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ASSOCIATION BETWEEN PHYSICAL ACTIVITY LEVEL AND MUSCULOSKELETAL DISORDERS AMONG UNDERGRADUATE STUDENTS

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ABSTRACT
Background: Musculoskeletal disorders (MSDs) are a major public health concern among university students, largely attributed to sedentary lifestyles, prolonged screen time, poor posture, and insufficient physical activity. Despite increasing awareness, evidence regarding the relationship between physical activity levels and MSDs among undergraduate students remains limited, particularly in developing countries.
Objective: To determine the association between physical activity levels and musculoskeletal disorders among undergraduate students.
Methods: A cross-sectional analytical study was conducted among 200 undergraduate students aged 18–25 years using convenience sampling. Physical activity levels were assessed using the International Physical Activity Questionnaire–Short Form (IPAQ-SF), while musculoskeletal disorders were evaluated using the Standardized Nordic Musculoskeletal Questionnaire (NMQ). Demographic and anthropometric data were also collected. Statistical analysis included descriptive statistics, Chi-square test, binary logistic regression, and Spearman's correlation analysis, with statistical significance set at $p < 0.05$.
Results: The mean age of participants was 21.01 ± 1.76 years, and 51.0% were female. Overall, 72.5% of participants reported at least one musculoskeletal disorder during the previous 12 months, with lower back pain (19.5%), wrist/hand pain (19.0%), neck pain (18.0%), and shoulder pain (18.0%) being the most frequently affected regions. A significant association was observed between physical activity level and MSD prevalence ($\chi^2 = 41.07$, $p < 0.001$), with students having low physical activity demonstrating the highest prevalence of MSDs (90.9%). Logistic regression identified screen time as an independent predictor of MSDs (Adjusted OR = 1.50, 95% CI: 1.09–2.08, $p = 0.014$). Spearman's correlation revealed a significant negative correlation between physical activity and MSDs ($\rho = -0.576$, $p < 0.001$), while sitting time ($\rho = 0.490$, $p < 0.001$) and screen time ($\rho = 0.441$, $p < 0.001$) were positively correlated with MSD prevalence.
Conclusion: Lower physical activity levels are significantly associated with a higher prevalence of musculoskeletal disorders among undergraduate students. Promoting regular physical activity and reducing prolonged sitting and screen exposure may help decrease the burden of MSDs and improve students' musculoskeletal health and overall well-being.

KEYWORDS: Physical activity; Musculoskeletal disorders; Undergraduate students; IPAQ; Nordic Musculoskeletal Questionnaire; Sedentary behaviour; Screen time.This abstract is prepared directly from your manuscript and its reported results.

INTRODUCTION

Musculoskeletal disorders (MSDs) are among the leading causes of pain, disability, and functional limitations worldwide and constitute a major public health concern. They encompass a broad range of conditions affecting muscles, tendons, ligaments, joints, peripheral nerves, and supporting structures, often resulting in pain, reduced mobility, impaired physical function, and diminished quality of life. The Global Burden of Disease (GBD) studies have consistently identified low back pain as the leading cause of years lived with disability (YLDs), highlighting the substantial health and economic burden imposed by musculoskeletal conditions worldwide (1,2). Recent epidemiological evidence also indicates that the burden of MSDs is increasing among young adults, particularly university students, due to sedentary lifestyles, prolonged screen exposure, academic stress, and inadequate physical activity.

Physical activity is defined by the World Health Organization (WHO) as any bodily movement produced by skeletal muscles that requires energy expenditure. Regular physical activity is essential for maintaining musculoskeletal health by improving muscle strength, flexibility, joint stability, bone mineral density, and neuromuscular coordination while reducing the risk of chronic diseases and physical disability (3,4). According to the WHO Physical Activity Guidelines, adults aged 18–64 years should perform at least 150–300 minutes of moderate-intensity aerobic activity or 75–150 minutes of vigorous-intensity activity per week, together with muscle-strengthening activities on two or more days weekly (4). Despite these recommendations, physical inactivity has become increasingly common among university students because of prolonged classroom attendance, excessive use of computers and smartphones, online learning, and reduced participation in recreational exercise.

