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The Relationship Between Back Pain and Sedentary Lifestyles and Sports Among University Students

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ABSTRACT. *Introduction:* Back pain is increasingly prevalent among university students and is commonly associated with sedentary behavior, prolonged sitting, and lifestyle-related risk factors. *Objective:* This study aimed to determine the prevalence of back pain among university students and to examine its association with sedentary lifestyle characteristics, specifically sitting posture and physical activity level. *Material and Methods:* A cross-sectional questionnaire-based study was conducted among 87 university students (M = 23.10 years). Data was collected on back pain occurrence over the past three months, sitting posture habits, sitting time, and physical activity. Physical activity was categorized using MET-minutes based on frequency, duration, and intensity. Associations were analyzed using chi-square tests, Fisher's exact test, and effect size measures. *Results:* Back pain prevalence was 78.2%, significantly exceeding the hypothesized 50% threshold ($p < 0.001$). A significant, moderate association was found between incorrect sitting posture and back pain ($\varphi = -0.358$, $p = 0.009$), with pain occurring predominantly among participants reporting poor posture. No statistically significant relationship was observed between physical activity level and either the presence or frequency of back pain *Conclusions:* The findings suggest that sitting posture may play a critical role in back pain development among university students next to physical activity volume. Preventive strategies should therefore integrate ergonomic education and posture awareness alongside physical activity promotion.

Keywords: *back pain, students, sitting posture, physical activity*

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INTRODUCTION

According to data from the World Health Organization (2023), approximately 619 million people lived with lower back pain in 2020, and the problem is expected to continue to grow as the population increases and ages, which significantly affects the daily functioning and quality of life of university students (Alshehri et al., 2023).

The prevalence of back pain among students in higher education is not negligible; according to research, the prevalence of lower back pain in the higher education population is estimated to be around 66% (Alshehri et al., 2023), while approximately 60-70% of students reported musculoskeletal pain in at least one area (neck, back, shoulders, lower back) in the past 12 months. (Parto et al., 2023)

This information highlights the importance of researching this topic, as young adults may lead a more sedentary lifestyle due to academic demands, which can potentially increase the risk of developing chronic pain, and also by recognizing the circumstances we can help in the long term to take preventive measures, which is well emphasized by research showing the importance of raising awareness among students, using ergonomic seating, engaging in an appropriate amount of exercise, and improving other socio-emotional conditions (Alshehri et al., 2023).

Alshehri et al. (2023) and Mahdavi et al. (2021) report that university students spend substantial time sitting each day for lectures, studying, and leisure screen use, illustrating the prevalence of sedentary lifestyles in this population.

Several studies have shown that regular physical activity may have a protective effect against the development of back pain, especially in the case of moderate-intensity exercise, while physical inactivity and prolonged sitting may be associated with an increased incidence of pain (Scarabottolo et al., 2017). In addition, sitting posture, i.e., correct or incorrect posture while sitting, may also play a role (Bagherian et al., 2023)-prolonged poor posture can lead to muscle tension and increased muscle strain, which can contribute to the development of back pain.

Based on previous research, the prevalence of back pain among students is high, and several factors- including sedentary lifestyle, level of physical activity, and sitting posture -potentially influence this phenomenon. This research therefore aims to determine the prevalence of back pain among students and to explore the relationships between sedentary lifestyle, physical activity, and sitting posture based on data obtained through a questionnaire.

HYPOTHESES

H1: We assume that the prevalence of back pain among students in the last three months is greater than 50%.

H2: There is a significant correlation between incorrect posture while sitting and back pain.

H3: There is a significant correlation between physical activity and the incidence of back pain.

