MUNI FSS

JOURNAL OF PSYCHOSOCIAL RESEARCH ON CYBERSPACE
CYBERPSYCHOLOGY

Razum, J., & Glavak-Tkalić, R. (2025). Prevalence and impact of Internet Gaming Disorder: A population-based study. *Cyberpsychology: Journal of Psychosocial Research on Cyberspace, 19*(1), Article 1.
https://doi.org/10.5817/CP2025-1-1

Prevalence and Impact of Internet Gaming Disorder: A Population-Based Study

Josip Razum & Renata Glavak-Tkalić

Ivo Pilar Institute of Social Sciences, Zagreb, Croatia

Abstract

Internet Gaming Disorder (IGD) has emerged as a significant public health concern, yet not enough is known about its prevalence among the general population as well as its relationship to well-being, mental health, specifically depression and anxiety, and gaming genres. This study aimed to address these questions. The research was conducted on a representative sample of the Croatian general population including 4,994 participants, aged between 15 and 64 years (M = 40.75, SD = 15.49). The Ten-Item Internet Gaming Disorder Test, Mental Health Inventory-5, Personal Well-being Index, Gaming time and Game Genres Preferences were used. The prevalence of the IGD in the general population of Croatia, aged 15-64 years, was estimated at 0.48%, 95% CI [0.30%, 1%], and among video game players (N = 1,239) at 1.63%, 95% CI [1.11%, 3%]. The highest prevalence was observed among young males. IGD showed the strongest relationship with depression, and weaker relationships with anxiety and well-being. Among the individual criteria, negative consequences for significant relationships, deception and escape had the strongest, while tolerance, loss of control and withdrawal had the weakest relationship to depression, anxiety and well-being, in a relative sense. Sports games and casual games players had lower risk for IGD, while other genres did not differ in their risk for IGD. Online and offline games did not differ in their risk for IGD. This study has shown that IGD has a relatively low prevalence among the general population and video game players, and that not all IGD criteria are equally relevant. Future longitudinal studies and studies on clinical samples are needed.

Keywords: internet gaming disorder; general population; DSM-5 criteria; mental health; game genres; Croatia

Editorial Record

First submission received:
March 4, 2024

Revisions received:
October 30, 2024
January 9, 2025

Accepted for publication:
January 13, 2025

Editor in charge:
Maèva Flayelle

Introduction

Even though Internet gaming can bring multiple cognitive, emotional, and other benefits to gamers (Granic et al., 2014; Halbrook et al., 2019; Razum & Huić, 2023), research has shown that some gamers may develop symptoms of problematic gaming. DSM-5 (The Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition) included Internet Gaming Disorder (IGD) in the Appendix, Section III, as a condition that requires further research (American Psychiatric Association, 2013), and based on reviews of available evidence the World Health Organization introduced Gaming Disorder as a new diagnostic category in their 2019 release of the 11th Revision of the International Classification of Diseases (ICD-11; World Health Organization, 2019). Despite a significant increase in the number of empirical studies on gaming, the classification of gaming disorder remains a matter of controversy,

and a debate on whether problematic gaming should be considered a diagnosable condition is still going on in the scientific community (Aarseth et al., 2017, Griffiths et al., 2017). Authors have warned against the "confirmatory approach" (Billieux et al., 2015; 2022; Reed et al., 2022) that was used in IGD and other behavioural addiction research. This meant that gaming was a-priori conceived as an addictive disorder, addiction criteria were applied, and it was confirmed that gaming addiction really existed when some participants met the criteria. Alternative explanations were not considered, in particular that there are many highly involved gamers, who spend large amounts of time gaming, and may be misdiagnosed as problematic gamers, especially if core symptoms, i.e., the behavioural and mental manifestations of the disorder, are not required for a diagnosis (Brand et al., 2020). Gaming time itself and its relationship to IGD are controversial. Pontes et al. (2022) found in a large-scale study that gaming time increases linearly with the number of endorsed IGD symptoms. However, it was suggested that highly involved gamers may play a lot of hours and not experience negative consequences (Billieux et al., 2019), and gaming time explains a relatively small portion of variance in IGD (Király, Tóth, et al., 2017; Pontes et al., 2022).

Besides these theoretical issues, among the most important criticisms of the research into gaming disorder are the use of convenience samples and very common measurement issues. More specifically, the use of a variety of self-report measures containing different items, various types of response scales and cut-off thresholds, make a comparison between results difficult (King et al., 2020; Muller et al., 2015; Petry, 2011). King et al. (2020) have found that 32 instruments were used to measure IGD, many of them being poorly validated and covering neither the DSM-5 nor ICD-11 criteria. Epidemiological studies conducted in different countries and using different instruments vary substantially in the proportion of players with IGD. Darvesh et al. (2020) found in their scoping review that the prevalence of IGD ranged from 0.21%–57.5% in general populations, 3.20%–91% in clinical populations, and 50.4%–79.3% in populations undergoing intervention for either GD or IGD (severe cases). In a systematic review and meta-analysis of prevalence studies conducted on IGD, Stevens et al. (2020) determined that the pooled worldwide prevalence rate of gaming disorder is 3.05%; 95% CI [2.38%, 3.91%], which lowers to 1.96%; 95% CI [0.19%, 17.12%] when only the studies meeting more strict sampling criteria, such as random sampling, were taken into account. Although the pooled prevalence rate of 1.96% sounds more credible and is comparable to the prevalence of e.g., pathological gambling, the confidence interval was still large [0.19%, 17.12%], with a great deal of variation between these prevalence rates attributable to the use of different instruments and, in particular, to different cut-off scores. Furthermore, many studies were conducted exclusively among adolescents. In their meta-analysis, H. S. Kim et al. (2022) reported a similar pooled prevalence of 3.3%; 95% CI [2.6%, 4.0%], which was reduced to 1.4%; 95% CI [0.9%, 1.9%] when they used only representative samples and applied the trim-and-fill method (i.e., a correction for publication bias; Duval & Tweedie, 2000).

Considering mentioned meta-analyses (H. S. Kim et al., 2022; Stevens et al., 2020) and conducting our own literature search, we found only a handful of studies that were carried out among representative samples of the general population (Brunborg et al., 2015; Festl et al., 2013; Haagsma et al., 2012; D. J. Kim et al., 2017; Mentzoni et al., 2011; Müller et al., 2014; Shiue, 2015; Wittek et al., 2016;), and only one of these studies, conducted in Germany (Müller et al., 2014), used criteria that correspond to DSM-5 IGD criteria. To the best of our knowledge, none of the representative studies used the ICD-11 criteria. The data on IGD prevalence in representative general population samples are therefore very scarce.

