

Internet Addiction and COVID-19 Misbeliefs Among Hungarian Online Gamers: A Cross-Sectional Study

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Introduction: The internet has become a part of everyday life, and during the COVID-19 pandemic the rate of internet use has raised even higher, which increases the possibility of compulsive and problematic use leading to the acceptance of online misbeliefs and conspiracy theories. This cross-sectional study aimed to explore the relationship between COVID-19-related misconceptions and internet addiction among adult recreational online gamers.

Methods: A sample of 1671 recreational video game users completed the online survey (male: $n = 1522$ (91.08%), mean age = 21.83, SD = 4.18; female: $n = 149$ (8.91%), mean age = 24.33, SD = 8.38). Demographic questions, risk factors and health-related questions, internet use and addiction were measured alongside a short questionnaire about common COVID-19-related topics, such as its origin and risk of infection.

Results: Out of all participants 248 (14.8%) answered all the COVID-19-related questions properly, thus having no misconceptions, while 545 (32.6%) had one wrong answer, 532 (31.8%) had 2 wrong answers, 251 (15.0%) had 3 wrong answers, 78 (4.7%) had 4 wrong answers and 17 (1.0%) had 5 wrong answers. Significant factors to a higher number of COVID-misconceptions were time spent studying (χ^2 (35,1671) = 63.86, $p = 0.002$), marital status (χ^2 (15,1671) = 30.65 $p = 0.01$) and secondary employment (χ^2 (51,671) = 14.88, $p = 0.01$). Although 17.1% of the participants reached the threshold score for internet addiction, the predictors of COVID-19 misconceptions were marital status ($\beta = -0.06$, $p = 0.01$) and time spent studying ($\beta = 0.05$, $p = 0.03$), while neither daily internet use, internet addiction scores or risk factors predicted these misconceptions in a linear regression model.

Discussion: Our study concludes that Internet addiction did not directly influence misconceptions about the COVID-19 pandemic in this population despite the surprisingly high rate of problematic users.

Keywords: internet addiction, COVID-19, risk factor, depression, online gaming

Introduction

The COVID-19 pandemic, caused by the novel coronavirus SARS-CoV-2, has had a profound impact on global health, economies, and societies worldwide. With the rapid dissemination of information through various media platforms, misconceptions (defined as people's wrong beliefs and knowledge of the pandemic due to misinformation or fake news) about COVID-19 have emerged, further complicating the management and control of the pandemic.¹ The pandemic has highlighted the importance of the internet as a source of information, connection, and support, since it was a tool to maintain social contacts and to obtain health and safety information.² Therefore, individuals may be more likely to turn to the internet for emotional support for recovering from distress, reinforcing negative moods or as a coping strategy, which can contribute to the development of internet addiction.³ Recent studies raised the possibility of constantly increasing rate of problematic users between the waves of COVID-19 especially among adolescents.^{4,5} Thus, the question arises: are internet addiction and the gathering of misinformation about the COVID-19 pandemic linked?

During the COVID-19 pandemic, the spread of misinformation, conspiracy theories and unverified information concerning the virus was accelerated (eg the virus' origin, the severity of the pandemic situation, how it spreads, etc.).⁶⁻⁸ And

while research articles and data were granted open access during the pandemic, several factors played a role in the spread of misinformation, for example: social media fatigue, fear of missing out, lack of information or verification skills, the overload of information.^{1,9} As a result, the majority of individuals may believe that at least one conspiracy theory regarding the pandemic is true.¹⁰ Misbeliefs are linked to various factors according to previous studies, such as low or high level of education, fear and anxiety, and internet use, while communication and media may also have significant impact on these.^{1,11–13} Misbeliefs about the pandemic are extremely harmful since they are hard to change, and they further accelerated the spread of the virus by hindering preventative behaviours (eg not wearing a face mask, not vaccinating, etc.).¹³

