



UNIVERSITY STUDENTS' LIFESTYLE IN THE CONTEXT OF PHYSICAL ACTIVITY, SEDENTARY HABITS, AND ACADEMIC ACHIEVEMENTS

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Abstract/Izvleček

This study aims to explore the relationship between physical activity, sedentary behaviour, and academic achievement among university students. A total of 243 students aged 18 to 24 years participated. Physical activity was assessed using the International Physical Activity Questionnaire – Short Form, while sedentary behaviour was measured with the SIT-Q-7d. Academic achievement was based on self-reported average grades and compared across physical activity levels using one-way ANOVA. Results indicate that higher physical activity is not necessarily linked to better academic performance. Excessive involvement in physical activity may reduce study time, potentially leading to lower academic outcomes.

Življenjski slog študentov v kontekstu gibalne dejavnosti, sedečega načina in akademskih dosežkov

Ključne besede:

gibalne dejavnosti,
sedeče vedenje,
akademski dosežki,
študenti, kognitivna
uspešnost.

Raziskava je preučevala povezavo med gibalno dejavnostjo, sedečim vedenjem in akademskim uspehom med 243 študenti, starimi od 18 do 24 let. Gibalna dejavnost je bila ocenjena z vprašalnikom IPAQ-SF, sedeče vedenje z vprašalnikom SIT-Q-7d, akademski uspeh pa s povprečno oceno. Rezultati enosmerne ANOVE so pokazali, da višja raven gibalne dejavnosti ni nujno povezana z boljšimi akademskimi dosežki in da prekomerna predanost gibalni dejavnosti lahko zmanjša čas, ki je na voljo za učenje, in tako vpliva na akademsko uspešnost. Nasprotno pa lahko zmerno sedeče vedenje, zlasti ob vikendih, v kombinaciji z učnimi dejavnostmi, koristi akademski uspešnosti.

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Introduction

The academic performance of university students is influenced by a complex interplay of lifestyle factors, with physical activity (PA) and sedentary behaviour emerging as important determinants. Longitudinal randomized controlled trials (RCTs) provide robust evidence that moderate PA enhances cognitive functions essential for academic success, such as working memory, attention, and executive control (Donnelly et al., 2016; Erickson et al., 2019). For instance, a meta-analysis of RCTs by Álvarez-Bueno et al. (2017) demonstrated that structured PA interventions improve academic outcomes in children and adolescents, with benefits attributed to enhanced brain connectivity and neurogenesis. Similarly, Hillman et al. (2014) found in an RCT that regular aerobic exercise improves executive function in children, suggesting potential benefits for university students. Beyond cognition, PA is associated with improved mental health, including better stress management and mood regulation, further facilitating academic achievement (Liu and Taresh, 2024). In contrast, excessive sedentary behaviour, particularly non-educational screen time, often correlates with suboptimal academic outcomes due to reduced cognitive engagement and physical well-being (Tremblay et al., 2011; Sánchez et al., 2024). However, certain sedentary activities like studying or reading may positively contribute to academic performance when structured appropriately (Hunter et al., 2018).

Regional differences also play an important role in shaping physical activity habits. For instance, Jančič and Planinšec (2018) found that students from Maribor were more physically active than their peers from Novi Sad, especially in family-based and unorganized physical activities. Such findings emphasize the influence of cultural and local contexts, which may extend into university years (Jančič & Planinšec, 2018). Despite this evidence, the assumption that higher PA levels universally enhance academic achievement is not without contradictions. Several studies report inconsistent or null associations, particularly in settings with academic demands and time constraints. For example, Pandolfo et al. (2018) found no correlation between PA and academic performance among high school students, suggesting that PA may not directly translate to academic benefits in demanding educational contexts. Similarly, Daley and Ryan (2000) reported no correlations between PA and academic performance in secondary school adolescents, indicating that time spent on PA may compete with study time. Vedøy et al. (2021) found no associations between objectively measured PA and academic achievement among Norwegian adolescents,

reinforcing that PA's cognitive benefits may not always translate to better grades. Additionally, Suárez-Cano et al. (2023) reported no correlation between PA and academic performance among Colombian students, highlighting the inconsistent relationship in diverse educational settings. These findings challenge the prevailing narrative and highlight the need to explore the optimal balance of PA for academic success. The role of sedentary behaviour is equally complex. While prolonged inactivity is detrimental, specific sedentary activities, such as academic work, may support cognitive development and academic outcomes (Sánchez-Oliva et al., 2023). For instance, Hunter et al. (2018) reported that time spent on homework is positively associated with academic performance, unlike leisure-oriented screen time, which correlates with poorer results. These contradictions underscore the need for a nuanced understanding of lifestyle factors in higher education.

