

Usage habits of electronic devices among computer science students – analysis of changes over time including consideration of problematic internet use and physical activity

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Key words: Internet addiction, mobile phone, desktop computer, physical activity, technological advancement.

Abstract

Introduction: Technological advancements have made the Internet a key part of daily life, but excessive device use poses health, psychological, and social risks. Prevention, ergonomics education, and regular physical activity are essential for maintaining well-being and preventing related issues.

Aim of the research: The aim of the research was to assess problematic Internet use and its association with the time spent on physical activity during leisure time among computer science students, as well as any changes in these patterns over the course of their studies.

Material and methods: The study assessed computer science students from Jan Kochanowski University in Kielce and Kielce University of Technology in 2018 and 2020 to evaluate the impact of Internet usage on their lives. Researchers utilised the Internet Addiction Questionnaire (TPUI22) and the International Physical Activity Questionnaire (IPAQ), along with a custom questionnaire, to analyse electronic device usage and physical activity habits.

Results: Computer science students showed significant changes in their usage habits for mobile phones and desktop computers during their education, increasing mobile phone use to over 3 hours and extending computer usage by 2 hours. A higher percentage of third-year students reported low physical activity levels (28.95%) compared to first-year students (15.79%). Overall, increased mobile phone and computer usage correlated with lower physical activity and higher levels of problematic Internet use.

Conclusions: Young adults spend up to 3 hours daily on mobile phones and over 5 hours on computers during studies, leading to decreased physical activity and lower energy expenditure. Increased device usage correlates with problematic Internet use, particularly among computer science students, indicating a need for education on responsible Internet habits and support for young people.

Introduction

Technological advancements have made the Internet a central part of daily life, with portable electronic devices enhancing communication, learning, and personal expression. However, excessive use of technology can lead to negative effects on health, emotions, and social behaviour, especially among younger individuals. These may be significant risk factors that, combined with sociodemographic factors, lifestyle, and mental health status can lead to multimorbidity in middle age. Risks include physical issues like spine problems, psychological concerns such as depression and anxiety, social isolation, addiction, and threats to data security and privacy. Additionally, cyberbullying and exposure to harmful content are significant concerns [1–3].

Recent studies on the COVID-19 pandemic show that social distancing requirements led to a significant increase in Internet usage, as students sought alternative ways to maintain social connections, but this also deepened feelings of loneliness and isolation [4, 5].

The World Health Organisation (WHO) and the American Psychological Association (APA) provide guidelines on Internet and social media use to promote mental and physical health. The WHO recommends limiting screen time for children under 5 years old, emphasising the importance of physical activity and sleep [6, 7]. The APA's 2023 recommendations stress balanced social media use, noting that its impact varies based on individual factors [8]. Parents should monitor content for young adolescents and gradually allow more autonomy as they mature [9]. The APA advises reducing screen time to avoid disrupting sleep and physical activity and warns of exposure to harmful content [10]. Social comparisons, especially regarding appearance, can negatively impact body image and mental health, particularly in girls [11, 12]. The Polish Psychiatric Association (PTP) highlights the negative impact of excessive Internet use on mental health, linking it to issues like sleep problems, social withdrawal, and neglect of responsibilities. The PTP emphasises early diagnosis and

a comprehensive therapeutic approach, combining psychotherapy and pharmacological treatment when necessary [13]. Studies show that prolonged Internet use, particularly beyond 2–3 hours per day, increases the risk of depression and anxiety [14]. Recommendations to mitigate these risks include regular physical activity, a healthy diet, setting screen time limits, and seeking psychological support when needed [15].

The rise of new technologies has heightened the risk of addiction to computers, mobile phones, and the Internet, presenting a global challenge. Symptoms of Problematic Internet Use include difficulty controlling usage, emotional distress, and denial of addiction. In May 2019, the WHO announced that video game addiction would be classified as a mental disorder (ICD-11: 6C51) by 2022, considering factors like time mismanagement and neglect of other hobbies [16, 17]. This addiction can lead to serious health issues, such as neck and spine pain from prolonged use in poor postures [18, 19].

Aim of the research

The aim of the research was to assess problematic Internet use and its relationship with the time spent on physical activity during the free time of computer science students and its changes during the course of their studies.

Material and methods

The study involved 228 computer science students from 2 Polish universities, Jan Kochanowski University in Kielce and Kielce University of Technology, including 39 females and 189 males aged 19 to 29 years. Each student participated in the research twice: once in the first year (October to December 2018) and again in the third year (October to December 2020).