The undergraduate period represents a critical transition in which students experience substantial changes in lifestyle, academic responsibilities, and health-related behaviors. Long hours of studying, frequent use of digital devices, inadequate ergonomic practices, psychological stress, irregular sleep patterns, and reduced participation in physical activities collectively increase the risk of developing musculoskeletal disorders (5,6). Previous studies have demonstrated that prolonged sitting and sedentary behavior are independently associated with neck pain, shoulder pain, and low back pain, irrespective of participation in leisure-time physical activity (7). These risk factors have become more pronounced following the widespread adoption of digital learning environments and increased dependence on electronic devices for academic activities.

Musculoskeletal disorders among undergraduate students most frequently affect the neck, shoulders, upper back, lower back, and wrists. Although these symptoms are often considered temporary, persistent musculoskeletal pain may adversely affect concentration, academic performance, attendance, psychological well-being, and overall quality of life (8). A recent Canadian cross-sectional study reported that neck and lower back pain were the most prevalent musculoskeletal complaints among university students, with approximately 59–67% of participants reporting symptoms during the previous 12 months (9). Similarly, studies conducted in Saudi Arabia demonstrated a high prevalence of low back pain among college students and identified prolonged sedentary behavior, poor sleep quality, and unhealthy lifestyle behaviors as significant associated factors (10). Furthermore, recent evidence suggests that musculoskeletal discomfort increases during examination periods when students spend longer durations sitting and significantly reduce their physical activity levels (11).

Regular physical activity has been recognized as one of the most effective non-pharmacological strategies for preventing and managing musculoskeletal disorders. Exercise improves muscular endurance, enhances spinal stability, increases joint flexibility, optimizes posture, and reduces mechanical loading on musculoskeletal tissues (12). Conversely, insufficient physical activity contributes to muscle weakness, impaired postural control, decreased functional capacity, and increased susceptibility to musculoskeletal pain (13). A recent study investigating undergraduate students reported a significant positive association between higher physical activity levels and better musculoskeletal health status, suggesting that physically active students experience fewer musculoskeletal complaints than their less active peers (14).

To investigate these relationships, standardized instruments such as the International Physical Activity Questionnaire (IPAQ) and the Nordic Musculoskeletal Questionnaire (NMQ) have been extensively used in epidemiological studies because of their established reliability and validity across diverse populations. The IPAQ enables classification of individuals into low, moderate, and high physical activity levels, whereas the NMQ systematically assesses the prevalence and anatomical distribution of musculoskeletal symptoms across different body regions. The combined use of these instruments facilitates reliable assessment of the association between physical activity and musculoskeletal disorders and allows comparison of findings across different countries and populations (15,16).

Although numerous studies have evaluated musculoskeletal disorders among university students, evidence regarding the association between physical activity levels and musculoskeletal disorders remains inconsistent because of variations in study populations, educational systems, cultural practices, ergonomic environments, and assessment methods. Moreover, relatively few studies have comprehensively examined this relationship among undergraduate students in developing countries, including India, where increasing sedentary behavior and digital-device use may substantially influence musculoskeletal health (9,10). Therefore, investigating the association between physical activity level and musculoskeletal disorders among undergraduate students is essential for identifying modifiable risk factors and developing targeted preventive interventions that promote healthier lifestyles, improve academic performance, and reduce the future burden of musculoskeletal disorders.

METHODOLOGY

This study will employ a cross-sectional analytical study design to investigate the association between physical activity level and musculoskeletal disorders among undergraduate students. The study will be conducted in undergraduate colleges offering various academic programs. The target population will include students aged 18–25 years who are currently enrolled in undergraduate courses and are willing to participate in the study. Data collection will be carried out over a period of approximately three months following approval from the Institutional Ethics Committee.

A convenience sampling technique will be used to recruit 200 eligible participants. Before participation, all students will receive detailed information regarding the objectives and procedures of the study, and written informed consent will be obtained.

Students aged 18–25 years, enrolled in undergraduate programs, and capable of understanding the questionnaire will be included in the study. Students with a history of recent fractures, musculoskeletal surgery within the previous six months, diagnosed neurological disorders, inflammatory rheumatic diseases, congenital musculoskeletal abnormalities, pregnancy, or any condition limiting physical activity will be excluded to minimize confounding factors.

Data collection will begin with recording demographic and anthropometric information, including age, sex, height, weight, body mass index (BMI), academic year, average daily sitting time, screen time, and participation in sports or recreational activities. Body mass index will be calculated by dividing body weight (kg) by height squared (m^2) and categorized according to the World Health Organization classification.