When assessing the relevance of gaming disorder, in addition to prevalence it is crucial to estimate its impact (King & Delfabbro, 2018; Przybylski et al., 2017). This is especially important in the light of long-standing critiques pointing out questionable relevance and/or "peripheral" nature of the symptoms included in the (DSM-5) IGD diagnosis, which might lead to overdiagnosing of the condition (Colder Carras & Kardefelt-Winther, 2018; Kuss et al., 2017). The studies conducted so far show a mixed picture. In a meta-analysis by Cheng et al. (2018), the findings confirmed moderate positive associations between IGD and psychological problems, but only a modest negative association with psychological well-being. Przybylski et al. (2017) reported no difference in well-being between individuals with and without IGD among different age groups. In a general population-based study by D. J. Kim et al. (2017), persons with IGD had higher depression scores than those without IGD. Ostinelli et al. (2021) found in their systematic review and meta-analysis that the prevalence of depression in persons with IGD varied substantially across studies, affecting approximately one out of every three participants. A meta-analysis by Männikkö et al. (2020) has shown that the relationship between IGD and anxiety is small to moderate across studies. However, among the studies included in the meta-analysis, none was conducted on a sample representative of the general population and, to our knowledge, until now there has been no such study conducted which would look into the relationship between IGD and anxiety.

In an individual participant data meta-analysis by Ballou and Zendle (2022), IGD was related to more distress experienced across different samples, both as categorical variable across different possible thresholds and as a continuous variable. However, not all criteria were identified as equally predictive of distress: withdrawal and escapism were the most predictive, and preoccupation, tolerance and loss of interest were the least predictive. The authors argued that withdrawal and escapism, as they were not judged favourably by the experts (Castro-Calvo et al., 2021), may represent processes and not the causal effect of problematic use. Overall, it seems that problematic gaming is more related to indicators of psychopathology and distress, but less to well-being. Also, the individual indicators seem to differ in their relation to these criteria. The amount of population-level evidence to clarify these relationships is insufficient, and therefore additional research is needed. Studies conducted on representative samples are important in this regard because convenience samples not only distort prevalence estimates but also relationships of IGD with other variables (Rumpf et al., 2019).

Another key question that should be looked into is whether there is a relation between certain game genres and an elevated risk of gaming disorder. Game genres are an important structural predictor of gaming disorder, and different genres representing different structural characteristics should pose different amounts of risk for developing gaming disorder (Entwistle et al., 2020). Until now, no consensus has been reached regarding the classification of game genres. Different authors proposed and used different classifications of game genres (e.g., Entwistle et al., 2020; Na et al., 2017), and new genres tend to emerge all the time. The genres used in different studies (Apperley, 2006; Na et al., 2017, Rehbein et al., 2021) include: action, role-playing, simulation, strategy, massively multiplayer online role-playing games (MMORPG), sport games, first-person shooter (FPS) games, multiplayer online battle arena (MOBA), battle royale, casual games and others. Rehbein et al. (2021) found in their systematic review that MMORPG, FPS, and real-time strategy games / MOBA were related to higher endorsement of IGD symptoms, with MMORPG being the most prominent. MMPROG and FPS were also found to elicit IGD among gamers with specific types of gaming motivation, like social and immersion motivation (Laconi et al., 2017). Contrary to these findings, studies by Entwistle et al. (2020) and Mathews et al. (2019) found no relationship or practically no significant relationship of different game genres to IGD symptoms. However, only a handful of studies concerning game genres and IGD symptoms were conducted on representative population samples (Rehbein et al., 2021), and in particular very popular genres such as sports games and especially casual games (Chess & Paul, 2019) were rarely considered.

Since the data on the prevalence of IGD among the general population are very limited, the first aim of this study was to present the data on the prevalence of IGD among the general population of Croatia. The second aim was to determine the association of IGD as a whole construct, and of IGD items, with subjective well-being and mental health as relevant criteria. Finally, the third aim was to determine the association of IGD with its important structural predictor: the game genres.

Methods

Participants

The study was part of a larger study carried out in 2019 on a representative sample of the Croatian population (N = 4,994), aged between 15 and 64 years (M = 40.75, SD = 15.49), living in private households. The participants who played video games at least once during the previous year were defined as video game players (N = 1,239). They were on average somewhat younger than the total sample (M = 31.23, SD = 12.13). Basic sociodemographic characteristics of participants are presented in Table 1.

Table 1. *Basic Sociodemographic Characteristics – Total Sample and Video Game Players.*

	Total sample	Video game players
N	4,994	1,239
Sex		
Male	2,091 (41.9%)	729 (58.8%)
Female	2,903 (58.1%)	510 (41.1%)
Age		
15–34	1,967 (39.4%)	828 (66.8%)
35–64	3,027 (60.6%)	411 (33.2%)
Education level	442 (8.9%)	103 (8.3%)
≤ Elementary school	936 (18.8%)	186 (15.0%)
High school (2 or 3 years)	2,164 (43.3%)	599 (48.3%)
High school (4 years)	615 (12.3%)	135 (10.9%)
College / BA	745 (14.9%)	193 (15.6%)
University (MA)	70 (1.4%)	15 (1.2%)
Post-graduate (missing)	22 (0.4%)	8 (0.7%)

Instruments

The *Ten-Item Internet Gaming Disorder Test (IGDT-10;* Király, Sleczka, et al., 2017), is a screening instrument developed to assess IGD, as proposed in the DSM–5 (American Psychiatric Association, 2013). It contains 10 Likert scale questions with the answers on a scale of 1 to 3 (0 – *never*, 1 – *sometimes*, 2 – *often*). The instrument has not been previously adapted to Croatian and in this study, it has been translated to Croatian and localized using the back-translation method. The suitability of the translation was verified in the pilot study. The confirmatory factor analysis conducted on the IGDT-10, showed that the one-factor model fits the data well, χ^2 (35) = 128.21, $p < .001$, CFI = .987, TLI = .984, RMSEA = .046, 90% CI [.037, .055], SRMR = .035. Measurement invariance testing showed that scalar invariance was achieved for males and females, as well as for the participants aged 15–34 years *versus* those aged 35–64 years (details in the Appendix A). When determining prevalence, scores 0 and 1 were converted into 0, and score 2 was converted into 1, as defined by Király, Sleczka, et al. (2017). Items 9 and 10 (functional impairment) were seen as one item (as they both belong to the same IGD criterion), whereby scoring 1 on either of them or on both, was scored as 1 point. As described in DSM-5 (American Psychiatric Association, 2013), scoring 5 out of 9 criteria was considered indicative of an IGD diagnosis. The omega reliability (ω) of the scale was .87.

The *Mental Health Inventory-5 (MHI-5;* Berwick et al., 1991) is a short instrument for assessing mental health in adults, which has shown good psychometric properties (e.g., Strand et al., 2003; Rivera-Riquelme et al., 2019), and correlates highly with longer instruments (Strand et al., 2003). The instrument was shown to be an excellent screener for mood disorders, with AUC values above .9, sensitivity of .84 and specificity of .88 (Cuijpers et al., 2009; Ten Have et al., 2024), and a good screener for anxiety disorders (AUC = .84, sensitivity = .76, specificity = .78; Ten Have et al., 2024). It includes five questions assessing aspects of mental health during the past month. Items are answered on a 6-point scale ranging from 1 – *none of the time* to 6 – *all the time*. The instrument has not been previously adapted for use in Croatia and had to be translated into Croatian and localized using back-translation method. The understandability of translation was verified in the pilot study. Exploratory factor analysis was conducted on a randomly selected 40% of the sample, and it yielded two factors, depression and anxiety, with two items each. Item four (…*have you been a happy person?*) did not fit on any of the factors and was thus excluded. A confirmatory factor analysis was conducted on the remaining 60% of the sample, and this model fit the data well, χ^2 (1) = 5.63, $p = .018$, CFI = .999, TLI = .992, RMSEA = .043, 90% CI [.014, .080], SRMR = .006. The omega reliability (ω) was .66 for the anxiety factor and .76 for the depression factor.