The motivation for this study stems from the need to address these inconsistencies and examine how PA and sedentary behaviour are associated with academic achievement among university students in Slovenia during a non-exam period. University students face unique challenges, including balancing academic responsibilities, social activities, and personal well-being, which may alter the efficacy of PA and sedentary behaviours. Prior research, such as Lipošek et al. (2019), suggests that moderate PA (2–3 hours per week) is positively associated with academic success, while excessive PA may not yield additional benefits. However, much of the literature focuses on children or adolescents, with fewer studies addressing higher education settings where academic demands are more intense and self-directed. The timing of data collection is critical, as PA levels may decrease during exam periods due to increased study time. This study captures students' typical lifestyle patterns by focusing on a non-exam period, providing a clearer picture of how PA and sedentary behaviour relate to academic performance. With its structured curricula and high academic expectations, Slovenia's educational system offers a unique context to explore these relationships, potentially informing tailored interventions for similar environments.

The growing public health concern about sedentary lifestyles among young adults further underscores the importance of this research. The prevalence of sedentary behaviour, particularly screen-based activities, has risen, contributing to a decline in physical and cognitive health (Sánchez et al., 2024). Interventions to promote PA and reduce harmful sedentary behaviours are critical, but their design requires a nuanced understanding of which behaviours support or hinder academic outcomes (Kovalenko, 2024). For example, Syväoja et al. (2014) found that academically

oriented sedentary time enhances sustained attention, while excessive non-educational screen time impairs cognitive function. These findings suggest that interventions must distinguish between beneficial and detrimental sedentary behaviours to optimize student performance. Additionally, individual differences, such as gender or baseline fitness levels, may moderate the effects of PA and sedentary behaviour (Salas-Gomez et al., 2020). For instance, Salas-Gomez et al. (2020) noted that PA's cognitive benefits may be more pronounced in women, suggesting potential gender-specific responses that could influence intervention strategies.

Theoretically, the relationship between PA, sedentary behaviour, and academic achievement is grounded in ecological models of health behaviour, which emphasize interactions between individual, environmental, and societal factors (Sallis et al., 2015). These models suggest that students' lifestyle choices are shaped by their academic environment, access to recreational facilities, and cultural attitudes toward PA. Understanding these dynamics is critical in Slovenia, where outdoor recreational opportunities are abundant, but screen-based sedentary behaviour is increasingly prevalent. Longitudinal RCTs, such as those by Donnelly et al. (2016), provide substantial evidence but are less common in university populations, highlighting a research gap. This study aims to lay the groundwork for longitudinal investigations by examining lifestyle factors in a non-exam period, offering insights into temporal relationships.

The societal implications of this research extend beyond academia, as fostering healthy lifestyles among university students can contribute to long-term health and productivity. Sedentary behaviour is a growing public health challenge with implications for obesity, mental health, and cognitive decline (Tremblay et al., 2011). Promoting PA in educational settings can mitigate these risks while enhancing academic performance, creating a dual benefit for students and society. However, the design of such interventions requires careful consideration of competing demands on student time. For example, Badrić et al. (2015) emphasized the importance of recreational PA for adolescents' health but noted barriers such as academic workload and limited access to facilities. These barriers are equally relevant for university students, who often juggle multiple responsibilities. By identifying optimal PA levels and sedentary behaviour patterns, this study can inform policies integrating PA into university curricula, such as mandatory PA programs or campus-based fitness initiatives. In addition to all the benefits of recreational activity, the

issues related to the formation of ecological awareness associated with a positive attitude toward the health benefits of physical exercise stand out (Prskalo, 2018).