The study used the Problematic Internet Use Questionnaire (TPUI22) to assess Internet addiction, consisting of 22 questions rated from 0 to 5, with scores ranging from 0 to 110. Higher scores indicate a greater risk of addiction, categorised for individuals aged ≤ 24 years as very low (0–1), low (2–10), average (11–49), high (50–79), and very high (80–110) [20]. Problematic Internet Use is defined as excessive Internet activity leading to various difficulties [21]. The International Physical Activity Questionnaire (IPAQ) was also used to evaluate physical activity over the past week, measuring intense, moderate, and walking activities, with results expressed in MET-minutes/week. Two parts of the IPAQ survey were used in the study:

1. Part 4: Recreation, sport, and physical activity in leisure time,

2. Part 5: Time spent sitting “in free time” [22].

Activity levels were classified as insufficient (below 600 MET-min/week), adequate (600–1500 MET-min/week), and high (above 1500 MET-min/week) [22, 23].

Statistical analysis

The results were analysed using statistical methods for both quantitative and qualitative features. Descriptive statistics were calculated for measurable data, while frequency and percentage analyses were used for qualitative data. The Kruskal-Wallis test analysed differences between more than 2 groups, and the Mann-Whitney test was used for 2 groups. Relationships between qualitative variables were assessed with χ^2 tests and Cramer's V coefficient. The Wilcoxon signed-rank test and McNemar test examined changes over time. Spearman's correlation measured relationships between quantitative variables, with a significance level set at $p < 0.05$. Analysis was performed using SPSS 26 and Statistica 13.3.

Results

First-year students reported using mobile phones for up to 3 hours daily (55.70%), but only 35.09% maintained this by their third year, indicating an overall increase in usage. A χ^2 test confirmed this correlation ($\chi^2 = 42.347$; $p < 0.001$) with a weak association (Cramer's V = 0.239) (Table 1). Similarly, while 52.19% of first-year students used computers for up to 4 hours daily, only 25.44% did in their third year, extending usage by about 2 hours ($\chi^2 = 85.84$; $p < 0.001$; Cramer's V = 0.193) (Table 2).

Analysis of Part 4 of the IPAQ questionnaire revealed that physical activity levels declined over 2 years, with low activity increasing from 15.79% to 28.95% and complete inactivity rising from 22.81% to 25.87%. These changes were significant (Wilcoxon test $Z = 3.46$; $p < 0.001$). Energy expenditure during intense physical activity decreased from 3774.56 to 3109.20 MET-min/week ($Z = 2.22$; $p = 0.02$), while moderate activity remained unchanged, and low physical activity decreased non-significantly from 352 to 320.33 MET-min/week ($Z = 4.62$; $p < 0.001$). Overall energy expenditure declined from 2101.79 to 1385.01 MET-min/week ($Z = 3.16$; $p < 0.001$) (Table 3).

The study analysed energy expenditure during leisure-time physical activity among first and third-year students, excluding non-active participants. Results revealed a significant decrease in intense physical activity, dropping from 3774.56 MET-min/week in the first year to 3109.20 MET-min/week in the third year (Wilcoxon test $Z = 2.22$; $p = 0.02$). Moderate activity remained stable (1045.31 MET-min/week in the third year vs. 1013.35 in the first; $Z = 0.80$; $p = 0.42$), while low physical activity decreased from 352 MET-min/week to 320.33 MET-min/week, i.e. not significantly ($Z = 4.62$; $p < 0.001$). Overall energy expenditure during leisure activities declined significantly from 2101.79 MET-min/week in the first year to 1385.01 in the third ($Z = 3.16$; $p < 0.001$) (Table 4).

Table 1. Changes over time in mobile phone usage among students in the first and third years of studies

1 st year \ 3 rd year	Up to 3 hours	3–4 hours	4–5 hours	More than 5 hours	I don't use it	Total for the 1 st year (Column percentage)
Up to 3 hours						
N	62	40	14	10	1	127
%	27.19	17.54	6.14	4.39	0.44	55.70
3–4 hours						
N	14	22	15	11	0	62
%	6.14	9.65	6.58	4.82	0.00	27.19
4–5 hours						
N	3	7	16	6	0	32
%	1.32	3.07	7.02	2.63	0.00	14.04
More than 5 hours						
N	0	2	1	3	0	6
%	0.00	0.88	0.44	1.32	0.00	2.63
I don't use it						
N	1	0	0	0	0	1
%	0.44	0.00	0.00	0.00	0.00	0.44
Total for the 3 rd year (Row percentage)						
N	80	71	46	30	1	228
%	35.09	31.14	20.18	13.16	0.44	100.00

$\chi^2 = 42.347$; $p < 0.001$; $VC = 0.239$; $p < 0.001$.

N – number of respondents in the group, % – percentage of respondents, χ^2 – McNemar's test result, VC – Cramer's V factor, p – asymptotic significance.

Analysis of Part 5 of the IPAQ questionnaire revealed that sitting time increased significantly, from 2693.48 to 3566.97 minutes weekly ($Z = 9.23$; $p < 0.001$) (Table 5), with daily sitting rising from 384.78 to 509.56 minutes (Table 6).