Personal Well-being Index (PWI; International Wellbeing Group, 2013) is a cross-culturally valid measure of population subjective well-being. It has seven items that assess the person's satisfaction with seven life domains: personal health, personal relationships, personal safety, standard of living, community connectedness, achievement in life, and future security. PWI has been previously translated and used in numerous studies in Croatia (Kaliterna & Prizmić-Larsen, 2014). It is answered on a scale from 0 – *no satisfaction at all* to 10 – *completely*

satisfied. The one factor model achieved a satisfactory fit in this sample, χ^2 (14) = 1447.49, $p < .001$, CFI = .958, TLI = .937, RMSEA = .130; 90% CI [.124, .135], SRMR = .046 and the omega reliability (ω) of the scale was .87.

Gaming time. Respondents were asked to indicate how much time (in hours) they spent playing video games daily in the last 30 days.

Game genre preference. Participants were asked to indicate one game genre that they played the most in the last 30 days. Possible answers were: strategy games, adventures, role-playing games (RPG), first person shooter games (FPS), sport games, MOBA (multiplayer online battle arena) games, battle royale, casual games, and other game types. Participants also indicated whether they preferred to play online or offline.

Procedure

This study is part of the larger research conducted within a project (for full study protocol, see Štimac Grbić & Glavak-Tkalić, 2020). To form a representative sample of the Croatian residents aged between 15 and 64 living in private households, as Croatia does not have a population registry, the population census of Croatia was first considered (Croatian Bureau of Statistics, 2013). The census included 2,873,828 inhabitants who fit these criteria. Considering expected prevalence rates based on previous general population surveys conducted in Croatia (Glavak-Tkalić et al., 2016) and the accepted margin of error for measuring substance use, gambling, and playing video games, the research was planned to be conducted on a sample size of 5,000 respondents. Probabilistic multistage stratified sampling was used. The sample was stratified by counties and by the type of settlement (urban *versus* rural), and 42 stratums were formed. Addresses were selected randomly from each stratum, considering their population size as a percentage of the total population. Altogether 12,622 addresses which belonged to households were selected and 9,449 of them were valid. These addresses were visited by paid university students who have previously undergone training. To randomly select a participant from a household, a household member who had the most recent birthday was selected to participate in the study and filled in the questionnaire, using paper-and-pencil method. The response rate was 52.9%, which resulted in a final sample of 4,994 respondents.

Pilot Study

To verify whether participants understood the meaning of items in the instruments used in the main research, a pilot study was conducted beforehand on a non-probabilistic quota sample (N = 96). This sample included various demographic (sex, age) and socioeconomic (education, employment status) segments of the population, as well as people with substance use disorder, gambling disorder and video game addiction who were undergoing inpatient or outpatient treatment in a psychiatric hospital.

Statistical Analysis

Statistical analyses were conducted using R 4.3.1 (R Core Team, 2023) by using packages dplyr (Wickham et al., 2023), lavaan (Rosseel, 2012), survey (Lumley, 2023), psych (Revelle, 2024) and semTools (Jorgensen et al., 2022). Mplus 8.10 (Muthén & Muthén, 2023) was used to conduct the measurement invariance analyses reported in the Appendix A. Prevalence of IGD was computed using population weights. The population weights were formed according to the sex and age distribution in the population, which slightly differed from that observed in the sample. Comparison of the population values and the sample distribution by age groups for both sexes, along with weights for individual demographic contingents, is available in Štimac Grbić & Glavak-Tkalić (2020). Relationships of IGD and its criteria with mental health, and relationships of IGD with game genres were computed within structural equation models (SEM).

Ethics

The study was approved by the Ethical Board of the Croatian Public Health Institute. All participants were informed about the study, and provided their informed consent. Parental consent was sought for participants under the age of 18 years.

Results

Males and younger respondents played video games more intensively than females and older respondents (Table 2).

Table 2. *Video Game Daily Playing Time* (%).

Video game daily playing time	All video game players (*N* = 1,239)	Male (*N* = 729)	Female (*N* = 510)	Age 15–34 (*N* = 828)	Age 35–64 (*N* = 411)
< 1 hour	48.0	40.4	60.3	40.3	60.3
1–2 hours	29.4	30.2	27.9	30.3	28.0
2–3 hours	11.3	14.4	6.3	14.4	6.2
3–4 hours	5.8	7.4	3.3	7.4	3.3
4+ hours	5.5	7.6	2.2	7.6	2.2

What is the Prevalence of DSM-5 IGD in the General Population of Croatia?

To determine prevalence of IGD, we computed the IGDT-10 sum score as defined by Király, Sleczka, et al. (2017). When computing the prevalence of IGD, the population weights were used. The prevalence of IGD among the general population of Croatia was estimated at 0.48%, 95% CI [0.30%, 1%] (Table 3). Additionally, we wanted to assess the prevalence of IGD among video game players, and it was estimated at 1.63%, 95% CI [1.11%, 3%]. The highest prevalence, in both the general population and the subsample of video game players, was observed among males and younger respondents.

Table 3. *Prevalence of IGD in the General Population and Among Video Game Players, by Sex and Age Groups*.

	General population	*N*	Video game players	*N*
Total sample	0.48 [0.30, 1.00]	4,994	1.84 [1.12, 3.00]	1,239
Male	0.92 [0.57, 1.47]	2,091	2.69 [1.68, 4.30]	729
Female	0.05 [0.01, 0.18]	2,903	0.25 [0.06, 1.01]	510
15–34 years	1.11 [0.70, 1.83]	1,967	2.55 [1.58, 4.11]	828
35–64 years	0.08 [0.02, 0.33]	3,027	0.56 [0.14, 2.21]	411
Male, 15–34 years	2.10 [1.27, 3.46]	860	3.51 [2.12, 5.74]	522
Female, 15–34 years	0.12 [0.03, 0.49]	1,107	0.43 [0.10, 1.74]	306
Male, 35–64 years	0.17 [0.04, 0.68]	1,231	0.96 [0.24, 3.75]	207
Female, 35–64 years	0.00	1,796	0.00	204

The percentages of video game players who endorsed each of the criteria are shown in Table 4.

Table 4. *The Percentage of All Participants (N = 4,494) and Video Game Players (N = 1,239) Who Endorsed Each of the Criteria*.

Criterion	% endorsed among general population	% endorsed among video game players
Preoccupation	1.85	7.02
Withdrawal	0.71	2.73
Tolerance	1.61	6.17
Loss of control	0.86	3.17
Giving up other activities	0.95	3.59
Continuation	1.00	3.78
Deception	0.54	1.99
Escape	2.00	7.65
Negative consequences (either of the items)	0.78	2.32
Negative consequences related to significant relationships	0.29	1.04
Negative consequences related to work	0.49	1.89

Based on our findings, it appears that preoccupation, tolerance and escape tend to have higher estimates than the other remaining criteria and that the negative consequences criterion has a lower estimate, which is close to the prevalence of IGD among video game players. Out of 20 video game players in the sample, who have surpassed the IGD cut-off value (1.84%), 14 have also fulfilled the negative consequences criterion (1.16%). Out of 29 video game players who have fulfilled the negative consequences criterion (2.39%), 15 have not fulfilled at least four other criteria and were not classified as problematic video game players (1.13%).