Globally, the relevance of this research is amplified by the universal challenge of declining PA and rising sedentary behaviour among young adults. The World Health Organization (2020) highlights that insufficient PA is a leading risk factor for non-communicable diseases, underscoring the need for evidence-based interventions. Studies from diverse contexts, such as Australia (Syväoja et al., 2014) and Spain (Sánchez-Oliva et al., 2023), suggest that the interplay between PA, sedentary behaviour, and academic performance is a global concern, yet context-specific factors, such as educational systems and cultural norms, shape outcomes. Slovenia's blend of structured education and outdoor recreational culture provides a unique lens to examine these dynamics, with potential implications for other countries. This study aims to contribute to the global evidence base by comprehensively analysing how PA and sedentary behaviour relate to academic achievement, informing local and international efforts to promote student well-being.

This study hypothesizes that moderate PA positively correlates with academic performance, while excessive PA may reduce study time and negatively impact grades. Conversely, prolonged sedentary behaviour, particularly non-educational, is expected to negatively correlate with academic outcomes, whereas academically oriented sedentary time may be beneficial. By addressing these hypotheses, this research seeks to advance the understanding of lifestyle factors in higher education and support the development of evidence-based interventions that balance PA and study demands, ultimately enhancing student success.

Methods

Sample Description

The study included 243 students from the University of Maribor, Slovenia, of whom 192 (79%) were female. Participants ranged in age from 18 to 24 years ($M = 21.34$, $SD = 1.46$).

Survey Questionnaires

PA was assessed using the International Physical Activity Questionnaire – Short Form (IPAQ-SF), a validated tool that measures the intensity (light, moderate, vigorous), duration, and frequency of physical activity over the past seven days (Lee

et al., 2011). The IPAQ-SF provides data on moderate to vigorous PA (MVPA) and light PA (LPA), allowing for categorization based on activity levels.

Sedentary behaviour was evaluated with the SIT-Q-7d questionnaire, which captures sitting time across various domains, including meals, commuting, studying, part-time work, and screen use (Wijndaele et al., 2014). This tool provides detailed insight into students' sedentary habits on weekdays and weekends.

Academic achievement was defined as the average grade of all passed exams, based on the Slovenian grading scale (6–10, where 6 is the minimum passing grade). Non-passed exams were excluded from the average grade calculation. Demographic information, including gender, age, and year of study, was also collected.

Data Collection

Data were collected via an online survey conducted in October 2023, during a non-exam period, to avoid bias from reduced physical activity associated with exam preparation. Students received a secure survey link, including the IPAQ-SF, SIT-Q-7d, questions about their cumulative average academic grade (based on all passed exams up to that point), and demographic details. The non-exam period ensured that PA levels, as captured by the IPAQ-SF's 7-day recall, reflected typical lifestyle patterns rather than exam-related constraints.

Statistical Analysis

Data were analysed using SPSS version 29. Based on World Health Organization (2020) guidelines, participants were categorized into three PA groups for MVPA: less active (<150 min/week), moderately active (151–300 min/week), and highly active (>300 min/week). A similar categorization was applied to LPA: less active (<150 min/week), moderately active (151–300 min/week), and highly active (>300 min/week). For sedentary behaviour, participants were divided into five groups based on daily sitting time on weekdays and weekends: <240 min/day, 241–300 min/day, 301–360 min/day, 361–420 min/day, and >420 min/day. ANOVA was used to determine whether there was a difference between the three groups at a risk level of $p < 0.05$. An additional post-hoc Scheffé test was used to determine differences between groups.

Results

Table 1

Differences in academic grades between moderate to vigorous physical activity (MVPA) groups

Group MVPA	N	M	SD	F	p	η^2
<150 min/week	63	8.64	.54	12.27	.001	.093
151-300 min/week	68	8.24	.63			
>300 min/week	112	8.20	.58			
Total	243	8.33	.61			

Note: Post-hoc Scheffé differences: <150 min/week higher than 151–300 min/week ($p < .001$) and >300 min/week ($p < .001$).

Table 1 presents the one-way ANOVA results for academic grades between MVPA groups. A difference was found ($F(2, 240) = 12.27, p = .001, \eta^2 = 0.093$), indicating a medium to large effect size according to Cohen's (1988) criteria. Post-hoc Scheffé tests revealed that the less active group (<150 min/week, $M = 8.64$) had higher grades than the 151–300 min/week ($M = 8.24, p < .001$) and >300 min/week ($M = 8.20, p < .001$) groups. No difference was found between the 151–300 and >300 min/week groups ($p = .925$).