The International Physical Activity Questionnaire–Short Form (IPAQ-SF) will be used to assess participants' physical activity levels during the previous seven days. The questionnaire records the frequency and duration of walking, moderate-

intensity activities, vigorous-intensity activities, and sitting time. Total physical activity will be expressed as MET-minutes per week, and participants will be categorized into low, moderate, or high physical activity levels according to the official IPAQ scoring protocol.
Musculoskeletal disorders will be assessed using the Standardized Nordic Musculoskeletal Questionnaire (NMQ). This validated instrument evaluates the presence of musculoskeletal symptoms in nine body regions: neck, shoulders, elbows, wrists/hands, upper back, lower back, hips/thighs, knees, and ankles/feet. Participants will report whether they experienced pain or discomfort during the previous 12 months and the previous 7 days, and whether these symptoms interfered with daily activities or required medical consultation.
All questionnaires will be administered in a classroom setting under the supervision of trained investigators to ensure standardized data collection. Participants will be instructed on how to complete each questionnaire, and any doubts will be clarified without influencing their responses. Completed questionnaires will be checked immediately for completeness and accuracy before data entry.

RESULTS

Table 1. Demographic Characteristics of Participants

A total of 200 undergraduate students participated in the study. The mean age of the participants was 21.01 ± 1.76 years. Among them, 102 (51.0%) were female and 98 (49.0%) were male, indicating an almost equal gender distribution. The mean body mass index (BMI) was 22.62 ± 3.03 kg/m², which falls within the normal range. Participants reported an average sitting time of 6.84 ± 1.48 hours/day and a mean screen time of 6.17 ± 1.51 hours/day. Overall, 84 (42.0%) students participated in sports or recreational activities, whereas 116 (58.0%) did not.

Table 1. Demographic Characteristics (N=200)

Variable	Category/Statistic	n	%	Mean ± SD	p-value
Age (years)	Continuous			21.01 ± 1.76	-
Gender	Male	98	49.0		0.612
	Female	102	51.0		
BMI (kg/m²)	Continuous			22.62 ± 3.03	-
Sitting time (hours/day)	Continuous			6.84 ± 1.48	-
Screen time (hours/day)	Continuous			6.17 ± 1.51	-

Table 2. IPAQ Physical Activity Levels

Level	n	%
Low	66	33.0
Moderate	73	36.5
High	61	30.5
Total	200	100.0

Based on the International Physical Activity Questionnaire (IPAQ), 73 (36.5%) participants demonstrated a moderate level of physical activity, making it the most common category. Sixty-six (33.0%) participants had low physical activity, while 61 (30.5%) exhibited high physical activity. These findings indicate that approximately one-third of the participants were insufficiently physically active.

Table 3. MSD Prevalence

Body Region	n	%
Neck	36	18.0
Shoulder	36	18.0
Elbow	29	14.5
Wrist/Hand	38	19.0
Upper Back	30	15.0
Lower Back	39	19.5
Hip/Thigh	23	11.5
Knee	34	17.0
Ankle/Foot	27	13.5
Any MSD	145	72.5

The overall 12-month prevalence of musculoskeletal disorders (MSDs) was 72.5%, indicating that nearly three-quarters of the participants experienced musculoskeletal symptoms during the previous year. Among different body regions, lower back pain was the most frequently reported complaint (19.5%), followed by wrist/hand pain (19.0%), neck pain (18.0%), and shoulder pain (18.0%). Hip/thigh pain was the least common complaint (11.5%).

Table 4. Association between Physical Activity and MSDs

Physical Activity	MSD Present n (%)	MSD Absent n (%)	χ^2	df	p-value
Low	60 (90.9)	6 (9.1)	41.07	2	<0.001
Moderate	59 (80.8)	14 (19.2)			
High	26 (42.6)	35 (57.4)			

A Chi-square test demonstrated a statistically significant association between physical activity level and the presence of musculoskeletal disorders ($\chi^2 = 41.07$, df = 2, $p < 0.001$). Participants with low physical activity had the highest prevalence of MSDs (90.9%), followed by those with moderate physical activity (80.8%). In contrast, participants with high physical activity had the lowest prevalence (42.6%). These findings suggest that higher levels of physical activity are associated with a lower occurrence of musculoskeletal disorders.