The Internet Problematic Use Test (TPUI22) results showed that most first-year computer science students scored in the average range (11 to 49 points), with high levels of Internet addiction present in 16% of first-year and 10% of third-year students (Wilcoxon test $Z = 3.59$; $p < 0.001$) (Table 7).

In the third year of study, the average score on the PUI test decreased significantly from 28.59 points in the first year to 23.31 points, remaining in the average range (Wilcoxon test $Z = 3.59$; $p < 0.001$) (Table 8).

A weak positive correlation was found between computer usage and problematic Internet use in both years ($p < 0.05$), while a similar correlation with phone usage was only significant in the third year ($p < 0.05$) (Table 9).

Discussion

Time spent using electronic devices and Internet addiction

The lack of restrictions on Internet access can contribute to the development of addiction to electronic devices. A study by Cudo *et al.* [24] found that around 4% of female students and 6% of male students in Lublin displayed advanced symptoms of Internet addiction, with males being more susceptible. In England, individuals aged 18– years spend an average of over 5 hours online daily [25], and nearly 50% of students are at risk of smartphone addiction due to prolonged usage [26]. Research has also shown a significant correlation between addiction and mental health issues, such as depression and anxiety [27, 28]. The highest addiction rates were identified in Belgium, the UK, and France [29].

Our analysis shows a significant correlation between electronic device usage and problematic Inter-

Table 2. Changes over time in daily computer usage among students in the first and third years of studies

1 st year \ 3 rd year	Up to 4 hours	4–5 hours	5–6 hours	More than 6 hours	I don't use it	Total for the 1 st year (Column percentage)
Up to 4 hours						
N	38	30	25	26	0	119
%	16.67	13.16	10.96	11.40	0.00	52.19
4–5 hours						
N	10	14	18	23	0	65
%	4.39	6.14	7.89	10.09	0.00	28.51
5–6 hours						
N	5	1	8	15	1	30
%	2.19	0.44	3.51	6.58	0.44	13.16
More than 6 hours						
N	4	1	3	4	1	13
%	1.75	0.44	1.32	1.75	0.44	5.70
I don't use it						
N	1	0	0	0	0	1
%	0.44	0.00	0.00	0.00	0.00	0.44
Total for the 3 rd year (Row percentage)						
N	58	46	54	68	2	228
%	25.44	20.18	23.68	29.82	0.88	100.00

$\chi^2 = 85.844$; $p < 0.001$; $VC = 0.193$; $p = 0.005$.

N – number of respondents in the group, % – percentage of respondents, χ^2 – McNemar's test result, VC – Cramer's V factor, p – asymptotic significance.

Table 3. Level of physical activity according to IPAQ classification during leisure time among students in the first and third years of studies

Year of study	Level of physical activity according to IPAQ classification in leisure time – n (%)				Z	P-value
	High	Sufficient	Low	No activity		
1 st year	78 (34.21)	62 (27.19)	36 (15.79)	52 (22.81)	3.46	< 0.001
3 rd year	51 (22.37)	52 (22.81)	66 (28.95)	59 (25.87)		

Z – Wilcoxon test value, p – asymptotic significance.

net use scores ($p < 0.001$), with increased usage linked to higher scores. However, the average score for Problematic Internet Use decreased from 28.59 points in the first year to 23.31 points in the third year, probably due to improved time management. The percentage of students at risk of addiction dropped from 2% to 1%, while 9% to 14% showed a high risk of problematic use, with most in the average score range. Similar results to ours were observed in the studies of other authors, such as Poprawa [20], Skonieczna *et al.* [30], and Cudo *et al.* [24].

Physical activity of students

Physical activity is essential for well-being, but increased electronic device usage often leads to lower activity levels. Research indicates that back pain can reduce student activity by 70% [31], and only one-third of participants report regular exercise [32, 33]. The COVID-19 pandemic exacerbated this issue, increasing smartphone use and sitting time [34, 35].

Our study found significant decreases in high (34.21% to 22.37%) and sufficient activity (27.19% to

Table 4. Leisure time physical activity among students in the first and third years of studies

Physical activity in leisure time [MET- min./week]	M ± SD	Min.–max.	P95	Z	P-value
High effort					
1 st year	3774.56 ±2536.56	1512–12 960	9786	2.22	0.02
3 rd year	3109.20 ±1618.97	1494–8280	6300		
Enough effort					
1 st year	1013.35 ±249.47	618–1480	1432	0.80	0.42
3 rd year	1045.00 ±240.17	678–1440	1422		
Low effort (walking)					
1 st year	352.00 ±196.17	33–594	594	4.62	< 0.001
3 rd year	320.33 ±184.94	16.5–594	594		
Total physical activity					
1 st year	2101.79 ±2270.94	33–12 960	8052	4.16	< 0.001
3 rd year	1385.01 ±1481.33	16.5–8280	4158		

M – average MET-min./week, SD – standard deviation, P95 – percentile 95, Z – Wilcoxon test value, p – asymptotic significance.