MATERIALS AND METHODS

Participants

The study was conducted in accordance with the ethical principles of the Declaration of Helsinki. Participation was voluntary and by completing the questionnaire, each individual agreed to participate in the research. Data collection was conducted using convenience sampling through online student forums and social media groups targeting higher education networks. Due to the decentralized nature of the distribution channels, a specific institutional breakdown cannot be provided; however, the sample includes students from various universities across both Romania and Hungary. We collected a total of 106 responses, but in accordance with the selection criteria, individuals who had suffered acute spinal injuries in the past six months or who had been diagnosed with chronic spinal disorders were excluded from the sample, totaling 19 individuals who, with the exception of this criterion, had very similar characteristics as the final sample (N=19, M=23.73, SD=5.02, Mdn=22.00)

The average age of respondents who met the criteria (N=87) was M=23.10 (SD=4.78, Mdn=22.00), and the majority of respondents were female (n=74, 85.1%), while a significantly smaller proportion of males (n=13, 14.9%) completed the questionnaire.

Variables examined in the questionnaire

The variables used in the research are systematically structured to enable the analysis of correlations between students' lifestyles and musculoskeletal complaints. The first section of the questionnaire records sociodemographic data (gender, age) and health history (previous injuries, spinal disorders), which serve as control variables. The central part of the study consists of independent lifestyle variables: correct posture while sitting, frequency, duration, and intensity of physical activity. Finally, the dependent variable was the prevalence of back pain experienced in the last three months. A combined analysis of these data makes it possible to verify whether more than half of the students are affected by back pain and whether there is a significant correlation between a sedentary lifestyle, lack of exercise, and the development of pain.

Determining the categories of individuals who sit correctly and incorrectly

Participants were classified into two nominal categories based on the self-reported frequency of their correct sitting posture. Following the "majority rule" for identifying habitual behavior, respondents who maintained correct posture for more than 50% of their sitting time (51-100%) were categorized as "correct sitters," while those maintaining it for 50% or less were classified as "incorrect sitters".

The use of self-reporting to assess postural habits and sitting time is a standard and validated approach in large-scale epidemiological and ergonomic studies. Recent research underscores that participants' subjective perception of their habitual posture is a significant indicator of musculoskeletal health, as habitual patterns -even when self-assessed- correlate strongly with the prevalence of non-specific back pain (Kallings et al., 2021).

Dichotomizing frequency data into binary categories (e.g., predominant vs. non-predominant postural behavior) is a commonly used approach in ergonomic and epidemiological studies, as it facilitates the identification of risk factors and allows the application of robust association tests such as Chi-square and Fisher's exact tests; for example, Bagherian et al. (2023) demonstrated that categorizing habitual posture in this way revealed significant associations with musculoskeletal pain, consistent with standard epidemiological methodology (Altman, 1991).

Determining and categorizing physical activity levels

When measuring physical activity, it is essential to consider frequency, duration, and intensity together, as these factors collectively constitute the "total dose" (volume) of exercise, which directly determines the body's physiological response. There is an inverse relationship between intensity and duration: research shows that higher-intensity exercise (VPA) can produce the same cardiovascular and metabolic benefits in a significantly shorter time than moderate-intensity activity (Garber et al., 2011; Ahmadi et al., 2022).

To objectively compare the physical activity levels of the study participants, we used the internationally recognized MET (Metabolic Equivalent of Task) calculation method. This approach allows the three key dimensions of sports activity -frequency (times/week), duration (minutes/session), and intensity- to be integrated into a single numerical indicator. Since the data were obtained from a self-reported questionnaire, we used the modified Borg RPE (Rating of Perceived Exertion) scale (1–10 scale) to determine intensity. We converted the subjective perception of exertion to MET values based on the validation studies by Garber et al. (2011). The MET values assigned to the RPE values (e.g., moderate intensity: 4 MET; vigorous intensity: 6–8.5 MET) reflect the relative energy expenditure during the activity. To classify participants into categories, we calculated their total weekly MET-minutes using the following formula:

$$\text{Weekly MET-minutes} = \text{MET value (based on RPE)} * (\text{Weekly hours}*60) \quad (1)$$

