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ORIGINAL ARTICLE / ОРИГИНАЛНИ РАД

The relationship between internet use and depressive symptoms among high school students

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SUMMARY

Introduction/Objective Problematic internet use has been associated with various mental health problems. The objective of this study was to investigate the internet use and its relationship with depressive symptoms among high school students.

Methods This cross-sectional observational study included 620 students from the first to the fourth grade of four high schools in Požarevac, Serbia. The research data were obtained from an *ad hoc* designed questionnaire on socio-demographic data, health habits, and the internet use, Internet Addiction Test (IAT) and Center for Epidemiological Studies Depression Scale for Children (CES-DC).

Results Out of 620 students (66.9% girls) there were 389 respondents (62.7%) who reported normal (n = 40), or average internet use (n = 349) with a mild level of addiction, while 226 (36.5%) subjects belonged to problematic internet use group, and five students (0.8%) showed a high level of internet addiction. A CES-DC score ≥ 15, considered indicative of clinically significant depressive symptoms, was found significantly more frequent among internet addicts compared to internet normal users (78.4% *vs.* 46.5%, respectively). Among internet addicts there was a significantly higher percentage of those who used psychologist/psychotherapist help compared to internet normal users (29.4% *vs.* 12.1%, respectively). The logistic regression analysis showed that internet addiction (IAT score ≥ 50) was the strongest independent predictor of clinically significant depressive symptoms (OR = 3.32; 95% CI = 2.24–4.91), after adjusting for confounders (female gender, urban living, Tik Tok and Twitter use, sports activities, and the use of the internet for learning or for aimless "surfing").

Conclusion We show that internet addiction is positively related to clinically significant depressive symptoms among high school students. Health education focused on the proper use of the internet may be regarded as mental health promotion.

Keywords: internet; behavior; addiction; depressive symptoms

INTRODUCTION

In recent years, over 40% of the world's population has gained access to the internet, and the use of mobile devices in this regard is increasing, especially the use of smartphones [1]. The portability of the internet through smartphones enables rapid access and widespread use of the global network [2]. According to the research of the Statistical Office of the Republic of Serbia for 2021 in Serbia, 81.2% of the population use the internet, 95.5% use a mobile phone, and 64% use a computer every day, or almost every day. Over 74% of the internet population have social media accounts [3].

Although life without the internet and its possibilities have become unimaginable, excessive use can also have harmful consequences [4]. It is very important to distinguish functional internet use that does not pose a significant health risk and is beneficial for most users, from an excessive, uncontrolled, and dysfunctional use, accompanied by preoccupation and the experience of loss of control. This attitude towards the internet can have various negative consequences, including neglecting social activities, communication, health, demands at work or school, as well as changes in eating and sleeping habits [1, 2].

The concept of internet addiction was originally introduced by an American author Kimberly Young [5] in the mid-90s of the 20th century. Young [5] described signs and symptoms like other psychological addictions that fit the definition of internet addiction later offered by Kuss and Griffiths [6]. They conceptualized internet addiction as a specific psychological addiction with similar signs as other psychological addictions such as loss of control, withdrawal symptoms, disruption of daily functioning, and loss of interest in other activities [6].

Numerous studies have examined the role of various psychological factors in the excessive use of the internet. Internet addiction has been positively associated with social isolation, but also with dissatisfaction with peer interactions. On the other hand, parental care and emotional support seem to provide protection against problematic internet use, while family dissatisfaction and lack of emotional support

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predict the emergence of internet addiction symptoms [7, 8]. Earlier research found a positive correlation between problematic internet use and depression [9]. Internet users find social and emotional support in the virtual world, and a sense of belonging while communicating online with other people [7]. Excessive internet use in children can lead to sedentary lifestyles and health problems such as obesity, poor posture, psychological issues and other health disorders and is also associated with attention deficit hyperactivity disorder and major depressive episodes [9–13].