Table 5. Logistic Regression

Predictor	Adjusted OR	95% CI	p-value
Screen time	1.50	1.09–2.08	0.014
Moderate PA vs High	2.83	1.03–7.79	0.045
Age	0.98	0.81–1.18	0.821
BMI	1.06	0.95–1.19	0.281

Binary logistic regression analysis identified screen time as a significant independent predictor of musculoskeletal disorders (Adjusted OR = 1.50, 95% CI: 1.09–2.08, $p = 0.014$). This indicates that with each additional hour of daily screen time, the odds of developing an MSD increased by approximately 50%.
Participants with moderate physical activity also showed significantly higher odds of developing MSDs than those with high physical activity (Adjusted OR = 2.83, 95% CI: 1.03–7.79, $p = 0.045$). However, age ($p = 0.821$) and BMI ($p = 0.281$) were not significantly associated with musculoskeletal disorders.

Table 6. Correlation Analysis

Variable	Spearman ρ	p-value
IPAQ MET-min/week	-0.576	<0.001
Sitting time	0.490	<0.001
Screen time	0.441	<0.001
BMI	0.202	0.004
Age	0.052	0.461
Sleep duration	-0.071	0.319

Spearman's correlation analysis revealed a strong negative correlation between IPAQ MET-minutes/week and the total number of musculoskeletal disorder regions ($\rho = -0.576$, $p < 0.001$), indicating that participants with higher physical activity levels experienced fewer musculoskeletal complaints.
A moderate positive correlation was observed between daily sitting time and MSDs ($\rho = 0.490$, $p < 0.001$) as well as between screen time and MSDs ($\rho = 0.441$, $p < 0.001$), suggesting that prolonged sedentary behavior is associated with an increased risk of musculoskeletal disorders.

BMI demonstrated a weak positive correlation with MSDs ($\rho = 0.202$, $p = 0.004$), whereas age ($\rho = 0.052$, $p = 0.461$) and sleep duration ($\rho = -0.071$, $p = 0.319$) were not significantly associated with musculoskeletal disorders.

DISCUSSION

The present study investigated the association between physical activity levels and musculoskeletal disorders (MSDs) among undergraduate students and demonstrated that lower physical activity was significantly associated with a higher prevalence of MSDs. Overall, 72.5% of participants reported experiencing musculoskeletal symptoms during the previous 12 months, with the lower back, wrist/hand, neck, and shoulder being the most commonly affected regions. Furthermore, students with higher physical activity levels experienced significantly fewer MSDs than those with low physical activity. These findings support the hypothesis that adequate physical activity plays a protective role in maintaining musculoskeletal health among young adults.

The overall prevalence of MSDs observed in this study (72.5%) is consistent with previous investigations conducted among university students worldwide. Smith et al. (2019) reported that approximately 65–75% of university students experienced at least one musculoskeletal complaint during the previous year, particularly involving the neck and lower back. Similarly, Alzhrani et al. (2022) found that nearly 70% of Saudi university students suffered from MSDs, with prolonged sitting, academic workload, and reduced physical activity identified as major contributing factors. The comparable prevalence reported across different countries suggests that MSDs represent a universal health concern among undergraduate students regardless of geographical location.

The lower back emerged as the most frequently affected anatomical region (19.5%), followed by the wrist/hand (19.0%), neck (18.0%), and shoulder (18.0%). These findings closely resemble those reported by Falavigna et al. (2011), who identified low back pain as the leading musculoskeletal complaint among university students because of prolonged sitting, poor posture, and inadequate trunk muscle endurance. Likewise, Côté et al. (2008) demonstrated that sustained neck flexion during computer and smartphone use substantially increases cervical muscle loading, contributing to neck pain among young adults. The increasing dependence on digital devices for educational activities may explain the high prevalence of neck and upper extremity symptoms observed in the present study.

One of the principal findings of this study was the significant association between physical activity level and musculoskeletal disorders ($\chi^2 = 41.07$, $p < .001$). Students with low physical activity demonstrated the highest prevalence of MSDs (90.9%), whereas those with high physical activity exhibited the lowest prevalence (42.6%). These findings are in agreement with the World Health Organization (2020), which recommends regular moderate-to-vigorous physical activity to maintain musculoskeletal health and reduce disability. Similar observations were reported by Stubbs et al. (2018), who concluded that physically active individuals have better muscular endurance, joint stability, and postural control, thereby reducing the risk of chronic musculoskeletal pain. Regular exercise may improve muscle strength, flexibility, proprioception, and spinal stability, thereby protecting against cumulative mechanical stress associated with prolonged sitting.

