Association Between Internet Addiction and Physical Activity in High School Students: A Cross-Sectional Study

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DOI: https://www.doi.org/10.64332/ujbb.3.1.5

Manuscript received: March 11, 2026.
Accepted for publication: April 21, 2026.

Abstract

Aim: The aim of this study was to examine the association between Internet addiction and physical activity among students enrolled in vocational health-oriented secondary schools.

Methods: A cross-sectional study was conducted among 157 students from two vocational health-oriented secondary schools. Data were collected using the Internet Addiction Test for Adolescents (IAT-A) and the Physical Activity Questionnaire for Adolescents (PAQ-A). Since the data were not normally distributed, nonparametric statistical methods were used. Group differences were analysed using the Mann–Whitney U test and the Kruskal–Wallis test, while the association between Internet addiction and physical activity was examined using Spearman's rank-order correlation.

Results: The median PAQ-A score was 2.40 (IQR 2.05–3.05), indicating generally low levels of physical activity among participants. Students who attended Physical and Health Education (PHE) demonstrated significantly higher physical activity levels compared with those who did not (Mann–Whitney $U = 2166$, $p = 0.013$, $r = 0.24$). Most students exhibited mild levels of Internet addiction (59.2%). No statistically significant differences in Internet addiction or physical activity were observed across most sociodemographic variables. Furthermore, no significant association was found between Internet addiction and physical activity ($\rho = 0.026$, $p = 0.745$).

Conclusion: No statistically significant association between Internet addiction and physical activity was observed in this sample. Participants demonstrated relatively low levels of physical activity and predominantly mild levels of Internet addiction. These findings suggest that Internet use and physical activity may represent independent behavioural domains in adolescents, highlighting the need for targeted interventions to promote physical activity regardless of Internet use patterns.

Keywords: internet addiction; physical activity; adolescents; students; physical education

Introduction

The Internet has become an integral component of modern life, providing substantial opportunities for education, communication, and entertainment, yet its excessive or inappropriate use may result in significant adverse consequences. Over a relatively short period, the Internet has become a dominant and highly sophisticated medium with a profound impact on the needs and behaviours of children and adolescents (1). Although Internet addiction has not yet been fully recognised, one subtype—Internet Gaming Disorder—has been included in the latest edition of the *Diagnostic and Statistical Manual of Mental Disorders* as a condition requiring further study (2). Internet addiction shares several characteristics with substance-related addictions, including those related to alcohol and drugs (3). Problematic Internet use is commonly defined as excessive engagement in online activities that negatively affect mental and physical health, as well as social, academic, and professional functioning (4). Researchers have increasingly focused on identifying diagnostic criteria and understanding the underlying mechanisms and consequences of Internet addiction (5). Some authors suggest that Internet addiction may be suspected when an individual spends more than 38 hours per week online, excluding occupational or academic requirements (6). Internet addiction has been associated with a wide range of social and health-related problems, including sleep disturbances, fatigue, weakened immune function, and increased susceptibility to illness. Psychological symptoms commonly associated with problematic Internet use include depression and anxiety (7).

Adolescents often use the Internet as a coping mechanism, which may further reinforce addictive patterns of behaviour. The prevalence of Internet addiction has been shown to increase significantly during adolescence, ranging between 4% and 18%, making this a critical period for preventive interventions (8). Earlier exposure to the Internet has been identified as a risk factor for the development of problematic use, while dysfunctional family environments may further increase vulnerability (9). A large European study involving 12,000 adolescents reported severe Internet addiction in 4.4% of participants (10). Therefore, preventive strategies should focus on strengthening emotional and social competencies, promoting responsible Internet use, and considering gender differences in behavioural patterns (11).

Physical activity is defined as any bodily movement produced by skeletal muscles that results in energy expenditure above resting levels (12). A substantial body of evidence confirms that physical activity plays a crucial role in the prevention and management of chronic diseases (13). Lower levels of physical activity are often observed among children from lower socioeconomic backgrounds, primarily due to limited access to organised sports and recreational opportunities (14). In addition to serving as behavioural role models, parents act as facilitators by enrolling children in sports clubs and supporting their participation in physical activities (15).

Compared with previous decades, contemporary children and adolescents increasingly adopt sedentary lifestyles, spending substantial amounts of time using computers, mobile devices, and television, often at the expense of physical activity (16). A large international study conducted across 71 countries among adolescents aged 11–18 years reported that 25.4% of participants did not engage in any form of physical activity, while only 22.9% were physically active on five or more days per week. Additionally, 16.9% of adolescents reported engaging in sedentary behaviour for more than five hours per day (17).