The internet has become an integral part of everyday life, providing unprecedented access to information, entertainment, and communication. With the rise of social media, online gaming, and streaming services, people are spending more time than ever before connected to the internet. Online gaming can have a number of benefits as a pastime; however, as its (and internet) usage continues to increase with subsequent risk of developing internet addiction and problematic gaming.^{13,14} Problematic internet use (or internet addiction) is characterized by compulsive and excessive internet use, which can have negative consequences on an individual's physical, psychological, and social well-being.^{15,16} It's been associated with a range of negative outcomes such as poor academic and occupational performance, social isolation, loss of control, pain, sleep disorders, depression, anxiety, low self-esteem and self-control and other mental health problems.^{17–20} The COVID-19 pandemic has further raised the rate of internet usage as people have been forced to stay home and rely on the internet for work, education, and social interaction. Studies have shown that internet addiction rates have increased during the pandemic, particularly among individuals who are socially isolated or experiencing high levels of stress.²¹ Several factors have been further associated with internet addiction during the COVID-19 pandemic, such as depression, anxiety, musculoskeletal pain and a decrease in physical activity, and even lower levels of self-reported health especially among students.^{18,22}

Misconceptions and misinformation about COVID-19 may contribute to internet addiction (and vice versa, as individuals seek out information, shared personal experiences and viewpoints and social support online.¹ With the constant influx of (mis) information and news about the pandemic, individuals may feel overwhelmed or uncertain about the facts surrounding the virus, which leads to accelerated health anxiety and misinformation sharing.^{23,24} Social media websites are full of ambiguous and inaccurate information about the pandemic that are easy to share due to the design of these websites, the lack of critique and the amplification of radical ideas.^{25,26} Moreover, the spread of misinformation and conspiracy theories about the pandemic can further fuel internet addiction, as individuals become immersed in online communities that reinforce their beliefs.¹

A major group of internet users are gamers. Despite the increasing popularity of online games, the number of female gamers in Hungary remains significantly lower compared to their male counterparts, even if this number is somewhat higher than other EU regions.^{14,27} Although internet addiction is not labelled as a medical condition, gaming disorder was included both in the appendix of the DSM-V (as a potential warning state) and in the ICD-11.¹⁴ The rate of internet addiction can be as high as 20% among recreational online gamers, which is significantly higher than the results (approximately 7%) of a relatively recent meta-analysis (however, it can vary between 13% and 50% based on geographical location, goals of internet use and age).^{14,28}

Despite extensive research on the topic, the connection between internet addiction and COVID misconceptions is rarely studied. The aim of our study is to will explore the impact of the COVID-19 pandemic on internet addiction, including the prevalence and risk factors associated with this condition in an online gamer population (among whom the rate of internet addiction is presumably two- or three-times higher comparing to the average population) taking several co-variates into account such as detailed demographics, risk factors, medical history and goals of internet use).

Materials and Methods

Participants

This online cross-sectional study questionnaire-based study was conducted from 03/2020 to 08/2020 with a non-probability sampling method. Data was collected via an online questionnaire (in Hungarian language). Study participants were recruited online among registered Hungarian gamers via twitch.com with the help of two influencers (see Acknowledgements) coordinated by Universum 8 Zrt. Participants were informed about the purpose of the study before

entering the survey. Participants aged >18 years and who read the information sheet (by clicking via “I read and understand the terms”) and signed the consent form prior to completing the survey (by clicking via “I agree”) were allowed to participate. Participation was anonymous and voluntary and participants could quit the study anytime they wanted. The study was approved by the Ethics Committee of the University of Pécs (8434-PTE 2020).

Measures

The questionnaire included demographic questions, risk factors and medical history, questions regarding internet habits and use and questions about COVID-19 misconceptions (see [Appendix 1](#)).

Demographic questions included gender, age, marital status, number of children, education, type of work, years spent with work, work schedule, legal relation and secondary employment.

Risk factors and health-related questions included medication, smoking, coffee consumption, alcohol and drug use; height and weight, diabetes, hypertension and cardiovascular problems, musculoskeletal problems and pain, and mental illness.

To explore the habits of internet usage, we included questions about internet use (hours spent daily besides work or education ranging from “less than 1 hour” to “6 hours or more”) and video game play (regularity of video game play ranging from “not playing video games at all” to “playing video games multiple hours a day, competitively”).