This methodology is consistent with the IPAQ (International Physical Activity Questionnaire, 2005) analysis protocol, which considers 600 MET-minutes per week to be the minimum threshold for health. Participants were classified into five categories based on the WHO (2020) physical activity guidelines. The frequency of physical activity (at least 4 times a week) was highly emphasized. This is based on the latest epidemiological research (Zhao et al., 2024), which confirmed that the frequency of physical activity is an independent protective factor in addition to volume (MET-minutes). Research indicates that acute physiological responses to exercise can persist for up to approximately 48–72 hours after a bout, but tend to diminish thereafter if exercise is not repeated, suggesting that multiple weekly sessions are necessary to maintain continuous adaptive stimulus to the musculoskeletal and metabolic systems (e.g., improvements in insulin sensitivity measurable 48–72 h post-exercise; regular exercise recommendations emphasizing ≤2-day gaps between sessions) (Way et al., 2016; Gerber et al. 2011). This approach has made it possible to precisely distinguish between 'regular training' and occasional, albeit high-volume, exercise (e.g., "weekend warrior" pattern):

- Inactive (< 600 MET-minutes/week): Individuals who do not meet the minimum amount of physical activity required for health maintenance.
- Low-level exercisers (600-1199 MET-minutes/week): Those who engage in low-volume or low-intensity exercise, and participants who achieve a high total volume but concentrate it into 1-2 sessions per week. Although recent research (Dos Santos et al., 2022) shows that this pattern is also effective in reducing the risk of mortality, however, this does not mean that it would be enough physical activity to counteract the negative effects of sitting.
- Moderate-level exercisers (1200-2500 MET-minutes/week and at least 3 times per week): This category includes those who meet the WHO recommendation. The inclusion of the frequency criterion is justified by metabolic adaptation and injury prevention.

- Active exercisers (> 2500 MET-minutes/week and at least 4 times per week): Those who engage in high-intensity and regular physical activity.

When setting the thresholds, we considered the results of Ahmadi et al. (2022), which emphasize the important role of intense exercise periods (VPA) and the meta-analysis by Ekelund et al. (2016), which points out that university students with a sedentary lifestyle need to reach a higher range (1500+ MET-minutes) to counteract the negative effects of sitting. To perform more accurate analyses, we combined the groups in pairs, thus creating groups of people who exercised sufficiently (Moderate exercisers and Active exercisers) and those who did not exercise sufficiently (Inactive and Low-level exercisers).

Determining the occurrence and frequency of pain

The occurrence and frequency of pain were determined using a self-reported questionnaire. Participants were asked to indicate whether they had experienced back pain in the past three months (group with pain/group with no pain) and, if so, to specify its frequency. The use of the self-report method is supported by the latest international recommendations for pain research, as pain is a subjective and individual experience, and the patient's own report is the primary and most valid source for measuring it (Raja et al., 2020, International Association for the Study of Pain [IASP], 2020). Based on the frequency of pain, respondents were classified into four categories: very rarely (never, once a month or less), sometimes (several times a month or once a week), very often (several times a week), and constantly (daily or constant pain). Structuring the responses into four categories is methodologically justified as it allows for the separation of episodic complaints of low clinical relevance from persistent pain conditions that significantly affect quality of life. This type of differentiation is essential for accurately mapping the heterogeneous nature of back pain and ensuring standardized measurement results.

Statistical processing of data

The data was processed using IBM® SPSS® Statistics Standard GradPack 29 and various statistical tests, all of which are explained in detail for each result.

Following the determination of descriptive statistics (frequencies and percentages), 95% confidence intervals (CI) were calculated using the Agresti–Coull method to estimate population parameters. To evaluate the sample prevalence of back pain, a one-sample proportion test (Score test) was performed against a hypothesized test value of 50% (0.50).

Relationships between categorical variables were analyzed using cross-tabulation and Pearson's chi-square (χ^2) test. In cases where the assumptions of the chi-square test were violated—specifically, when the expected cell counts fell below 5—significance was determined using Fisher's Exact Test. When expected frequencies were below 5 in more than 20% of the cells, the analysis was deemed unreliable due to severe violation of statistical assumptions, and the corresponding results were excluded from interpretation.