In our opinion, there is not sufficient research to draw definitive conclusions about the connection between internet use and mental health of adolescents.

The aim of this study was to investigate the relationship between internet use and depressive symptoms among of high school students.

METHODS

This research was designed as a cross-sectional observational study, which included 620 students from the first to the fourth grade of four secondary schools in Požarevac, Serbia. The research included students of a Gymnasium, a Medical School, Economic and Commercial Schools, and an Agricultural School in Požarevac. The research instrument was an *ad hoc* designed questionnaire consisting of the following three parts.

1. Socio-demographic data, data on student school success, health habits, and data related to internet use [gender, age, place of residence (urban or semiurban), average mark, engaging in physical activity, consumption of psychoactive substances, average length of sleep, visit to a psychologist or psychiatrist, time spent on the internet, the purpose of using the internet, accounts on social networks].

2. The Internet Addiction Test (IAT), a reliable and valid test developed by Dr. Kimberly Young, is used to measure internet addiction. The test measures the level of internet addiction, consisting of 20 questions rated on a five-point Likert scale (1 = almost never, 2 = rarely, 3 = sometimes, 4 = often, 5 = almost always). The total score of the questionnaire has a range of 0–100 points and indicates four levels of internet use: normal level (0–30), average online use with a mild level of addiction (31–49), problematic use with a moderate level (50–79), and pathological, with a high level of internet addiction (80–100). A higher final score indicates more internet use and a higher level of addiction. A score ≥ 50 points indicates that the use of the internet creates problems in the normal social functioning of an individual [14, 15].

3. The Center for Epidemiological Studies Depression Scale for Children (CES-DC) is a 20-item self-report test used to quantify depressive symptoms in children and adolescents. The CES-DC is considered to have high reliability and validity for age groups between 12 and 18 years. In the CES-DC scoring system, each item has four possible responses: "not at all" = 0, "a little" = 1, "fairly" = 2, and "very much" = 3. Based on the scoring of all items, a final score can range 0–60. A higher score indicates a higher level of depressive symptoms. A score of 15 and above is considered indicative of clinically significant depressive symptoms [16].

All students voluntarily participated in the research. The research was conducted in accordance with ethical principles and with the informed consent of school leaders, school principals, class teachers, and students (we got written approval from the management of the four high schools). We previously gave verbal instructions for filling out the questionnaire. Completing the questionnaire took about 30 minutes.

Statistical analysis

Statistical analysis was performed using the IBM SPSS Statistics, Version 20.0 (IBM Corp., Armonk, NY, USA). The parametric test used in this study is Student's t test. The non-parametric tests used in this study are Pearson's χ^2 test and Mantel–Haenszel χ^2 test for trend. Regression models with depressive symptoms as dependent and IAT adjusted for variables significant in the univariate model were tested by Nagelkerke's R^2.

RESULTS

There were 620 students who participated in the study, of which 415 (66.9%) were girls and 205 (33.1%) were boys. Based on the categorization of the IAT score, all respondents were divided into two groups: normal internet users (IAT score 0–49) without pronounced symptoms of addiction, and problematic and pathological users of the internet, i.e., with addictive behavior (IAT scores ≥ 50%). There were 40 respondents (6.5%) who reported normal use of the internet, 349 students (56.3%) belonged to average internet users with a mild level of addiction, while 226 (36.5%) reported problematic use of the internet and five students (0.8%) showed a high level of internet addiction.

Table 1 shows the distribution of respondents according to demographic characteristics. The average school achievement was significantly worse among students addicted to the internet compared to normal internet users (4.19 *vs.* 4.30, respectively). The percentage of students from urban areas among internet addicts was significantly higher than those from semiurban areas (64.1% *vs.* 35.9%, respectively). The distribution of internet addicts in relation to grade was different than expected in terms of a significantly lower percentage of fourth-graders in comparison to other grades, but, overall, the downward trend was not significant. Female students were more frequently addicted to the internet compared to males (borderline statistical significance), while age and type of high school were not significantly related to problematic internet use.