As there are no clear diagnostic criteria for internet addiction, it is highly recommended that excessive internet use is measured with a continuous questionnaire.¹⁴ We chose the Problematic Internet Use Questionnaire (PIUQ) because its structure tightly adheres to the proposed diagnostic criteria for internet addiction and was created based on clinimetric and psychometric analysis of Young’s Internet Addiction Test, independently validated by several groups and used in our previous published work.^{14,28,29} The questionnaire contained 18 items, each scored on a 5-point Likert-type scale ranging from 1 (never) to 5 (always). A confirmatory factor analysis verified the three-factor model of the questionnaire, with each subscale containing six items. The obsession subscale refers to obsessive thinking about the internet (daydreaming, rumination and fantasizing) and withdrawal symptoms caused by the lack of internet use (anxiety and depression) —“How often do you feel tense, irritated, or stressed if you cannot use the internet for as long as you want to?”. The neglect subscale contains items about neglecting everyday activities, social life, and essential needs (“How often do you spend time online when you’d rather sleep?”). The control disorder subscale reflects difficulties in controlling time spent on the internet (“How often do you realize saying when you are online, ‘just a couple of more minutes and I will stop?’”). Since in this study we focused on global psychological consequences of internet addiction, we used the PIUQ total score in the statistical analyses, which was computed by summing the scores on all the items of the scale. A total score exceeding 41 points suggests internet addiction.^{14,29–31}

To explore misbeliefs about the COVID-19 pandemic, we posed 8 common questions about the topic, each with 4 possible answers to choose from one option being the correct answer, the others decoys, and the option “I don’t know”. The questions included the origin, the way of spreading, risk of infection, way of contamination, risks, the population most endangered by the virus and treatment. Correct answers, misbeliefs and “I don’t know” answers were counted separately. It is worth to mention that there was no generally accepted and validated questionnaire at the time of the study. See [Appendix 1](#) for the full questionnaire.

Statistical Analysis

Group statistics were evaluated using chi-square tests and independent-samples *t*-tests. Pearson’s correlation was used to determine the relationship between two measures. To determine the role of different values as independent risk factors for internet addiction, logistic regression was used. For all odds ratios, an exact confidence interval (CI) of 95% was constructed. For all the statistical analysis IBM SPSS Statistics program was used (version 22.0, New York, NY, USA).

Results

Demographics

Among study participants, there were 1522 males (91.1%), 1058 were single (63.3%) and 1609 (96.3%) had no children. The participants’ mean age was 22.06 years (SD = 4.75). The study sample’s age distribution was the following: 18–25 years

86.95% (n = 1453), 26–35 years 11.01% (n = 184), 36–45 years 1.19% (n = 20), 46–55 years 0.71% (n = 12), and 56 and above were 0.11% (n = 2). Regarding education level: 8.7% (n = 162) of the participants had elementary school as their highest level of education, 77.0% (n = 1286) had secondary-level education, while 13.3% (n = 223) had a higher level of education, furthermore 43% (n = 726) of the study sample is not continuing their studies, while the rest is still studying.

Risk Factors

From the study population, 31.7% (530) were regular smokers, 16.9% (282) regularly consume alcohol, and 27.6% (461) consumed drugs during their life. As for long-term illnesses and conditions, 2.3% (38) of the study sample had diabetes, 9.0% (151) had hypertension, 3.9% (66) had cardiovascular disease, 2.6% (44) had musculoskeletal pain, and 3.1% (51) had a history of mental illness.

Univariate Analysis - COVID Misconceptions

Out of all participants 248 (14.8%) answered all the COVID-19-related questions properly, thus having no misconceptions, while 545 (32.6%) had one wrong answer, 532 (31.8%) had 2 wrong answers, 251 (15.0%) had 3 wrong answers, 78 (4.7%) had 4 wrong answers and 17 (1.0%) had 5 wrong answers. The distribution of COVID-19 misconceptions in the study sample is shown in Table 1. Only wrongly answered questions were categorized as misconceptions, “I don’t know” answers were categorized separately. Significant factors to a higher number of COVID-misconceptions were time spent studying (χ^2 (351,671) = 63.86, p = 0.002), marital status (χ^2 (151,671) = 30.65 p = 0.01) and secondary employment (χ^2 (51,671) = 14.88, p = 0.01).