Physical and Health Education (PHE) is implemented throughout the educational system. Its primary objective is the acquisition and refinement of motor skills, knowledge, and habits that satisfy the fundamental human need for movement. Through structured instruction and the development of lifelong habits, PHE contributes to the formation of essential competencies, including adaptability to evolving work and life conditions, responsibility, solidarity, moral values, self-esteem, and acceptance of diversity (18). Notably, some vocational

health-oriented secondary schools provide limited or no structured physical education classes, even though for many students such classes represent the primary opportunity for organised physical activity. Students enrolled in health-oriented educational programmes, including future nurses and other healthcare professionals, represent a particularly relevant population. Reduced physical activity combined with an increased risk of problematic Internet use may have long-term implications for their physical and mental health. Moreover, as future healthcare providers, their health behaviours may influence their professional role modelling and health promotion practices.

Given these considerations, it is important to examine whether an association exists between Internet addiction and physical activity within this specific educational context. Understanding this relationship may inform the development of targeted interventions aimed at promoting physical activity, particularly in settings where formal physical education is limited or absent. Therefore, the aim of this study was to examine the relationship between Internet addiction and physical activity among secondary school students enrolled in vocational health-oriented educational programmes. The primary outcome of this study was the level of Internet addiction measured using the Internet Addiction Test for Adolescents (IAT-A), while physical activity level measured by the PAQ-A was examined in relation to Internet addiction and selected sociodemographic characteristics. We hypothesised that higher levels of Internet addiction would be associated with lower levels of physical activity.

Methods

Study design

This was a cross-sectional study.

Ethics

The study was approved by the Ethics Committee of the Catholic University of Croatia (REG. NO.: 498-15-06-24-005). Participation was voluntary and anonymous. All participants were informed about the purpose of the study prior to data collection. Written informed consent was obtained from all participants, and for minors, parental or guardian consent was secured in accordance with institutional and ethical guidelines.

Participants and data collection

The study sample included fourth-year students from two vocational health-oriented secondary schools: the Vinogradska School of Nursing and the Zagreb Health School. A voluntary response sampling method was applied, which may introduce selection bias, as students with a greater interest in the topic may have been more likely to participate. Consequently, this sampling approach may limit the generalizability of the findings beyond the studied population.

Data were collected using an online survey administered via the LimeSurvey platform between February 1 and April 10, 2024. The survey consisted of a structured questionnaire including sociodemographic items and two standardised self-report instruments.

Internet addiction was assessed using the Internet Addiction Test for Adolescents (19), a 20-item self-report questionnaire designed to measure problematic Internet use among adolescents. Each item is rated on a five-point Likert scale ranging from 1 (rarely) to 5 (always), with higher scores indicating greater levels of Internet addiction. An example item includes: "How often do you stay online longer than intended?" Total scores range from 20 to 100. Based on established criteria, scores were categorised as follows: 20–49 indicating normal use, 50–79 mild addiction, and 80–100 moderate to severe addiction. In the present study, the IAT-A score was primarily treated as a continuous variable in statistical analyses. Physical activity was assessed using the Physical Activity Questionnaire for Adolescents (PAQ-A), a validated self-administered instrument designed to measure general levels of physical activity over the previous seven days among adolescents aged approximately 14–19 years (20). The questionnaire consists of nine items, of which eight are scored on a 5-point scale, while the ninth item identifies respondents who were unable

to be physically active due to specific circumstances during the previous week. The first item assesses participation in sports during leisure time, with responses ranging from 1 (no participation) to 5 (seven or more times). Items 2–7 evaluate physical activity during school lessons, breaks, lunch, after school, evenings, and weekends, with scores assigned according to activity intensity. The final PAQ-A score is calculated as the mean of the eight scored items, ranging from 1 (low physical activity) to 5 (high physical activity) (20). Permission to use the instrument was obtained. Internal consistency reliability was assessed using Cronbach's alpha coefficient. The IAT-A demonstrated high internal consistency (α=0.89), while the PAQ-A showed good reliability (α=0.80), indicating that both instruments consistently measured the intended constructs within this sample.

Statistical Analysis

Statistical analysis was performed using JASP statistical software. Descriptive statistics were calculated for all variables and are presented as means and standard deviations for continuous variables, and as frequencies and percentages for categorical variables.