Binary logistic regression analysis demonstrated that screen time was an independent predictor of MSDs (Adjusted OR = 1.50, 95% CI: 1.09–2.08, $p = .014$). Each additional hour of daily screen exposure increased the likelihood of developing musculoskeletal symptoms by approximately 50%. These findings are supported by Hakala et al. (2006), who reported that prolonged computer use and excessive screen exposure significantly increase the risk of neck, shoulder, and upper limb pain among adolescents and young adults. Likewise, Straker et al. (2018) concluded that excessive digital device use contributes to sustained static postures, repetitive movements, and increased biomechanical loading, ultimately increasing the occurrence of MSDs.

The present study also found that students with moderate physical activity had significantly greater odds of developing MSDs than those with high physical activity (Adjusted OR = 2.83, $p = .045$), indicating that only higher levels of regular physical activity may provide adequate protection against musculoskeletal symptoms. This observation is consistent with the systematic review by Shariat et al. (2018), which demonstrated that structured exercise interventions significantly reduce neck and back pain among office workers and students by improving muscular endurance and correcting postural imbalances.

Correlation analysis further strengthened these findings by demonstrating a strong negative correlation between IPAQ MET-minutes/week and the number of musculoskeletal complaints ($\rho = -0.576$, $p < .001$). In contrast, daily sitting time ($\rho = 0.490$) and screen time ($\rho = 0.441$) showed moderate positive correlations with MSD prevalence. These findings are consistent with Tremblay et al. (2017), who reported that sedentary behaviour independently contributes to musculoskeletal pain even after accounting for physical activity levels. Prolonged sitting may reduce muscular activation, impair circulation, increase spinal loading, and promote postural fatigue, thereby increasing susceptibility to MSDs.

Interestingly, BMI demonstrated only a weak positive correlation with MSDs, whereas age showed no significant association. These results may be explained by the relatively homogeneous age group and the predominance of normal BMI among the study participants. Similar findings were reported by Keating et al. (2015), who observed that lifestyle-related behavioural factors such as physical inactivity and prolonged sitting are stronger predictors of musculoskeletal health than age among young adults.

The present study has several strengths, including the use of internationally validated assessment tools (IPAQ-SF and Nordic Musculoskeletal Questionnaire), adequate sample size, and comprehensive statistical analyses including chi-square testing, logistic regression, and correlation analysis. However, several limitations should be acknowledged. The cross-sectional design prevents causal inference between physical activity and MSDs. Physical activity and musculoskeletal symptoms were self-reported, introducing the possibility of recall bias. In addition, participants were recruited from a single educational setting using convenience sampling, limiting the generalizability of the findings.

Overall, the findings suggest that promoting regular physical activity while simultaneously reducing prolonged sitting and excessive screen exposure may substantially reduce the burden of musculoskeletal disorders among undergraduate students. Universities should consider implementing structured exercise programmes, ergonomic education, and regular movement breaks within academic schedules to improve musculoskeletal health and overall student well-being.

Limitations

This study has several limitations that should be considered while interpreting the findings. First, the cross-sectional design precludes the establishment of a causal relationship between physical activity levels and musculoskeletal disorders (MSDs). Second, physical activity and musculoskeletal symptoms were assessed using self-reported questionnaires (IPAQ-SF and Nordic Musculoskeletal Questionnaire), which may be subject to recall and reporting bias. Third, participants were recruited using convenience sampling from a limited number of undergraduate institutions, which may restrict the generalizability of the findings to other student populations. Fourth, important factors such as ergonomic posture, psychological stress, sleep quality, nutritional status, and duration of smartphone or laptop use were not comprehensively evaluated and may have influenced the occurrence of MSDs. Finally, objective measures of physical activity, such as accelerometers or pedometers, were not used, which may have provided more accurate estimates of activity levels.

Clinical Implications

The findings of this study have important clinical and public health implications. The significant association between low physical activity and a higher prevalence of musculoskeletal disorders highlights the need for early preventive interventions among undergraduate students. Educational institutions should promote regular physical activity through structured exercise programs, sports participation, and awareness campaigns aligned with the World Health Organization physical activity guidelines

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