Table 1 The Distribution of COVID-19-Related Misconceptions in the Study Sample

		Number of COVID-19 Misconceptions {n(%)}						Total	Significance (p)
		0	1	2	3	4	5		
Gender	Male	223 (14.7)	494 (32.5)	483 (31.7)	236 (15.5)	70 (4.6)	16 (10.5)	1522	0.603
	Female	25 (16.8)	51 (34.2)	49 (32.9)	15 (10.1)	8 (5.4)	1 (0.7)	149	
Highest level of education	Elementary school	29 (17.9)	49 (30.2)	53 (32.7)	23 (14.2)	7 (4.3)	1 (0.6)	162	0.351
	Secondary school	184 (14.3)	433 (33.6)	413 (32.1)	189 (14.7)	56 (4.4)	11 (0.8)	1286	
	College. university	35 (15.7)	63 (28.2)	66 (29.6)	39 (17.5)	15 (6.7)	5 (2.2)	223	
Age groups	18–25	222 (15.3)	470 (32.3)	465 (32)	216 (14.9)	64 (4.4)	16 (1.1)	1453	0.476
	26–35	20 (10.9)	63 (34.2)	61 (33.1)	29 (15.8)	10 (5.4)	1 (0.5)	184	
	36–45	4 (20)	8 (40)	5 (25)	2 (10)	1 (5)	0	20	
	46–55	1 (8.3)	4 (33.3)	1 (8.3)	4 (33.3)	2 (16.7)	0	12	
	56–65	1 (100)	0	0	0	0	0	1	
Marital status*	single	145 (13.7)	329 (31.1)	356 (33.6)	166 (15.7)	49 (4.6)	13 (1.2)	1058	0.010*
	in a relationship	90 (16.4)	194 (35.4)	159 (29)	75 (13.7)	26 (4.7)	4 (0.7)	548	
	married	12 (21.4)	19 (33.9)	16 (28.5)	9 (16.1)	0	0	56	
	widowed. divorced	1 (11.1)	3 (33.3)	1 (11.1)	1 (11.1)	3 (33.3)	0	9	
Time spent studying*	1–12 months	8 (20)	6 (15)	14 (35)	6 (15)	4 (10)	2 (5)	40	0.002*
	12–24 months	1 (5)	5 (25)	8 (40)	4 (20)	0	2 (10)	20	
	24–36 months	3 (14.2)	9 (42.8)	6 (28.6)	1 (4.8)	1 (4.8)	1 (4.8)	21	
	36–48 months	4 (16)	3 (12)	12 (48)	5 (20)	1 (4)	0	25	
	5–10 years	8 (10.3)	26 (33.3)	19 (24.4)	18 (23.1)	6 (7.7)	1 (1.3)	78	
	10–15 years	85 (14.6)	210 (36.1)	180 (30.1)	81 (13.9)	19 (3.3)	7 (1.2)	582	
	> 15 years	34 (18.9)	52 (29)	57 (31.8)	24 (13.4)	11 (6.1)	1 (0.6)	179	
	finished studying	105 (14.4)	234	236	112	36	3	726	

(Continued)

Table 1 (Continued).

		Number of COVID-19 Misconceptions {n(%)}						Total	Significance (p)
		0	1	2	3	4	5		
Secondary employment*	no	210 (15.2)	454 (33)	447 (32.5)	195 (14.1)	59 (4.2)	10 (0.7)	1375	0.011*
	yes	38 (12.8)	91 (30.7)	85 (28.7)	56 (18.9)	19 (6.4)	7 (2.4)	296	
Internet addiction	no	201 (14.5)	452 (32.6)	441 (31.8)	210 (15.2)	67 (4.8)	14 (1)	1385	0.945
	yes	47 (16.4)	93 (32.5)	91 (31.8)	41 (14.3)	11 (3.8)	3 (1)	286	

Notes: *variables are significantly related to the number of COVID-19 misconceptions (in all data $p < 0.05$).