For the IAT-A scale, the Shapiro–Wilk test indicated a statistically significant deviation from normality ($W=0.891$, $p<0.001$). Similarly, the PAQ-A scores significantly deviated from normality ($W=0.768$, $p<0.001$). Given these findings, nonparametric statistical methods were applied in subsequent analyses. Differences between two independent groups were analysed using the Mann–Whitney U test, while comparisons across more than two groups were performed using the Kruskal–Wallis test. When appropriate, post hoc pairwise comparisons with Bonferroni correction were conducted. Associations between Inter-net addiction and physical activity were examined using Spearman's rank-order correlation coefficient. Categorical variables were compared using the chi-square (χ^2) test. The level of statistical significance was set at $p<0.05$. Effect sizes were calculated where appropriate and interpreted according to standard guidelines.

Results

Sociodemographic Characteristics of the Participants

A total of 157 students participated in the study. Most participants lived in a family home (n=135; 86%), while 22 students (14%) resided in a student dormitory. Regarding family structure, the majority of participants lived with both parents (n=127; 81%), 25 students (16%) lived with a single parent, and 5 students (3%) reported living without parental care. Most students reported an average economic status (n=133; 85%), while 17 participants (11%) reported above-average economic status and 7 (4%) reported below-average economic status. In terms of school affiliation, 55 students (35%) were enrolled in the Vinogradska School of Nursing, and 102 students (65%) attended the Zagreb Health School.

Table 1. *Differences in physical activity scores*

Variable	N	Median	IQR (Q1–Q3)	Mean Rank	U	p	r
School							
Vinogradska School of Nursing	55	1.80	1.33–2.60	66.51	2118	0.011	0.24
Zagreb Health School	102	2.26	1.71–2.74	85.74			
PHE							
Yes	100	2.26	1.71–2.74	85.84	2166	0.013	0.24
No	57	1.86	1.39–2.58	67.00			

IQR – interquartile range (Q1–Q3); U – Mann–Whitney U test;
r – effect size (rank-biserial correlation); PHE – Physical and Health Education.

Differences in Physical Activity Scores According to School and Participation in Physical Education

Analysis of differences in physical activity according to school and participation in Physical and Health Education (PHE) is presented in Table 1. Students from the Zagreb Health School demonstrated significantly higher levels of physical activity (median=2.26; IQR 1.71–2.74) compared with students from the Vinogradska School of Nursing (median=1.80; IQR 1.33–2.60), with a statistically significant difference (Mann–Whitney U=2118, p=0.011). The effect size was small to moderate (r=0.24).

Similarly, students who participated in Physical and Health Education had higher physical activity levels (median=2.26; IQR 1.71–2.74) compared with those who did not participate (median=1.86; IQR 1.39–2.58), and this difference was statistically significant (Mann–Whitney U=2166, p=0.013), with a small to moderate effect size (r=0.24).

Distribution of Internet Addiction Levels

Table 2 presents the distribution of Internet addiction levels among 157 participants. Normal Internet use was observed in 49 students (31.2%), while the majority (n=93; 59.2%) demonstrated mild addiction. Moderate addiction was identified in 13 participants (8.3%), and severe addiction in 2 participants (1.3%). Overall, most students exhibited mild levels of problematic Internet use.

Table 2. *Distribution of Internet Addiction Levels*

Internet Addiction Level	N	%
Normal	49	31.2
Mild	93	59.2
Moderate	13	8.3
Severe	2	1.3
Total	**157**	**100.0**

Internet Addiction and Physical Activity According to Sociodemographic Characteristics

No statistically significant differences in Internet addiction levels were observed according to gender (U=1414.00; p=0.942), residence in a dormitory (U=1236.50; p=0.209), study programme (U=2669.00; p=0.618), disciplinary measures (U=746.50; p=0.117), participation in Physical and Health Education (U=2690.50; p=0.560), family structure (U=0.771; p=0.680), or socioeconomic status (Kruskal–Wallis=0.799; p=0.671).

Similarly, physical activity levels did not differ significantly according to family structure (U=1435.50; p=0.450), residence in a student dormitory (U=1325.50; p=0.420), disciplinary measures (U=994.00; p=0.966), gender (U=1190.50; p=0.221), or socioeconomic status (Kruskal–Wallis=0.799; p=0.671).

Association Between Internet Addiction and Physical Activity

No statistically significant association was found between Internet addiction and physical activity (Spearman's ρ=0.026, p=0.745).