How are IGD Symptoms Associated With Subjective Well-Being and Mental Health Among Video Game Players?

To answer this question, we have used structural equation modelling (SEM) as it provides the relations between latent variables which are more precise, i.e., the composites are not formed simply based on sum scores and measurement error is removed. Sum-scoring the variables creates heavily constrained parallel factor models, and this assumption rarely holds (McNeish & Wolf, 2020). We first present the table with latent correlations between the used constructs, including the control variables age and sex (Table 5). The model used to produce these correlations fit the data well according to the conventional benchmarks, WLSMV χ^2 (217) = 748.03, $p < .001$, CFI = .965, TLI = .959, RMSEA = .046, 90% CI [.042, .050], SRMR = .057.

Table 5. *Latent Correlations Between the Study Variables*.

	1	2	3	4	5	6
1. IGD	-	.34**	.14*	−.10*	−.34**	−.31**
2. Depression		-	.74**	−.56**	−.01	.10*
3. Anxiety			-	−.47**	.04	.13*
4. Subjective well-being				-	−.21**	−.03
5. Age					-	.16**
6. Sex						-

Note: Significance levels: *$p < .05$ or $p < .01$; **$p < .001$; Sex is coded as 1 = male, 2 = female

The SEM model where IGDT-10 predicts subjective well-being, anxiety and depression from MHI-5, has fit the data well according to the conventional benchmarks, WLSMV $\chi^2(183) = 556.59$, $p < .001$, CFI = .974, TLI = .970, RMSEA = .042 [.038–.046], SRMR = .053. We have tested an additional model where age and sex were used as control variables, as they may be confounders (Ballou & Zendle, 2022). This model has also fit the data well, WLSMV χ^2 (219) = 984.24, $p < .001$, CFI = .944, TLI = .946, RMSEA = .055, 90% CI [.052, .059], SRMR = .047. To provide a sensitivity analysis, we are presenting the standardized structural coefficients from both models.

Table 6. *Relationships Between IGD and Subjective Well-Being and Mental Health.*

Outcomes	Standardized structural coefficient	*p*	Standardized structural coefficient (age and sex included in the model as covariates)	*p*
Subjective well-being	−.10	.011	−.18	<.001
Anxiety	.14	.001	.19	<.001
Depression	.34	<.001	.38	<.001

The relationship observed between IGD and depression was stronger than the relationships between IGD and subjective well-being, and IGD and anxiety (Table 6). It seems that age and sex have acted as suppressor variables (Smith et al., 1992) at least to some extent, especially with regard to subjective well-being. In other words, including sex and age in the model increased the size of the relationship between gaming disorder and the outcome variables.

In a more detailed analysis, individual IGD items were related to subjective well-being, anxiety and depression in individual SEM models fitted for each IGD item. All the individual models fit the data (details in the Appendix B).

Tolerance, loss of control and withdrawal seem to have the weakest relations to subjective well-being, anxiety and depression (Table 7). Items negative consequences related to significant relationships, deception and escape have shown the strongest relations to external criteria among the IGD items.

Table 7. *Relationships Between Individual IGD Indicators and Subjective Well-Being and Mental Health*.

IGD criteria	Structural coefficient						Structural coefficient (age and sex included in the model as covariates)					
	SWB	*p*	ANX	*p*	DEP	*p*	SWB	*p*	ANX	*p*	DEP	*p*
Preoccupation	−.08	.121	.10	.077	.27	<.001	−.20	.005	.17	<.001	.33	<.001
Withdrawal	−.08	.257	.11	.159	.40	<.001	−.16	.020	.16	.052	.43	<.001
Tolerance	−.05	.319	.08	.178	.23	<.001	−.13	.018	.13	.046	.26	<.001
Loss of control	.02	.764	.07	.391	.41	<.001	−.02	.691	.09	.226	.43	<.001
Giving up other activities	−.11	.057	.07	.321	.26	<.001	−.17	.003	.09	.170	.28	<.001
Continuation	−.13	.037	.18	.013	.35	<.001	−.21	.001	.23	.002	.39	<.001
Deception	−.17	.051	.32	.001	.55	<.001	−.24	.006	.36	<.001	.59	<.001
Escape	−.13	.012	.27	<.001	.45	<.001	−.18	<.001	.29	<.001	.46	<.001
Negative consequences related to significant relationships	−.33	.001	.36	.004	.80	<.001	−.38	<.001	.39	.002	.82	<.001
Negative consequences related to work	−.03	.761	.20	.033	.47	<.001	−.13	.091	.25	.007	.51	<.001

Note: To account for multiple testing, $p < .01$ was used as the significance level. Because the IGD criteria considerably differed in their variances, only subjective well-being, anxiety and depression were standardized to enable a fairer comparison between the criteria. Thus, the structural coefficients for a specific IGD criterion can be interpreted as a standardized change in subjective well-being, anxiety or depression which corresponds to a change of one unit in the original scale of the IGD criterion.

How are Game Genres Associated With IGD Symptoms?

All genres except casual games were mostly played by younger males (Table 8).

Table 8. *Game Genres Distributed Over Sex and Age Groups (%).*

Genre (*N*)	Male	Female	Age = 15–34	Age = 35–64
RPG (*N* = 51)	80.4	19.6	74.5	25.5
Strategic (*N* = 116)	81.9	18.1	66.4	33.6
Adventure (*N* = 90)	65.6	34.4	87.8	12.2
FPS (*N* = 81)	86.4	13.6	80.0	20.0
Sports (*N* = 138)	92.0	8.0	84.8	15.2
MOBA (*N* = 46)	91.3	8.7	93.4	6.5
Battle royale (*N* = 52)	75.0	25.0	94.2	5.8
Casual (*N* = 348)	27.3	72.7	43.7	56.3

In two more SEM models the video game genres were entered as predictors of IGD (Table 9), using sex and age as covariates. In the first model, predictors were genres predominantly played by the video game players, and the genre role playing games (RPG) was used as the reference genre, as different studies have reported higher IGD scores for players of offline and online role-playing games (Entwistle et al., 2020). The model fit the data well, WLSMV χ^2 (116) = 231.84, $p < .001$, CFI = .973, TLI = .990, RMSEA = .033, 90% CI [.027, .039], SRMR = .053.

Only players playing Sport games and Casual games had significantly lower IGD scores than players playing RPG games.