Multivariate Analysis – COVID Misconceptions

According to a linear regression model, the predictors of COVID-19 misconceptions were marital status ($\beta = -0.06$, $p = 0.01$) and time spent with studying ($\beta = 0.05$, $p = 0.03$), while neither daily internet use, internet addiction scores or risk factors predicted these misconceptions. The overall regression was statistically significant ($R^2 = 0.006$, $F(1, 1668) = 4.59$, $p = 0.03$) (Table 2).

Univariate Analysis - Internet and Video Game Use

Daily internet use – on top of using the internet for study and work was measured. The study sample's internet use distribution was the following: 2.6% (43 participants) use the internet 1 hour or less, 13.6% (227) use it for about 2 hours, 23.5% (392) for 3 hours, 22.1% (369) for 4 hours, 15.7% (262) for 5 hours, 6.7% (112) for 6 hours and 15.9% (266) for more than 6 hours. Playing video games competitively, 1.1% (18) of the participants do not play video games at all, 11% (183) sometimes play, 42% (706) play regularly, while 45% (764) play for extended periods daily. Statistical analysis showed a significant correlation between time spent on the internet daily and internet addiction scores ($r(1671) = 0.19$, $p < 0.01$) and age ($r(1671) = -0.11$, $p < 0.01$). While no significant correlation was found between daily internet use and number of COVID misconceptions ($r(1671) = -0.1$, $p > 0.05$). Also there was no difference in daily internet use among participants grouped by the presence of risk factors such as: diabetes ($t(1669) = 0.28$), hypertension ($t(1669) = -1.23$), cardiovascular diseases ($t(1669) = -0.98$), musculoskeletal pain ($t(1669) = 1.58$, all $p > 0.05$). However, having a history of mental illness raised the time spent on the internet daily (4.14 vs 4.68 mean score; $t(1669) = -2.20$, $p = 0.02$).

Univariate Analysis - Internet Addiction

Nearly one fifth, 17.1% ($n = 286$ participants) of the study population reached the threshold score for internet addiction. Internet addiction was higher in the participants with the following risk factors: hypertension (32.66 vs 35.91 mean score; $t(1669) = -3.67$, $p < 0.01$), cardiovascular disease (32.84 vs 35.59 mean score; $t(1669) = -2.04$, $p = 0.04$) and mental

Table 2 Predictors of COVID-19-Related Misconceptions in a Linear Regression Model ($R^2 = 0.006$, $F(1, 1668) = 4.59$, $p = 0.03$)(* $p < 0.05$)

Valuables	Beta	t	Significance (p)
Marital status	-0.060	-2.451	0.014*
Time spent studying	0.053	2.144	0.032*
Daily internet use	-0.007	-0.269	0.788
Internet addiction scores	-0.020	-0.798	0.425
Diabetes	0.008	0.327	0.744
Hypertension	0.022	0.882	0.378
Cardiovascular disease	0.033	1.372	0.170
Musculoskeletal pain	-0.018	-0.725	0.469
History of mental illness	-0.001	-0.036	0.971

illness (32.79 vs 37.98 mean score, $t(1669) = -3.42$, $p = 0.001$). While the presence of diabetes ($t(1669) = -0.24$) and musculoskeletal pain ($t(1669) = -1.00$) did not amount to different daily internet activity (all $p > 0.05$).

Multivariate Analysis – Internet Addiction

Logistic regression analysis showed that significant factors determining internet addiction were having children ($p = 0.03$), working status ($p = 0.02$), extended internet use ($p < 0.001$), musculoskeletal pain ($p = 0.03$), hypertension ($p = 0.01$), smoking ($p = 0.05$), alcohol consumption ($p < 0.001$). While the number of COVID-19 misconceptions ($p = 0.74$), video game use ($p = 0.52$), diabetes ($p = 0.69$), cardiovascular disease ($p = 0.15$), history of mental illness ($p = 0.16$) and drug use ($p = 0.93$) did not have a significant effect on Internet addiction.