Table 5. Sitting time among students in the first and third years of studies

Students	Total sitting time (7 days a week)				
	M ± SD [minutes]	Min.–max.	P95	Z	P-value
1 st year	2693.48 ±1084.50	420–7200	4800	9.23	< 0.001
3 rd year	3566.97 ±1008.04	1020–6600	5160		

M – average value expressed in minutes, SD – standard deviation, Min. – minimum, Max. – maximum, P95 – percentile 95, Z – Wilcoxon test value, p – asymptotic significance.

Table 6. Average total daily sitting time among students in the first and third years of studies

Students	Total sitting time per day (total sitting time divided into 7 days)				
	M ± SD [minutes]	Min.–max.	P95	Z	P-value
1 st year	384.78 ±154.92	60–1028.57	685.71	9.23	< 0.001
3 rd year	509.56 ±144.00	145.71–942.85	737.14		

M – average value expressed in minutes, SD – standard deviation, Min. – minimum, Max. – maximum, P95 – percentile 95, Z – Wilcoxon test value, p – asymptotic significance.

Table 7. Results of the Internet Problematic Use Test (TPUI22) among students in the first and third years of studies

TPUI22 results	1 st year		3 rd year		Z	P-value
	n	%	n	%		
Very low (0–1 points)	0	0	23	10	3.59	< 0.001
Low (2–10 points)	37	16	35	15		
Average (11–49 points)	156	68	146	64		
High (50–79 points)	31	14	21	9		
Very high (80–110 points)	4	2	3	1		
Total	228	100	228	100		

Z – Wilcoxon test value, p – asymptotic significance.

Table 8. Comparison of mean scores in the Internet Problematic Use Test (TPUI22) among students in the first and third years of studies

Problematic internet use	1 st year		3 rd year		Z	P-value
	M	SD	M	SD		
	28.59	18.17	23.31	17.97	3.59	< 0.001

M – mean, SD – standard deviation, Z – Wilcoxon test value, p – asymptotic significance.

Table 9. Correlation of problematic Internet use with time spent using electronic devices in the group of students in the first and third years of studies

Time using electronic devices	Problematic internet use			
	1 st year		3 rd year	
	rho	P-value	rho	P-value
Mobile phone	0.08	0.17	0.20	< 0.001
Computer	0.21	0.00	0.14	0.03

rho –Spearman's rank correlation coefficient, p – asymptotic significance.

22.81%), while low physical activity rose from 15.79% to 28.95%. Additionally, the percentage of students who stopped exercising increased from 22.81% to 25.87%, with these changes being statistically significant ($p < 0.001$).

A study by Grabowska [36] found significant differences in physical activity among Polish students, with 50.7% of students at Wrocław University of Science and Technology exhibiting high activity levels, while the University of Wrocław and the Medical University had higher percentages of low activity (52.4% and 40.3%, respectively). Sochacka and Zdziarski [37] reported that 80% of students experienced a decline in physical activity during the COVID-19 pandemic.

Our research showed a significant decrease in average total physical activity among IT students from 2101.79 to 1385.01 MET-min./week ($p < 0.001$), with intense activity dropping from 3774.56 to 3109.20 MET-min./week ($p = 0.02$). Walking-related activity also declined from 352.00 to 320.33 MET-min./week ($p < 0.001$), while moderate activity slightly increased from 1013.35 to 1045 MET-min./week, though not significantly ($p = 0.42$).

Similar findings regarding MET-min./week were observed among medical and non-medical students [37]. A report for the Ministry of Sport and Tourism indicated that Poles average about 432.5 MET-min./week for intense physical effort, while moderate effort averages around 196.4 MET-min./week, and walking-related activity is about 677.6 MET-min./week. In contrast, Norwegians report much higher walking activity [38, 39].

Our research revealed a significant increase in average sitting time among students, rising from 2693.48 minutes in the first year to 3566.97 minutes in the third year ($p < 0.001$). Daily sitting time also increased from 384.78 minutes to 509.56 minutes ($p < 0.001$). Similar trends were noted in other studies [37].

Conclusions

Students who increase their use of electronic devices simultaneously reduce their physical activity. These changes can negatively affect the overall health and well-being of students. Therefore, it is essential to promote healthy habits related to both Internet use and physical activity among young adults.

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Ethical approval

Approval for the study was granted by the Bioethics Committee (consent number: Resolution No. 28/2018).

Conflict of interest

The authors declare no conflict of interest.

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