Since we measured whether the preferred game genre was played online or offline, in the second model we divided the games into online, offline and casual games, using online games as the reference category. We kept the casual games as a separate category because a) 37.7% players in the sample played casual games, b) because they have somewhat different characteristics than other video game genres; they are easy to learn and to play and do not require a large time investment or previous special video game skills (Russoniello et al., 2009), and c) because in gaming journalism and culture there has for a long time existed a divide between "hardcore" and "casual" games, with the latter being extremely popular nowadays, but underrepresented in academic research (Chess & Paul, 2019). The model showed a good fit, WLSMV χ^2 (71) = 174.88, $p < .001$, CFI = .974, TLI = .984, RMSEA = .041, 90% CI [.034, .049], SRMR = .052. Primarily offline video game players did not significantly differ in their IGD scores from players who predominantly played online games ($b = .002$, $p = .980$), whereas players who played casual games had lower IGD scores than those who played both online ($b = -.663$, $p < .001$) and offline games ($b = -.661$, $p < .001$; this was computed in a second model with casual games as the reference category).

Table 9. *Structural Coefficients From Game Genres Predicting IGD.*

Game genre	Structural coefficients	*p*
Strategic	−.17	.297
Adventure	−.31	.071
First-person shooter	−.34	.044
Sports	−.64	<.001
MOBA	−.46	.012
Battle royale	−.49	.013
Casual	−1.0	<.001

Note. To account for multiple testing, $p < .01$ was used as the significance level. Because the genre variables were binary, unstandardized coefficients were used, but the IGD latent variable was standardized to ease interpretation. Thus, a b_1 structural coefficient for a specific genre can be interpreted as a difference in standard deviations of the IGD latent variable which corresponds to playing a specific genre versus primarily playing RPG's. Values below 0 indicate that players of a particular genre had lower IGD scores than RPG players.

Discussion

The prevalence of the IGD among the general population of Croatia, aged 15–64, was estimated at 0.48%, which is lower than the worldwide prevalence of gaming disorder estimated when taking into account only studies using more restrictive sampling criteria, as is demonstrated by the prevalence estimates of 1.96% reported by Stevens et al. (2020) and 1.4% reported by H. S. Kim et al. (2022), obtained from their meta-analytic studies. Our prevalence rates were lower than those reported in previous studies; this is probably because we used the sample representative of the entire population, while other studies often used samples representative of adolescents or young adults. In our study we also delineated the prevalence estimate for the general population from the prevalence estimate for video game players only. Most studies, especially those that employed convenience samples of video game players, would report only on the prevalence of IGD among video game players. Moreover, sometimes the prevalence in the general population is cited, but the results are actually from studies conducted on video game players. In the current study a considerably higher rate of IGD was found among young adults (aged 15 to 34) with the prevalence rate of 1.1%, than among older adults (aged 35 to 64) with the prevalence rate of only 0.08%. The prevalence of IGD was higher among males than females (0.92% and 0.05%, respectively), as expected based on previous research. For example, Stevens et al. (2020) found that gaming disorder rates were approximately 2.5:1 in favor of males compared to females.

The prevalence of IGD among video game players was estimated at 1.63%. The highest rates of IGD were found among young adult male video game players, and the prevalence rate of IGD in the age group 15 to 34 years was 3.51%. Prevalence of IGD among video game players was logically higher than the one in the general population which includes non-players, but nevertheless, the disorder still affects a small minority of players. Since we found that a considerable percentage of video game players in our sample played multiple hours every day, most of them could actually be highly engaged rather than problematic gamers (Billieux et al., 2019).

Expectedly, IGD has shown the strongest relationship with depression in a relative sense, followed by anxiety and well-being, suggesting that IGD is possibly a coping mechanism to alleviate psychosocial problems and dysphoric moods (Kardefelt-Winther, 2014a). Furthermore, our study confirms a relatively small relationship with well-being obtained in previous studies (Cheng et al., 2018; Przybylski et al., 2017). It is unusual that IGD was not related to well-being more strongly, especially since it is expected to cause problems in one's everyday life, which is likely to lower well-being. This finding should be further explored in clinical studies including persons diagnosed with IGD. The relationship to anxiety was rather low as well and it seems that anxiety does not play a large role in gaming disorder. This finding was previously shown in other studies (Männikkö et al., 2020) but was now for the first time demonstrated on a representative sample.

Among individual criteria, tolerance, loss of control and withdrawal had the weakest relations to depression, anxiety and subjective well-being. Tolerance was also one of the most reported criteria in the sample. Tolerance and withdrawal have already been criticized as criteria adopted from addiction research and not apt to assess IGD (Kardefelt-Winther, 2014b; Castro-Calvo et al., 2021; Razum et al., 2023). Evidence coming from the current study provides more information in this direction. Tolerance and withdrawal may indicate highly engaged gaming, as increases in gaming time and irritability when gaming is taken away may also be present in competitive gamers. Larrieu et al. (2023) have found that the cluster of competitive gamers had better mental health and higher scores on protective factors for problematic gaming than other clusters of gamers they analyzed in their study. Conversely, the items negative consequences related to significant relationships, deception and escape have shown the strongest relationships to the external criteria, which indicates the importance of negative consequences as a criterion for IGD (Colder Carras & Kardefelt-Winther, 2018; King & Delfabbro, 2018). Negative consequences were also the least frequently endorsed criteria in our sample. Escape has been previously criticized as a criterion (e.g., Castro-Calvo et al., 2021; Kardefelt-Winther, 2015b), but in their individual participant meta-analysis, Ballou and Zendle (2022) have found that of all IGD criteria, the escape criterion is most strongly related to distress. According to the authors, this could be explained by a potential confound, and endorsing escape may reflect the presence of emotional difficulties in a person. The explanation seems plausible as escape was also the most frequently endorsed criterion in our sample. Conversely, escapism could also be the culprit. In a study by Larrieu et al. (2023), the cluster of "escapers" had the lowest physical and psychological health and highest IGD symptoms. Quantitative studies (Allen & Anderson, 2018; Jouhki et al., 2024) and recent qualitative studies (Monley et al., 2024; Razum & Huić, 2023) stress that playing video games to escape from unmet or thwarted psychological needs and to then fulfil these needs within video games is maladaptive. Giardina et al. (2024) differentiate between *active escapism*, which does not have to be maladaptive, and where gamers are taking advantage of the stimulative

environment of video games to compensate for life struggles and the more extreme *escape*, where gamers play to avoid the rejected physical environment.