The largest percentage of students used a smartphone with internet access (96.1%), and 81.5% of students used a desktop computer or laptop with internet access. Only 0.2% of students declared that they did not have any of these devices and did not use the internet.

Table 1. Distribution of respondents per demographic characteristics

Characteristic		Subject groups in relation to IAT score						p
		Total		0–49		50–100		
		N	%	N	%	N	%	
Gender	Male	205	33.1	139	35.7	66	28.6	0.067[a]
	Female	415	66.9	250	64.3	165	71.4	
Place of living	Semiurban	270	43.5	187	48.1	83	35.9	0.003[a]
	Urban	350	56.5	202	51.9	148	64.1	
School	Gymnasium	135	21.8	92	23.7	43	18.6	0.394 [a]
	Medical High School	229	36.9	145	37.3	84	36.4	
	Economic and Commercial High School	166	26.8	98	25.2	68	29.4	
	Agricultural High School	90	14.5	54	13.9	36	15.6	
Grade	1	153	24.7	84	21.6	69	29.9	0.042[a] 0.070[b]
	2	207	33.4	139	35.7	68	29.4	
	3	193	31.1	118	30.3	75	32.5	
	4	67	10.8	48	12.3	19	8.2	
		AS	SD	AS	SD	AS	SD	
Age		16.12	1.06	16.18	1.07	16.02	1.03	0.071[c]
Average mark		4.26	0.64	4.30	0.64	4.19	0.64	0.027[c]

[a]Pearson's χ^2 test;
[b]Mantel–Henschel χ^2test for trend;
[c]Student's t-test

Table 2. Distribution of respondents in relation to time spent on the internet

Variables		Groups of respondents in relation to IAT score						p
		Total		0–49		50–100		
		n	%	n	%	n	%	
Hours spent browsing the internet for learning	0	28	4.5%	12	3.1%	16	6.9%	0.082
	1/2 h	102	16.5%	58	14.9%	44	19%	
	1/2 – 1 h	138	22.3%	87	22.4%	51	22.1%	
	1–2 h	201	32.4%	137	35.2%	64	27.7%	
	2–3 h	93	15%	60	15.4%	33	14.3%	
	3 h–4 h	32	5.2%	22	5.7%	10	4.3%	
	> 4 h	26	4.2%	13	3.3%	13	5.6%	
Hours a day spent on social networks	0	2	0.3%	1	0.3%	1	0.4%	< 0.001
	1/2 h	13	2.1%	10	2.6%	3	1.3%	
	1/2 – 1 h	24	3.9%	22	5.7%	2	0.9%	
	1–2 h	101	16.3%	87	22.4%	14	6.1%	
	2–3 h	148	23.9%	111	28.5%	37	16%	
	3–4 h	141	22.7%	80	20.6%	61	26.4%	
	> 4 h	191	30.8%	78	20.1%	113	48.9%	
Hours spent playing computer and video games	0	303	48.9%	214	55%	89	38.5%	0.001
	1/2 h	97	15.6%	51	13.1%	46	19.9%	
	1/2 – 1 h	42	6.8%	27	6.9%	15	6.5%	
	1–2 h	75	12.1%	46	11.8%	29	12.6%	
	2–3 h	33	5.3%	19	4.9%	14	6.1%	
	3–4 h	29	4.7%	14	3.6%	15	6.5%	
	> 4 h	41	6.6%	18	4.6%	23	10%	
Using the internet for learning	No	206	33.2%	103	26.5%	103	44.6%	< 0.001
	Yes	414	66.8%	286	73.5%	128	55.4%	
Using the internet for aimless "surfing"	No	411	66.3%	276	71%	135	58.4%	0.001
	Yes	209	33.7%	113	29%	96	41.6%	
Tik Tok	No	259	41.8%	196	50.4%	63	27.3%	< 0.001
	Yes	361	58.2%	193	49.6%	168	72.7%	
Twitter	No	457	73.7%	298	76.6%	159	68.8%	0.033
	Yes	163	26.3%	91	23.4%	72	31.2%	