To quantify the strength of the associations, the Phi (ϕ) coefficient was calculated for 2 × 2 contingency tables, while Cramer's V (V) was utilized for larger tables. The magnitude of the effect sizes was interpreted based on Cohen's (1988) criteria. For all statistical decisions, the significance level was set a priori at $\alpha = 0.05$ ($p < 0.05$), and the resulting p-values were reported either as exact values or according to their critical thresholds (e.g., $p < 0.001$).

RESULTS

Prevalence of back pain among respondents

We examined the frequency of back pain among respondents over the past three months.

To test the hypothesis, we performed a one-sample proportion test using a test value of 50% (0.5). Based on the descriptive statistical data, 78.2% (68 people) of the participants in the sample ($N = 87$) reported back pain in the past three months. Based on the results of the statistical test (Score test), it can be stated that the observed prevalence statistically significantly exceeds the 50% rate assumed in the hypothesis ($Z = 5.253$; $p < 0.001$).

The accuracy of the measurement is further reinforced by the 95% confidence interval (Agresti-Coull method), according to which the true prevalence of back pain is between 68.3% and 85.6%. Since the confidence interval is entirely above the expected 50% threshold, the hypothesis that more than half of the students are affected by back pain has been statistically confirmed.

Table 1. Prevalence of back pain

Category	Frequency (N)	Proportion (%)	95% CI	Test Value	Z-Score	Significance (p)
Back pain	68	78.2%	68.3%-85.5%	0.50	5.253	< 0.001*
No back pain	19	21.8%	14.4%-31.7%	0.50	-5.253	< 0.001*
Total	87	100.0%	-	-	-	-

CI= Confidence interval

The correlation between incorrect sitting posture and back pain

We examined the correlation between correct sitting posture and the occurrence of back pain using cross-tabulation analysis and the Chi-square test. Since the expected count was less than 5 in certain cells of the cross-tabulation, Fisher's Exact Test was used to determine significance. The statistical test yielded a significant result (χ^2 (1)=11.12, p = 0.009). The Phi coefficient indicating the strength of the relationship was -0.358, which indicates a moderate correlation (Cohen,1988) between the two variables.

In addition to the significant Chi-square test result, the analysis of frequency data highlights the nature of the correlation: the occurrence of pain is concentrated in the group of people who sit incorrectly (81%), as opposed to those who sit correctly (0%). This may be related to the assumption that poor posture is a risk factor for the development of back pain.

At the same time, it is important to note that the data may be distorted, as only 3 of the 87 respondents stated that they sat correctly in at least 51% of cases, and none of them experienced back pain.

Table 2. Prevalence of back pain

Sitting Posture	BP: Yes (*n*)	BP: No (*n*)	Total (*N*)	IBP (%)
Incorrect sitting (≤ 50%)	68	16	84	81.0%
Correct sitting (> 50%)	0	3	3	0.0%
Total	68	19	87	78.2%

Note: χ^2(1)=11.12, p = 0.009;
BP= Back pain, **IBP**= Incidence of back pain

The correlation between regular physical activity and the incidence of back pain

We used cross-tabulation analyses and chi-square tests to examine the relationships between pain and physical activity in the sample studied (N = 87).

First, we analyzed the relationship between the presence of pain (painful/not painful) and the combined assessment of physical activity (enough exercise/not enough exercise). The conditions for applying the chi-square test were met, as the expected frequency exceeded 5 in each cell. The analysis did not show a statistically significant correlation between the two variables (χ^2 (2) = 0.004; p = 0.949). The Phi coefficient, which indicates the strength of the association, shows a negligible, clinically non-meaningful correlation (φ = -0.007). According to the descriptive statistical data, 67.6% of subjects experiencing pain and 68.4% of those without pain considered themselves to be sufficiently active, which further reinforces the lack of correlation.