When considering game genres, as expected, all genres except casual games were mostly played by young adult males. The most prevalent game genres among the general population were casual, sports, strategic, and adventure. Our study is among the first that includes both sports games and casual games, which have been neglected in the study of the relationship between game genres and IGD despite their prevalence. Casual games were the only game genre played more by females than males. As well as with sports games, players who played casual games had significantly lower IGD scores than those playing RPG games. Furthermore, casual video game players had lower IGD scores than those who played both online and offline games. A possible reason is that casual games are usually less time-consuming, simpler, and require less engagement compared to other more complex games, such as strategic, MOBA etc. (Chess & Paul, 2019). Lemmens and Hendricks (2016) have found in their study that casual games and sports games were related to IGD, but their relationship was smaller than that of other genres. We could assume that casual games and sports games could be played with other motives than other types of games (e.g., RPG, MOBA), and that these games could be a less likely choice for those who use games to escape from life problems. Liao et al. (2023) have found that "brain and skills games" players were, when compared to action and shooter games, strategy and RPG players, least likely to endorse the escapism motive and most likely to endorse the "passing time" motive. Further representative studies should comprehensively compare different genres based on predominant motives for playing and the resulting risk for IGD. The field would also benefit from using a more standardized and comprehensive classification of gaming genres. All other genres besides sport games did not differ in their IGD scores. This provides two important insights. Firstly, playing sport games and casual games incurs less risk for IGD than playing other genres. Secondly, all other genres that were included in our study (strategic games, first person shooters, MOBA, battle royale, RPG games), did not differ among each other in the amount of risk for IGD. These results bring novel insights to previous literature, where certain genres, such as first-person shooters, MOBA and role-playing games, were found to put players at a higher risk of developing IGD (Rehbein et al., 2021). It may be that in fact genres such as sport games and casual games incur less risk, and all other genres pose a similar amount of risk. Another relevant finding is that online games do not seem to pose a greater risk for IGD than offline games. From previous studies it seems that time spent playing online games has a higher correlation with IGD than time spent playing offline games (Lemmens & Hendricks, 2016) and that online gamers have higher IGD scores than offline gamers (Montag et al., 2021). However, the authors admit that these effects are small (Montag et al., 2021) and we conducted our study on a representative sample, which should have given more correct estimates. Further studies are needed, preferably on clinical samples, to elucidate whether there are differences between predominantly online and offline gamers with IGD.

Based on the results of this research, we can conclude that IGD had a relatively low prevalence among the general population as well as among video game players. The results suggest that IGD is most related to depression, and less related to anxiety and well-being. Not all IGD criteria are equally relevant, because some have stronger relationships to mental health, in particular negative consequences related to significant relationships. Casual games and sports games were found to incur less risk for IGD, and other genres did not differ in their risk. Online and offline games posed the same amount of risk. The study results may be used as a basis for planning public health policies and interventions.

Strengths and Limitations

This study is one of the rare studies conducted on a large nationally representative sample of heterogeneous respondents, which increases the generalizability of findings, however, it has certain limitations. Only individuals living in private households were included in the study, possibly excluding individuals for which a higher prevalence of IGD might be expected (e.g., students living on campus, persons in correctional facilities). The formation of a representative sample via private households can also be seen as an advantage, as other population representative surveys with IGD were often formed with online panels (e.g., Haagsma et al., 2012), which restricts the study participants to panel members. Participants who take part in the panels run by market research companies could be more inclined to use technologies such as video games than other members of the general population. Furthermore, the study was conducted among the respondents aged 15–64, and it is possible that higher prevalence of IGD could be found among respondents younger than 15, increasing the prevalence for the general population. The study was cross-sectional, and we cannot conclude about the direction of relationships between IGD and other variables. The study was conducted in 2019, and since the COVID-19

pandemic and lockdown in 2020 altered online behavior for many people, the results might differ if the research was conducted today. However, a systematic review has found that there is no clear evidence of an increase in IGD during the pandemic (Gopali et al., 2023). Despite the mentioned limitations, this is one of the rare studies of IGD conducted among the general population and using the DSM-5 criteria for IGD.

Conflict of Interest

The authors have no conflicts of interest to declare.

Authors' Contribution

Josip Razum: conceptualization, data curation, formal analysis, writing – original draft, writing – reviewing & editing. **Renata Glavak-Tkalić:** conceptualization, data curation, funding acquisition, investigation, methodology, project administration, supervision, writing – original draft, writing – reviewing & editing.

Acknowledgement

The data has been collected within a larger study conducted in collaboration of Ivo Pilar Institute of Social Sciences with Croatian Public Health Institute under the project "Substance use among the general population in Croatia" (Ref. No. 05/2-73/19-1627/1084).

Statement on the Use of AI Services

The authors declare they have not used any AI services to generate or edit any part of the manuscript or data.

References

Aarseth, E., Bean, A. M., Boonen, H., Colder Carras, M., Coulson, M., Das, D., Deleuze, J., Dunkels, E., Edman, J., Ferguson, C. J., Haagsma, M. C., Helmersson Bergmark, K., Hussain, Z., Jansz, J., Kardefelt-Winther, D., Kutner, L., Markey, P., Nielsen, R. K. L., Prause, N., … Van Rooij, A. J. (2017). Scholars' open debate paper on the World Health Organization ICD-11 Gaming Disorder proposal. *Journal of Behavioral Addictions*, *6*(3), 267–270. https://doi.org/10.1556/2006.5.2016.088

Allen, J. J., & Anderson, C. A. (2018). Satisfaction and frustration of basic psychological needs in the real world and in video games predict internet gaming disorder scores and well-being. *Computers in Human Behavior*, *84*, 220–229. https://doi.org/10.1016/j.chb.2018.02.034

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). American Psychiatric Association.

Apperley, T. H. (2006). Genre and game studies: Toward a critical approach to video game genres. *Simulation & Gaming, 37*(1), 6–23. https://doi.org/10.1177/1046878105282278

Ballou, N., & Zendle, D. (2022). "Clinically significant distress" in Internet Gaming Disorder: An individual participant meta-analysis. *Computers in Human Behavior*, *129*, Article 107140. https://doi.org/10.1016/j.chb.2021.107140

Berwick, D. M., Murphy, J. M., Goldman, P. A., Ware, J. E., Barsky, A. J., & Weinstein, M. C. (1991). Performance of a five-item mental health screening test. *Medical Care*, 169–176. https://doi.org/10.1097/00005650-199102000-00008

Billieux, J., Flayelle, M., & King, D. L. (2022). Addiction: Expand diagnostic borders with care. *Nature, 611*, Article 665. https://doi.org/10.1038/d41586-022-03760-y.

Billieux, J., Flayelle, M., Rumpf, H. J., & Stein, D. J. (2019). High involvement versus pathological involvement in video games: A crucial distinction for ensuring the validity and utility of gaming disorder. *Current Addiction Reports, 6*, 323–330. https://doi.org/10.1007/s40429-019-00259-x

Billieux, J., Schimmenti, A., Khazaal, Y., Maurage, P., & Heeren, A. (2015). Are we overpathologizing everyday life? A tenable blueprint for behavioral addiction research. *Journal of Behavioral Addictions, 4*(3), 119–123. https://doi.org/10.1556/2006.4.2015.009

Brand, M., Rumpf, H.-J., King, D. L., Potenza, M. N., Wegmann, E. (2020). Clarifying terminologies in research on gaming disorder and other addictive behaviors: Distinctions between core symptoms and underlying psychological processes. *Current Opinion in Psychology, 36*, 49–54. https://doi.org/10.1016/j.copsyc.2020.04.006.