Pearson's χ^2 test

Table 3. Distribution of respondents in relation to the need for professional help and the occurrence of depressive symptoms

Variables		Groups of respondents in relation to IAT score						p
		Total		0–49		50–100		
		N	%	N	%	N	%	
Help of psychologist/ psychotherapist	No	410	66.1	291	74.8	119	51.5	<0.001[a]
	Thinks about it	81	13.1	42	10.8	39	16.9	
	Used once	73	11.8	32	8.2	41	17.7	
	Used several times	42	6.8	15	3.9	27	11.7	
	Still use	14	2.3	9	2.3	5	2.2	
Help of psychiatrist-child psychiatrist	No	500	80.6	329	84.6	171	74.0	0.002[a]
	Thinks about it	18	2.9	5	1.3	13	5.6	
	Used once	74	11.9	43	11.1	31	13.4	
	Used several times	23	3.7	10	2.6	13	5.6	
	Still use	5	0.8	2	0.5	3	1.3	
CES DC score - depressive symptoms	No	258	41.6	208	53.5	50	21.6	< 0.001[b]
	Yes	362	58.4	181	46.5	181	78.4	

[a]Mann-Whitney U test
[b]Pearson's χ^2 test

Table 4. Logistic regression model with CES-DC total score of 15 and more as dependent variable

Variables	OR	95% CI		p
IAT score (≥ 50 = 1; < 50 = 0)	3.317	2.242	4.907	< 0.001
Place of living (Semiurban = 1; Urban = 2)	1.164	0.814	1.665	0.404
Gender (Male = 1; Female = 2)	2.075	1.408	3.058	0.000
Using the internet for learning (Yes = 1; No = 0)	0.611	0.413	0.902	0.013
Using the internet for aimless "surfing" (Yes = 1; No = 0)	1.224	0.839	1.788	0.294
Tik Tok (Yes = 1; No = 0)	1.639	1.121	2.395	0.011
Twitter (Yes = 1; No = 0)	1.091	0.710	1.676	0.691
Sport activities (Yes = 1; No = 0)	0.953	0.665	1.367	0.794
A constant	0.069			< 0.001

IAT – Internet Addiction Test; CES-DC – Center for Epidemiological Studies Depression Scale for Children;
Nagelkerke's $R^2 = 0.196$

The results of the analysis of distribution of internet addicts and normal internet users in relation to time spent on the internet and the purpose of use are shown in Table 2. A significantly higher percentage of internet addicts compared to normal internet users were spending more than four hours on the internet daily, particularly if the purpose of use was social networks (48.9% *vs.* 20.1%, respectively) and playing computer and video games (10% *vs.* 4.6%, respectively). Among the internet normal users there was a significantly higher percentage of those who did not play computer and video games compared to internet addicts (55% vs 38.5%, respectively). Using the internet for learning was significantly more frequent among internet non-addicts compared to internet addicts (73.5% *vs.* 55.4%, respectively), while aimless "surfing" was significantly more popular among internet problematic users compared to internet normal users (41.6% *vs.* 29%, respectively). Using Tik-Tok was significantly more frequent among internet addicts compared to internet normal users (72.7% *vs.* 49.6%, respectively) and a similar relation was found concerning Twitter use (31.2% *vs.* 23.4%, respectively).

Highly significant differences were observed between the examined groups regarding the need for professional psychological support (Table 3). Among internet addicts, there was a significantly higher percentage of those who sought psychologist/psychotherapist help compared to internet normal users (29.4% *vs.* 12.1%, respectively). There was also a significantly higher percentage of internet addicts who thought of, or used several times the help of a child psychiatrist, compared to internet normal users (11.2% *vs.* 3.9%).