Discussion

The main finding of this study is that no statistically significant association between Internet addiction and physical activity was detected in this sample of students. This finding does not necessarily indicate the absence of a relationship between these variables, but rather that no association was identified under the conditions of this study. It is possible that the relationship between Internet use and physical activity is more complex and influenced by additional factors not captured in the present analysis. Several potential confounding variables may have influenced the observed results. Factors such as sex, sleep patterns, mental health status, academic stress, purpose of Internet use, and participation in organised sports may affect both Internet use and physical activity levels. Future studies should include these variables in multivariate models to better understand the underlying relationships.

Similar findings have been reported in a study conducted among 589 Vietnamese adolescents, where no significant association between Internet addiction and physical activity was identified, and overall physical activity levels were low in both groups (21). Likewise, research among Malaysian

students found no significant relationship between social media addiction and physical activity, although more than half of the participants showed signs of problematic use (22).

However, other studies have reported a significant negative association, suggesting that higher levels of physical activity are linked to lower levels of Internet addiction and that physical activity may serve as a protective or therapeutic factor (23). Meta-analyses further indicate that physical activity interventions can significantly reduce Internet addiction symptoms in adolescents and may represent one of the most effective intervention strategies (24,25). Research among Chinese students similarly demonstrated that higher physical activity is associated with lower risk of Internet addiction and improved psychological well-being (26).

Contrasting results have also been reported. A study conducted among Polish and Portuguese students during the COVID-19 pandemic found a positive association between physical activity and Internet addiction, possibly reflecting increased use of online platforms and digital tools promoting physical activity (27). Longitudinal research from Switzerland showed that lower participation in sports predicted a higher risk of problematic gaming behaviour over time (28). Additionally, findings from Croatian university students indicate that increased time spent gaming is associated with lower physical activity and increased sedentary behaviour (29).

Although several sociodemographic variables did not show statistically significant differences, these findings are still important as they may indicate that Internet addiction is not strongly influenced by these characteristics in this population, or that the effects are subtle and require larger samples to detect.

In the present study, students who attended Physical and Health Education (PHE) classes demonstrated higher levels of physical activity compared with those who did not, emphasising the importance of structured physical education. Previous research similarly indicates that participation in school-based physical education significantly increases the likelihood of maintaining physical activity during adolescence and adulthood, while also contributing to improved cognitive performance and academic outcomes (30). The growing integration of technology into daily life suggests that combining digital tools with physical activity promotion may represent a promising approach. Educational and monitoring applications can support physical activity engagement, although excessive recreational technology use should be carefully managed (18).

Limitations

This study has several limitations. The use of a voluntary response sample may have introduced selection bias, limiting the generalizability of the findings. Additionally, the use of self-reported measures may be subject to recall and social desirability bias. Given the cross-sectional design of the study, causal relationships between variables cannot be established. Despite these limitations, the study contributes to the growing body of research on adolescent health behaviours and highlights the need for further investigation into the complex relationship between Internet use and physical activity. Future research should consider longitudinal designs and objective measures of physical activity.

Strengths

Despite these limitations, this study contributes to the limited body of research examining the relationship between Internet addiction and physical activity among adolescents in vocational health-oriented education. Understanding these behaviours is particularly important, as habits formed during adolescence may have long-term health implications.

Implications for Future Research

Future studies should include larger and more diverse samples across multiple regions

to enhance generalizability. The use of objective measures of physical activity, such as accelerometers, is recommended. Additionally, digital monitoring tools could improve the accuracy of Internet use assessment. Further research should focus on specific student populations, particularly those with limited access to structured physical education, in order to develop targeted interventions promoting healthy behaviours despite increasing digital engagement.

Conclusion

In this study, no statistically significant association between Internet addiction and physical activity was detected among students from vocational health-oriented secondary schools. The participants generally demonstrated relatively low levels of physical activity and predominantly mild levels of Internet addiction. These findings should be interpreted with caution due to the cross-sectional design of the study, which does not allow causal conclusions. The relationship between Internet use and physical activity may be influenced by additional factors not examined in this study.

Further research, particularly using longitudinal designs and including a broader range of behavioural and psychosocial variables, is needed to better understand the complex interactions between Internet use and lifestyle behaviours in adolescents.

Declarations

Authors contributions: M.J. and VM contributed to data collection, data analysis, and drafting of the manuscript. D.G. contributed to the conception and design of the study and critical revision of the manuscript. I.M. contributed to the conception and design of the study, supervision, and critical revision of the manuscript.

Funding: This research received no external funding.

Competing interests: The authors declare no competing interests.

Data sharing statement: The data that support the findings of this study are available from the corresponding author (I.M.) upon reasonable request.

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