Discussion

In this study, we aimed to investigate the relationship between COVID-19-related misconceptions and internet addiction in a sample of adult recreational video gamers. During the COVID-19 pandemic, internet addiction was a more prevalent problem than ever, along with other mental health issues, such as depression due to isolation.^{2,3,20,23} Previous studies suggest that internet addiction and online gaming or social media use are strongly linked, and so we hypothesized that during the pandemic, due to the quick spread of misinformation on the internet, internet addiction and COVID-19 misconceptions were also highly linked factors.^{2,3,14}

It should be kept in mind that a generally accepted, internationally validated disbelief instrument was absent at the time of our research, the first scientific questionnaire was published in 2021.³² Interestingly, only ~15% of our study population had proper knowledge about COVID-19, which is in contrast with previous studies, while ~5% had severe disbeliefs about the infection.^{33,34}

Interestingly, time spent studying but not educational level was associated with the presence of disbeliefs in both uni- and multivariate analysis. This is slightly controversial to previous studies, which showed a strong association between educational level and trust in science.³⁵ Our results can be attributed to the fact that in Hungary we have to face the rapidly shrinking pedagogic and medical population in the last two decades, which could have serious consequences on education and medical care leading to drop in confidence in these areas, but this explanation is rather speculative than scientific.^{36,37}

Marital status was also strongly related to misbeliefs in both uni- and multivariate analysis. Several factors have previously been shown to be associated with this phenomenon, such as younger age, gender (more common in males) and source of information (more common among social media users), but the role of marital status has not been examined before based on our literature search.³⁸ This link may be due to sociopsychological reasons, such as sharing beliefs or facilitated transmission and acceptance of misinformation.^{1,7}

Secondary employment was also a predictor of disbeliefs. Employment and occupation may significantly affect vaccine hesitancy based on a recent study, and our results showed the role of overwhelming with work.³⁹ This can result in distress and social anxiety, which can be the predecessors of disbeliefs.¹³ However, this parameter lost its significance in a multivariate analysis.

Our study could not find any direct causality between problematic internet use and COVID-19 misconceptions in contrast with previous theories and studies.^{1,10,13,14,25} This finding could be due to the study's sample: while the participant's hours spent on the internet besides work or study was high (38.9% spend more than 4 hours daily on the internet), most of this time was likely spent on online video game-related content and not on social media. Social media was the virtual space for misinformation to spread during the COVID-19 pandemic, and it further fuelled internet addiction, since individuals were seeking more information and the reinforcement of their beliefs.^{1,14} But it's likely that the video gamer population did not spend their time on social media platforms and so were prone to less misinformation and conspiracy theories.

However, the rate of internet addiction was relatively high among this adult population and was also associated with risk factors, like musculoskeletal pain, cardiovascular disease, smoking and alcohol consumption. These results suggest that internet addiction is not a problem in itself but rather a part of a complex net of variables that influence a person's lifestyle.^{14,16} Sitting for long periods of time can lead to pain and obesity, raising the risk for hypertension, metabolic syndrome or diabetes.^{14,16} But a sedentary lifestyle may also contribute to a worse level of mental health.²²

The limitations of the study include the online nature of the study. Although face-to-face surveys provide more reliable data and may also include physical examination, during the COVID-19 pandemic online platforms were a much safer way to conduct a study and to reach more participants. Although the study sample had a higher percentage of male gamers than females, this disparity is present in the overall gamer scene in many European studies, but generalizing the results to other populations should still be addressed with caution. In the study, while video gaming time was measured, time spent on social media or information-seeking strategies was not, which could've been underlying factors and may have influenced the results. Also, while the results were controlled for a number of risk factors, various mental illnesses like anxiety were not taken into account. The above-mentioned limitations can significantly influence our findings.

Conclusion

Although our study could not confirm an established link between COVID disbeliefs and problematic usage of the internet, it has highlighted the role of educational background and marital status. Furthermore, the rate of internet addiction was surprisingly high among recreational online gamers and was associated with several risk factors, such as mental illness and substance use. These findings highlight the complex interplay between digital behaviors, mental health, and substance-related risk factors in the context of the ongoing global health crisis.

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