According to the results from Table 3, a CES-DC score ≥ 15, considered indicative of clinically significant depressive symptoms, was found significantly more frequently among internet addicts compared to internet normal users (78.4% *vs.* 46.5%, respectively).

Table 4 shows the regression model with depressive symptoms as the dependent variable and adjusted for variables that were significant or borderline significant in the univariate model. The strongest independent predictor of clinically significant depressive symptoms was Internet Addiction (IAT) and it remained significant even after adjusting for variables on which the IAT categories differ significantly. Practically, the IAT score affects CES-DC total score itself, independently of other parameters that have a relationship with it. The other significant independent predictors of high CES-DC total score were female gender, use of internet for Tik Tok and for aimless "surfing."

The model was tested for multicollinearity using Variance Inflation Factor (VIF), and it was found that no VIF exceeded the value of 1.25 ($1/(1\text{-NagelkerkeR}^2) = 1/$

(1-0.196) = 1/0.804 = 1.244). Thus, we consider that the predictors are not mutually collinear and can be used together in the model.

DISCUSSION

According to our results, more than one-third of investigated students (36.5%) indicated problematic use of the internet and 0.8% showed a high level of internet addiction. An Italian study showed that 28% of high school students were highly dependent on the internet, which is close to our results [17]. According to the results of the latest meta-analysis that aimed to estimate the global prevalence of digital addiction in the general population, an increasing trend of digital addiction in the last two decades and a dramatic worsening during the COVID-19 pandemic were found [18]. In relation to the place of residence, students from urban areas were significantly more prone to internet addiction compared to those from semiurban areas, while the higher percentage of girls compared to boys was borderline significant – these results are similar to those in the research of Kuzmanović et al. [19], where a higher index of excessive internet use was recorded in girls. High school students use the internet for various purposes, learning, education, information, entertainment, playing games, communication, as well as for accessing social networks. Social networks are the most popular among young people and have become an indispensable part of their free time and entertainment [20]. According to our research, high school students mostly use the internet to access social networks (91.8%), which coincides with the results of research conducted in Serbia on a representative national sample of 1500 adolescents, 90% of whom access social networks daily [19].

When it comes to the time spent using the internet, significant differences were observed for searching the internet for social networks and playing games, where almost one-half of the respondents addicted to the internet were spending more than 4 hours daily on the internet. In current circumstances, when a good part of teaching and social life takes place via the internet, it is difficult to determine the criteria for normal or excessive use of the internet. In a study by Hinić [21], it is stated that most respondents who sought help for internet addiction spent more than 30 hours a week online, which would be four and a half hours a day. Although studies have shown that a time interval of two hours of internet use can precede addiction, and 6 hours of use is the main risk factor for internet addiction, recent studies indicate the importance of the time schedule in which the internet is used as a risk factor for internet addiction [22].

In our study, highly significant differences in the need for professional psychological support were observed among the examined groups regarding the extensivity of internet use. Malinauskas and Malinauskiene [23] point out that psychological interventions can help reduce the intensity of internet addiction by focusing on three main goals – reducing the hours of internet use, improving functioning in critical periods of life, and reducing exposure to harmful online content and activities. Also, the quality of parental care is a very important factor in protecting adolescents from mental health disorders and internet addiction [24]. Trumello et al. [24] point out that in the prevention of internet addiction, family interventions aimed at improving the parent–child relationship, improving communication, and understanding are also very important.