Brunborg, G. S., Hanss, D., Mentzoni, R. A., & Pallesen, S. (2015). Core and peripheral criteria of video game addiction in the game addiction scale for adolescents. *Cyberpsychology, Behavior, and Social Networking*, *18*(5), 280–285. https://doi.org/10.1089/cyber.2014.0509

Castro-Calvo, J., King, D. L., Stein, D. J., Brand, M., Carmi, L., Chamberlain, S. R., Demetrovics, Z., Fineberg, N. A., Rumpf, H., Yücel, M., Achab, S., Ambekar, A., Bahar, N., Blaszczynski, A., Bowden-Jones, H., Carbonell, X., Chan, E. M., Ko, C., Timary, P., … Billieux, J. (2021). Expert appraisal of criteria for assessing gaming disorder: An international Delphi study. *Addiction, 116*(9), 2463–2475. https://doi.org/10.1111/add.15411

Cheng, C., Cheung, M. W.-L., & Wang, H.-y. (2018). Multinational comparison of internet gaming disorder and psychosocial problems versus well-being: Meta-analysis of 20 countries. *Computers in Human Behavior*, *88*, 153–167. https://doi.org/10.1016/j.chb.2018.06.033

Chess, S., & Paul, C. A. (2019). The end of casual: Long live casual. *Games and Culture*, *14*(2), 107–118. https://doi.org/10.1177/1555412018786652

Colder Carras, M., & Kardefelt-Winther, D. (2018). When addiction symptoms and life problems diverge: A latent class analysis of problematic gaming in a representative multinational sample of European adolescents. *European Child & Adolescent Psychiatry, 27*(4), 513–525. https://doi.org/10.1007/s00787-018-1108-1

Croatian Bureau of Statistics. (2013). *Census of population, households and dwellings 2011, population by sex and age.* https://web.dzs.hr/Hrv_Eng/publication/2012/SI-1468.pdf

Cuijpers, P., Smits, N., Donker, T., ten Have, M., & de Graaf, R. (2009). Screening for mood and anxiety disorders with the five-item, the three-item, and the two-item Mental Health Inventory. *Psychiatry Research, 168*(3), 250–255. https://doi.org/10.1016/j.psychres.2008.05.012

Darvesh, N., Radhakrishnan, A., Lachance, C. C., Nincic, V., Sharpe, J. P., Ghassemi, M., Straus, S. E., & Tricco, A. C. (2020). Exploring the prevalence of gaming disorder and Internet gaming disorder: A rapid scoping review. *Systematic Reviews, 9*(1), Article 68. https://doi.org/10.1186/s13643-020-01329-2

Duval, S., & Tweedie, R. (2000). A nonparametric "Trim and Fill" method of accounting for publication bias in meta-analysis. *Journal of the American Statistical Association, 95*(449), 89–98. https://doi.org/10.1080/01621459.2000.10473905

Entwistle, G. J. M., Blaszczynski, A., & Gainsbury, S. M. (2020). Are video games intrinsically addictive? An international online survey. *Computers in Human Behavior*, *112*, Article 106464. https://doi.org/10.1016/j.chb.2020.106464

Festl, R., Scharkow, M., & Quandt, T. (2013). Problematic computer game use among adolescents, younger and older adults. *Addiction*, *108*(3), 592–599. https://doi.org/10.1111/add.12016

Giardina, A., Schimmenti, A., Starcevic, V., King, D. L., Di Blasi, M., & Billieux, J. (2024). Problematic gaming, social withdrawal, and escapism: The Compensatory-Dissociative Online Gaming (C-DOG) model. *Computers in Human Behavior*, *155*, Article 108187. https://doi.org/10.1016/j.chb.2024.108187

Glavak-Tkalić, R., Miletić, G.-M., Maričić, J. (2016). *Uporaba sredstava ovisnosti u hrvatskom društvu: istraživanje na općoj populaciji.* [Substance use in the Croatian society: Research among the general population]. Ivo Pilar Institute of Social Sciences & Office for Combating Drug Abuse of the Government of the Republic of Croatia. https://www.pilar.hr/wp-content/uploads/2018/01/Elaborat_2015.pdf

Gopali, L., Dhital, R., Koirala, R., Shrestha, T., Bhusal, S., Rimal, R., Shrestha, C., & Shah, R. (2023). Effect of COVID-19 pandemic on internet gaming disorder among general population: A systematic review and meta-analysis. *PLOS Global Public Health*, *3*(4), Article e0001783. https://doi.org/10.1371/journal.pgph.0001783

Granic, I., Lobel, A., & Engels, R. C. M. E. (2014). The benefits of playing video games. *American Psychologist*, *69*(1), 66–78. https://doi.org/10.1037/a0034857

Griffiths, M. D., Kuss, D. J., Lopez-Fernandez, O., & Pontes, H. M. (2017). Problematic gaming exists and is an example of disordered gaming: Commentary on: Scholars' open debate paper on the World Health Organization ICD-11 Gaming Disorder proposal (Aarseth et al.). *Journal of Behavioral Addictions*, *6*(3), 296–301. https://doi.org/10.1556/2006.6.2017.037

Haagsma, M. C., Pieterse, M. E., & Peters, O. (2012). The prevalence of problematic video gamers in the Netherlands. *Cyberpsychology, Behavior, and Social Networking*, *15*(3), 162–168. https://doi.org/10.1089/cyber.2011.0248

Halbrook, Y. J., O'Donnell, A. T., & Msetfi, R. M. (2019). When and how video games can be good: A review of the positive effects of video games on well-being. *Perspectives on Psychological Science*, *14*(6), 1096–1104. https://doi.org/10.1177/1745691619863807

International Wellbeing Group. (2013). *Personal wellbeing index: 5th edition.* Australian Centre on Quality of Life, Deakin University.

Jorgensen, T. D., Pornprasertmanit, S., Schoemann, A. M., & Rosseel, Y. (2022). semTools: Useful tools for structural equation modeling. R package version 0.5-6. https://CRAN.R-project.org/package=semTools

Jouhki, H., Savolainen, I., Hagfors, H., Vuorinen, I., & Oksanen, A. (2024). What are escapists made of, and what does it have to do with excessive gambling and gaming? *International Journal of Mental Health and Addiction.* Advance online publication. https://doi.org/10.1007/s11469-024-01394-x

Kaliterna, Lj., & Prizmic-Larsen, Z. (2014). Personal Wellbeing Index in Croatia. In A. C. Michalos (Ed.), *Encyclopedia of quality of life and well-being research* (pp. 1351–1354). Springer. https://doi.org/10.1007/978-94-007-0753-5_3995

Kardefelt-Winther, D. (2014a). A conceptual and methodological critique of internet addiction research: Towards a model of compensatory internet use. *Computers in Human Behavior, 31*, 351–354. https://doi.org/10.1016/j.chb.2013.10.059

Kardefelt-Winther, D. (2014b). A critical account of DSM-5 criteria for internet gaming disorder. *Addiction Research & Theory*, *23*(2), 93–98. https://doi.org/10.3109/16066359.2014.935350

King, D. L., & Delfabbro, P. H. (2018). The concept of "harm" in internet gaming disorder. *Journal of Behavioral Addictions*, *7*(3), 562–564. https://doi.org/10.1556/2006.7.2018.24

King, D. L., Chamberlain, S. R., Carragher, N., Billieux, J., Stein, D., Mueller, K., Potenza, M. N., Rumpf, H. J., Saunders, J., Starcevic, V., Demetrovics, Z., Brand, M., Lee, H. K., Spada, M., Lindenberg, K., Wu, A. M. S., Lemenager, T., Pallesen, S., Achab, S., … Delfabbro, P. H. (2020). Screening and assessment tools for gaming disorder: A comprehensive systematic review. *Clinical Psychology Review*, *77*, Article 101831. https://doi.org/10.1016/j.cpr.2020.101831