Table 2

Differences in academic grades between light physical activity (LPA) groups

Group LPA	N	M	SD	F	p	η^2
<150 min/week	63	8.54	.69	7.62	.001	.060
151-300 min/week	102	8.34	.52			
>300 min/week	77	8.15	.61			
Total	242	8.33	.61			

Note: Post-hoc Scheffé difference: <150 min/week higher than >300 min/week ($p < .001$).

Findings in Table 2 indicate a difference in academic grades across LPA groups ($F(2, 239) = 7.62, p = .001, \eta^2 = 0.060$), and the effect size was moderate according to Cohen's (1988) criteria. Post-hoc Scheffé tests indicated that the <150 min/week group ($M = 8.55$) had higher grades than the >300 min/week group ($M = 8.15, p < .001$). No differences were found between <150 and 151–300 min/week ($p = .099$) or 151–300 and >300 min/week ($p = .114$).

Table 3*Differences in academic grades between weekday sedentary groups (WSG)*

Group WSG	N	M	SD	F	p	η^2
<240 min/day	44	8.38	.42			
241-300 min/day	75	8.20	.65			
301-360 min/day	46	8.37	.59	1.913	0.109	-
361-420 min/day	27	8.56	.81			
>420 min/day	51	8.31	.56			
Total	243	8.33	.61			

Table 3 indicates no difference in academic grades across weekday sedentary groups ($F(4, 238) = 1.913, p = .109, \eta^2 = 0.031$). The highest mean grade was in the 361–420 min/day group ($M = 8.56$), but no post-hoc comparisons were conducted.

Table 4*Differences in academic grades between weekend day sedentary groups (WDSG)*

Group WDSG	N	M	SD	F	p	η^2
<240 min/day	24	8.36	.39			
241-300 min/day	47	8.30	.47			
301-360 min/day	63	8.13	.72	2.904	0.023	0.047
361-420 min/day	44	8.45	.34			
>420 min/day	65	8.45	.74			
Total	243	8.33	.61			

Note: Post-hoc Scheffé tests showed no pairwise differences (all $p > .05$).

Table 4 shows a difference across weekend day sedentary groups ($F(4, 238) = 2.904, p = .023, \eta^2 = 0.047$), indicating a medium effect size according to Cohen's (1988) criteria. Post-hoc Scheffé tests revealed no pairwise differences (all $p > .05$), with the closest comparison between 301–360 min/day ($M = 8.13$) and >420 min/day ($M = 8.45, p = .063$).

Discussion

This study examined the relationship between PA, sedentary behaviour, and academic achievement among university students in Slovenia during a non-exam

period. The findings revealed an unexpected pattern: students engaging in less than 150 minutes per week of MVPA and LPA achieved higher academic grades than those with higher PA levels. Additionally, weekday sedentary behaviour showed no impact on grades. In contrast, weekend sedentary behaviour had a weak association, with higher grades observed in groups with 361–420 and >420 minutes per day. These results challenge the conventional assumption that increased PA enhances academic performance and suggest a more nuanced interplay between lifestyle factors and academic outcomes.

The counterintuitive finding that lower MVPA and LPA levels were associated with better academic grades aligns with a limited but growing body of research. For instance, Pandolfo et al. (2018) found no correlation between PA and academic performance among high school students, suggesting that PA may not directly enhance grades in contexts with high academic demands. Similarly, Daley and Ryan (2000) reported no correlations between PA and academic performance in secondary school adolescents. This indicates that time spent on PA may compete with academic tasks, reducing study efficiency. Vedøy et al. (2021) found no associations between objectively measured PA and academic achievement among Norwegian adolescents, supporting that PA's cognitive benefits may not consistently translate to academic outcomes. Likewise, Suárez-Cano et al. (2023) reported no correlation between PA and academic performance among Colombian students, emphasizing the inconsistent relationship across diverse educational contexts. Our results, with MVPA ($\eta^2 = 0.093$) and LPA ($\eta^2 = 0.060$) showing medium effect sizes, suggest that students prioritizing study over PA may benefit academically, possibly because of increased coursework and exam preparation time. This is particularly relevant during non-exam periods, as data collection in October 2023 avoided exam-related reductions in PA, ensuring typical lifestyle patterns were captured.