Table 3. Sufficient physical activity and the incidence of back pain

IBP	SPA n (%)	ISPA n (%)	Total n
Pain	46 (67,6%)	22 (32,4%)	68
No pain	13 (68,4%)	6 (31,6%)	19
Total	59 (67,8%)	28 (32,2%)	87

Note: χ^2 (2) = 0,004; p = 0,949; φ = -0,007
IBP= Incidence of back pain, **SPA**= sufficient physical activity, **ISPA**= insufficient physical activity

We then examined the relationship between the frequency of back pain (ranging from "very rarely hurts" to "constantly hurts" and subjectively assessed physical activity (sufficient physical activity/ insufficient physical activity). The prerequisites for the chi-square test were largely met in this case as well, as only 12.5% of the cells had an expected frequency of less than 5. The analysis did not reveal a statistically significant correlation between the variables ($\chi^2(3) = 3.230$; p = 0.358). Cramer's V index, which measures the strength of the correlation, indicates a weak association (V = 0.193). Based on the results, there is no significant correlation between the frequency of pain and sufficient physical activity in the sample studied.

Table 4. The frequency of back pain and sufficient physical activity

IPB	SPA n (%)	ISPA n (%)	Total n
Very rarely	24 (68,6%)	11 (31,4%)	35
Sometimes	20 (74,1%)	7 (25,9%)	27
Very often	8 (50,0%)	8 (50,0%)	16
Constantly	7 (77,8%)	2 (22,2%)	9
Total	59 (67,8%)	28 (32,2%)	87

Note: χ^2 (3) = 3,230; p = 0,358; Cramer 's V = 0,193
In 12.5% of cells, the expected frequency was below 5.
IBP= Incidence of back pain, **SPA**= sufficient physical activity, **ISPA**= insufficient physical activity

We also planned a chi-square test to examine the correlation between the presence of pain (with pain/without pain) and a more objective level of physical activity (inactive, low level of exercise, moderately active and active), but during the analysis, the expected frequency remained below 5 in 25% of the cells. This violated the conditions for applying the statistical test, so we did not consider the results reliable and did not draw any conclusions from them.

Table 5. Frequency of pain and level of physical activity

Level of physical activity	Pain n (%)	No pain n (%)	Total n
Inactive	26 (38,2%)	8 (42,1%)	34
Low-level exercisers	20 (29,4%)	5 (26,3%)	25
Moderate exercisers	14 (20,6%)	3 (15,8%)	17
Active exercisers	8 (11,8%)	3 (15,8%)	11
Total	68 (100,0%)	19 (100,0%)	87

Note: χ^2 (4) = 0,472; p = 0,925; Cramer 's V = 0,074.
In 25.0% of cells, the expected frequency was less than 5

Similarly, when examining the relationship between the level of physical activity and the frequency of back pain, 56.3% of cells had a low expected frequency, which also made it impossible to reliably apply the chi-square test. Accordingly, the results of this analysis were not presented either.

Table 6. Level of physical activity and the frequency of back pain

IPB	I n (%)	LLE n (%)	ME n (%)	AE n (%)	Total n
Very rarely	13 (37,1%)	11 (31,4%)	7 (20,0%)	4 (11,4%)	35
Sometimes	12 (44,4%)	8 (29,6%)	4 (14,8%)	3 (11,1%)	27
Very often	4 (25,0%)	4 (25,0%)	4 (25,0%)	4 (25,0%)	16
Constantly	5 (55,6%)	2 (22,2%)	2 (22,2%)	0 (0,0%)	9
Total	34	25	17	11	87

Note: χ^2 (5) = 5,726; p = 0,767; Cramer's V = 0,148
In 56.3% of cells, the expected frequency was less than 5
I= Inactive, **LLE**= Low-level exercisers, **ME**= Moderate exercisers, **AE**= Active exercisers

Overall, no statistically significant relationship was found between the presence or frequency of pain and the subjective assessment of physical activity in the sample studied, because methodological limitations prevented valid conclusions from being drawn in the case of analyses using more detailed categories of physical activity.

DISCUSSION

The present study aimed to examine the prevalence of back pain among university students and to explore its relationship with sedentary lifestyle factors, particularly sitting posture and physical activity. The results indicate that back pain is highly prevalent in the examined population, with more than three-quarters of respondents (78.2%) reporting back pain in the previous three months. This finding strongly supports **H1**, confirming that back pain affects more than half of university students and represents a significant public health concern in this age group.

