duration of more than two hours was strongly linked with lower back and hip discomfort. Whereas, ¹² Thamrin et al., (2023) similarly showed that excessive screen time increased the risk of low back pain among university students. These findings can be explained by the physiological effects of extended sedentary behavior, which lowers muscle activation and blood circulation, accelerates muscle exhaustion, and increases the mechanical strain on the spine and the surrounding soft tissues. Regular physical activity, on the other hand, enhances muscle strength, joint

flexibility, postural stability and tissue perfusion and provides protection against musculoskeletal disorders. The current results further underscore the need of boosting regular physical exercise and limiting excessive periods of sitting as practical methods to reduce musculoskeletal issues among university students.

There was no significant association between dietary behavior and musculoskeletal complaints. Furthermore, the selection behavior of healthy food did not approach statistical significance. Cilacı & Öney, (2023) reported similar findings in university students that although most of the participants had a high attitude towards healthy nutrition, the prevalence of musculoskeletal discomfort was still high, suggesting that healthy eating behavior alone may not be enough to prevent musculoskeletal complaints. In contrast, Mesquita et al., (2024) suggested that healthy dietary patterns may improve musculoskeletal health via decreasing systemic inflammation, oxidative stress and impaired muscle function, whereas unhealthy dietary behaviors may promote biological processes related to persistent musculoskeletal pain. Furthermore, Ward et al., (2024) suggested that food behaviors should be addressed with other modifiable lifestyle behaviors such as physical activity, sedentary behavior, sleep and body weight in the context of musculoskeletal pain. Thus, the absence of a significant correlation in the present study could suggest that eating behavior alone is not enough to explain musculoskeletal symptoms in university students, especially when other lifestyle related risk factors are more dominant.

CONCLUSION

Activity behavior especially physical activity and sitting duration were strongly related with musculoskeletal complaints among undergraduate students in the present study. On the other hand, there was no statistically significant association between musculoskeletal symptoms and nutritional status, dietary behavior and healthy food selection

behavior. These data may reflect a stronger contribution of activity-related behaviors to the prevalence of musculoskeletal problems than dietary factors in this cohort. Hence, promotion of regular physical activity and reduction of extended sitting should be emphasized as a part of the university health promotion programs for the prevention of musculoskeletal diseases. Future studies in bigger and more diverse populations and with prospective study designs are recommended to better evaluate the combined impact of dietary, behavioral, ergonomic, and psychological factors on musculoskeletal health.

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3 CONFLICT OF INTEREST

The author hereby declares that this research is free from conflicts of interest with any party.

AUTHOR'S CONTRIBUTION

Rahmasari contributed to the research concept and manuscript preparation. Habiba contributed to the selection of methods, instrument development, and data collection. Kibri contributed to the interpretation of results and writing of the discussion section. Saputri contributed to the research concept, discussion and manuscript writing.

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GENERAL COMMENTS

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