Conversely, numerous studies report a positive correlation between PA and academic achievement, highlighting our findings' discrepancies. Through longitudinal RCTs, Donnelly et al. (2016) demonstrated that structured PA interventions improve cognitive functions like working memory, which supports academic success. Álvarez-Bueno et al. (2017) found in a meta-analysis that regular PA enhances academic outcomes in children and adolescents, attributing benefits to neurogenesis and improved brain connectivity. These studies suggest that moderate PA (e.g., 150–300 min/week) optimizes cognitive performance, contrasting with our finding that the least active group (<150 min/week) performed best. The discrepancy may stem from contextual factors, such as the university setting, where

academic demands are self-directed and time-intensive, potentially amplifying the trade-off between PA and study time (Pandolfo et al., 2018).

Regarding sedentary behaviour, the lack of effect on weekdays ($\eta^2 = 0.031$, $p = .109$) aligns with research indicating that not all sedentary behaviour is detrimental. Hunter et al. (2018) found that academically oriented sedentary time, such as studying, is associated with better academic performance, unlike leisure-based screen time. The highest grades in the 361–420 min/day group suggest moderate weekday sitting, likely involving academic tasks, which may support concentration and learning. The weak effect of weekend sedentary behaviour ($\eta^2 = 0.047$, $p = .023$), with higher grades in the 361–420 and >420 min/day groups, further supports this. Sánchez-Oliva et al. (2023) noted that structured sedentary activities, like reading or writing, can enhance cognitive outcomes, which may explain why prolonged weekend sitting did not impair grades. However, studies like Daramola and Aribasoye (2023) argue that excessive sedentary behaviour impairs cognitive function, suggesting that the type and context of sedentary activity are critical moderators.

The finding that higher PA levels were associated with lower grades may reflect a time allocation issue. Students engaging in >300 min/week of MVPA or LPA may have less time for academic tasks, as suggested by Yu et al. (2023), who noted that excessive PA can lead to cognitive fatigue or reduced study efficiency. This is particularly relevant for LPA, where the lowest grades in the >300 min/week group ($\eta^2 = 0.060$) indicate that even light activities, if excessive, may displace study time. Similarly, the weak effect of weekend sedentary behaviour suggests that students who spend more time on academic tasks during weekends may outperform those with less structured routines. This aligns with Syväoja et al. (2014), who found that academically oriented sedentary time enhances attention. These results underscore the importance of balancing PA and study time, with moderate PA and structured sedentary behaviour potentially optimizing academic outcomes. Several limitations must be acknowledged. First, the study relied on self-reported measures (IPAQ-SF, SIT-Q-7d), which may introduce response bias or inaccuracies. Objective tools like accelerometers could improve data accuracy. Second, the cross-sectional design limits causal inferences; longitudinal studies are needed to establish temporal relationships. Third, the sample was predominantly female (79%) and from a single institution, potentially limiting generalizability. Finally, factors like sleep, diet, and mental health, which may mediate PA and academic performance, were not assessed. Future research should explore the qualitative nature of sedentary behaviour to distinguish between productive (e.g., studying) and unproductive (e.g., screen time)

activities. Longitudinal studies could clarify the long-term effects of PA and sedentary behaviour on academic outcomes, addressing the current study's cross-sectional limitations. Investigating moderating factors, such as gender, stress, or academic workload, may further explain discrepancies with studies reporting positive PA effects. Additionally, replicating the study in diverse educational contexts could enhance external validity and identify context-specific patterns.

Conclusion

This study provides novel insights into the complex relationship between PA, sedentary behaviour, and academic achievement among university students. The finding that lower PA levels and structured weekend sedentary behaviour are associated with higher grades challenges the assumption that more PA universally enhances academic performance. These results highlight the need for a balanced lifestyle, where moderate PA and academically oriented sedentary time optimize study efficiency. By citing studies with opposing findings, this research underscores the role of contextual factors in shaping academic outcomes, offering practical implications for students and educators aiming to design effective lifestyle interventions.

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