Symptoms of depression were significantly more present in the group of internet addicts compared to the comparison group. A regression model with depressive symptoms as a dependent variable adjusted for IAT variables that are significant in the univariate model shows that internet addiction remains a significant predictor. Excessive use of the internet and social networking platforms could weaken the bonds between individuals and their families, friends and loved ones. As a result, individuals may feel lonelier and more depressed [25]. Research conducted in Turkey on a population aged 12–18 years showed a positive relationship between daily internet use and social media addiction and depression [26]. In the same study, symptoms of depression were recorded in 28% of respondents, while in our study the prevalence was significantly higher (58.4%). The results of the study by Obeid et al. [27] show that a higher level of internet addiction is positively correlated with a higher degree of depression in adolescents aged 13–17 years.

The results of a study conducted by Sami et al. [28], on a sample of adolescents from Europe, revealed that pathological internet use is associated with various mental health problems, including depression and suicidal ideation. However, there are also studies showing that depression symptoms predict internet addiction, such that depressed individuals use their phones to cope with unpleasant emotions [29]. Moreover, lonely teenagers find it more difficult to make face-to-face contacts, which may increase their interest in online dating. Some studies indicate a two-way relationship between internet addiction and depression. People who are addicted to the internet tend to develop a depressed mood, while people suffering from depression are prone to excessive use of the internet and internet addiction [30].

Limitations of the study

This research was conducted in 2021 during the COVID-19 pandemic, when classes were mostly conducted online, with students spending more time on the internet, influencing the obtained results on the internet use. There was no insight into the medical documentation about the presence of any other diseases of the students that could be related to depression. We had no insight into the family history and no feedback from the psychologist about the students' visits. We also did not control family relations and parental care, as well as the socio-economic status of the students. We recommend an intervention study aiming at the effects of a positive change in the use of the internet on the students' mental health.

CONCLUSION

Based on the results of our research we can conclude that internet addiction is associated with clinically significant depressive symptoms in high school students. These results may be helpful in planning preventive measures against mental disorders among adolescents.

Conflict of interest: None declared.

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Повезаност коришћења интернета и симптома депресије код средњошколаца

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САЖЕТАК

Увод/Циљ Проблематично коришћење интернета повезано је са различитим проблемима менталног здравља.
Циљ овог истраживања је био да се испита употреба интернета и његова повезаност са симптомима депресије међу средњошколцима.

Методе Ова опсервациона студија пресека обухватила је 620 ученика од првог до четвртог разреда четири пожаревачке средње школе. Подаци истраживања су добијени из *ad hoc* дизајнираног упитника о социодемографским подацима, здравственим навикама и употреби и навикама везаним за интернет, теста зависности од интернета (*IAT*) и скале депресије за децу Центра за епидемиолошке студије (*CES-DC*).

Резултати Од 620 ученика (66,9% девојчица) било је 389 испитаника (62,7%) који су пријавили нормалну ($n = 40$) или просечну употребу интернета ($n = 349$) са благим степеном зависности, док 226 (36,5%) испитаника припада групи проблематичне употребе интернета, а пет ученика (0,8%) показало је висок степен зависности од интернета. *CES-DC* скор ≥ 15, који се сматра индикативним за клинички значајне симптоме депресије, био је значајно чешћи међу зависницима од интернета у поређењу са нормалним корисницима интернета (78,4% према 46,5%, респективно). Међу зависницима од интернета значајно је већи проценат оних који су користили помоћ психолога/психотерапеута у односу на нормалне кориснике интернета (29,4% према 12,1%, респективно). Логистичка регресиона анализа је показала да је најјачи независни предиктор клинички значајних симптома депресије зависност од интернета (*IAT* скор ≥ 50) (*OR* = 3,32; 95% *CI* = 2,24–4,91), после прилагођавања (женски пол, урбани живот, коришћење Тик Тока и Твитера, спортске активности и коришћење интернета за учење или за бесциљно „сурфовање").

Закључак Показали смо да је зависност од интернета позитивно повезана са клинички значајним симптомима депресије код средњошколаца. Здравствено образовање усмерено на правилно коришћење интернета може се сматрати промоцијом менталног здравља.

Кључне речи: интернет; понашање; зависност; симптоми депресије