The observed prevalence is consistent with, and in some cases exceeds, values reported in recent international studies. For example, Parto et al. (2023) found a prevalence of 60-70% for pain in different areas (neck, back, shoulders, lower back). The higher prevalence found in the present study may be explained by differences in measurement periods (three-month prevalence), increased academic workload, prolonged screen exposure, and post-pandemic lifestyle changes that have further intensified sedentary behavior among students. These findings reinforce the growing body of evidence suggesting that musculoskeletal complaints are not only common but increasingly normalized among young adults.

A significant association was found between incorrect sitting posture and the occurrence of back pain, supporting H2. The moderate strength of the relationship ($\varphi = -0.358$) suggests that posture is a meaningful risk factor in the development of back pain. This result aligns with ergonomic and biomechanical research showing that prolonged poor sitting posture increases spinal load, muscular imbalance, and static strain, all of which contribute to pain development (Bagherian et al., 2023; Kallings et al., 2021; Mahdavi et al., 2021; Ekelund et al., 2016)

Importantly, the concentration of back pain almost exclusively among participants who reported predominantly incorrect posture highlights the potential cumulative effect of habitual postural behavior. Similar findings have been reported by Bontrup et al. (2019), who emphasized that self-reported habitual posture is a strong predictor of non-specific back pain, even when objective measurements are not available. However, the very small number of participants classified as “correct sitters” (n = 3) represents a limitation and suggests that future studies should aim for larger and more balanced posture-based subgroups, potentially using objective posture-monitoring tools.

Contrary to H3, no statistically significant relationship was found between physical activity and the incidence of back pain. This result contrasts with several studies reporting a protective effect of regular physical activity, particularly moderate-to-vigorous exercise, against back pain (Alanazi & Kashoo, 2025; Scarabottolo et al., 2017). However, recent literature increasingly highlights that physical activity alone may not be sufficient to counteract the negative effects of prolonged sedentary behavior, especially when sitting time remains high (Ekelund et al., 2016; Dzakpasu et al., 2021).

One plausible explanation is that many physically active participants in the present sample still spent a large portion of their day sitting, which may have attenuated the protective effects of exercise. This interpretation is supported by Ekelund et al. (2016), who demonstrated that high volumes of sedentary time require substantially higher levels of physical activity to offset associated health risks.

CONCLUSIONS

This study examined the prevalence of back pain among university students and its association with sedentary lifestyle factors, particularly sitting posture and physical activity. The findings indicate that back pain is highly prevalent, affecting more than three-quarters of students, and represents a significant public health concern in this population. A statistically significant association was found between incorrect sitting posture and the occurrence of back pain, suggesting that habitual poor posture is an important contributing factor. In contrast, physical activity alone did not show a significant protective effect, indicating that regular exercise may be insufficient to offset prolonged sedentary behavior. Overall, the results highlight that sedentary behavior—particularly poor sitting posture—may play a more critical role in back pain development than overall activity levels. Therefore, preventive strategies should combine ergonomic education and postural awareness with the promotion of physical activity.

Limitations of the study and directions for future research

Several limitations should be considered when interpreting the findings: the cross-sectional design prevents causal conclusions, while reliance on self-reported data may introduce bias, particularly in assessing sitting habits and physical activity. The uneven distribution of subgroups-especially the small number of participants with correct posture-reduces statistical reliability, and the MET-based classification of physical activity fails to capture qualitative aspects of movement, which may explain the lack of association with back pain. Future research should adopt longitudinal and intervention-based designs that examine the combined effects of sitting posture, sitting duration, and multiple dimensions of physical activity, integrating objective measurements with subjective assessments and extending analyses across diverse cultural contexts to better reflect the complex lifestyles of university students.

AUTHOR CONTRIBUTIONS

KSZ conceptualized the study, developed the methodology, performed the statistical analyses, and wrote the original draft of the manuscript. ÁZSZ, NM and HSZ were responsible for the data collection and managed the literature review, they supervised the research process and contributed to the critical revision of the manuscript. All authors have read and agreed to the published version of the manuscript.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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