Kim, D. J., Kim, K., Lee, H.-W., Hong, J.-P., Cho, M. J., Fava, M., Mischoulon, D., Heo, J.-Y., & Jeon, H. J. (2017). Internet game addiction, depression, and escape from negative emotions in adulthood: A nationwide community sample of Korea. *Journal of Nervous & Mental Disease*, *205*(7), 568–573. https://doi.org/10.1097/NMD.0000000000000698

Kim, H. S., Son, G., Roh, E.-B., Ahn, W.-Y., Kim, J., Shin, S.-H., Chey, J., & Choi, K.-H. (2022). Prevalence of gaming disorder: A meta-analysis. *Addictive Behaviors*, *126*, Article 107183. https://doi.org/10.1016/j.addbeh.2021.107183

Király, O., Tóth, D., Urbán, R., Demetrovics, Z., & Maraz, A. (2017). Intense video gaming is not essentially problematic. *Psychology of Addictive Behaviors, 31*(7), 807–817. https://doi.org/10.1037/adb0000316

Király, O., Sleczka, P., Pontes, H. M., Urbán, R., Griffiths, M. D., & Demetrovics, Z. (2017). Validation of the ten-item Internet Gaming Disorder Test (IGDT-10) and evaluation of the nine DSM-5 Internet Gaming Disorder criteria. *Addictive Behaviors*, *64*, 253–260. https://doi.org/10.1016/j.addbeh.2015.11.005

Kuss, D. J., Griffiths, M. D., & Pontes, H. M. (2017). Chaos and confusion in DSM-5 diagnosis of Internet Gaming Disorder: Issues, concerns, and recommendations for clarity in the field. *Journal of Behavioral Addictions*, *6*(2), 103–109. https://doi.org/10.1556/2006.5.2016.062

Laconi, S., Pirès, S., & Chabrol, H. (2017). Internet gaming disorder, motives, game genres and psychopathology. *Computers in Human Behavior, 75*, 652–659. https://doi.org/10.1016/j.chb.2017.06.012

Larrieu, M., Fombouchet, Y., Billieux, J., & Decamps, G. (2023). How gaming motives affect the reciprocal relationships between video game use and quality of life: A prospective study using objective playtime indicators. *Computers in Human Behavior*, *147*, Article 107824. https://doi.org/10.1016/j.chb.2023.107824

Lemmens, J. S., & Hendriks, S. J. F. (2016). Addictive online games: Examining the relationship between game genres and internet gaming disorder. *Cyberpsychology, Behavior, and Social Networking, 19*(4), 270–276. https://doi.org/10.1089/cyber.2015.0415

Liao, Z., Chen, X., Huang, S., Huang, Q., Lin, S., Li, Y., Tang, Y., & Shen, H. (2023). Exploring the associated characteristics of internet gaming disorder from the perspective of various game genres. *Frontiers in Psychiatry, 13*, Article 1103816. https://doi.org/10.3389/fpsyt.2022.1103816

Lumley, T. (2023). survey: Analysis of complex survey samples. R package version 4.2. https://cran.r-project.org/web/packages/survey/survey.pdf

CMännikkö, N., Ruotsalainen, H., Miettunen, J., Pontes, H. M., & Kääriäinen, M. (2020). Problematic gaming behaviour and health-related outcomes: A systematic review and meta-analysis. *Journal of Health Psychology*, *25*(1), 67–81. https://doi.org/10.1177/1359105317740414

Mathews, C. L., Morrell, H. E., & Molle, J. E. (2019). Video game addiction, ADHD symptomatology, and video game reinforcement. *The American Journal of Drug and Alcohol Abuse*, *45*(1), 67–76. https://doi.org/10.1080/00952990.2018.1472269

Mentzoni, R. A., Brunborg, G. S., Molde, H., Myrseth, H., Skouverøe, K. J. M., Hetland, J., & Pallesen, S. (2011). Problematic video game use: Estimated prevalence and associations with mental and physical health. *Cyberpsychology, Behavior, and Social Networking*, *14*(10), 591–596. https://doi.org/10.1089/cyber.2010.0260

McNeish, D., & Wolf, M. G. (2020). Thinking twice about sum scores. *Behavior Research Methods*, *52*(6), 2287–2305. https://doi.org/10.3758/s13428-020-01398-0

Monley, C. M., Liese, B. S., & Oberleitner, L. M. (2024). Gamers' and non-gamers' perspectives on the development of problematic video game play. *Current Psychology*, *43*(1), 552–561. https://doi.org/10.1007/s12144-023-04278-w

Montag, C., Schivinski, B., & Pontes, H. M. (2021). Is the proposed distinction of gaming disorder into a predominantly online vs. offline form meaningful? Empirical evidence from a large German speaking gamer sample. *Addictive Behaviors Reports*, *14*, Article 100391. https://doi.org/10.1016/j.abrep.2021.100391

Müller, K. W., Glaesmer, H., Brähler, E., Woelfling, K., & Beutel, M. E. (2014). Prevalence of internet addiction in the general population: Results from a German population-based survey. *Behaviour & Information Technology*, *33*(7), 757–766. https://doi.org/10.1080/0144929X.2013.810778

Muller, P., Caliandro, C., Peycheva, V., Gagliardi, D., Marzocchi, C., Ramlogan, R., & Cox, D. (2015). Regular gaming behavior and internet gaming disorder in European adolescents: Results from a cross-national representative survey of prevalence, predictors, and psychopathological correlates. *European Child & Adolescent Psychiatry, 24*(5), 565-574. https://doi.org/10.1007/s00787-014-0611-2

Muthén, L. K., & Muthén, B. O. (2023). *Mplus user's guide.* https://www.statmodel.com/html_ug.shtml

Na, E., Choi, I., Lee, T.-H., Lee, H., Rho, M. J., Cho, H., Jung, D. J., & Kim, D.-J. (2017). The influence of game genre on internet gaming disorder. *Journal of Behavioral Addictions, 6*(2), 248–255. https://doi.org/10.1556/2006.6.2017.033

Ostinelli, E. G., Zangani, C., Giordano, B., Maestri, D., Gambini, O., D'Agostino, A., Furukawa, T. A., & Purgato, M. (2021). Depressive symptoms and depression in individuals with internet gaming disorder: A systematic review and meta-analysis. *Journal of Affective Disorders*, *284*, 136–142. https://doi.org/10.1016/j.jad.2021.02.014

Petry, N. M. (2011). Commentary on Van Rooij et al. (2011): 'Gaming addiction' – a psychiatric disorder or not? *Addiction*, *106*(1), 213–214. https://doi.org/10.1111/j.1360-0443.2010.03132.x

Pontes, H. M., Schivinski, B., Kannen, C., & Montag, C. (2022). The interplay between time spent gaming and disordered gaming: A large-scale world-wide study. *Social Science & Medicine*, *296*, Article 114721. https://doi.org/10.1016/j.socscimed.2022.114721

Przybylski, A. K., Weinstein, N., & Murayama, K. (2017). Internet gaming disorder: Investigating the clinical relevance of a new phenomenon. *American Journal of Psychiatry*, *174*(3), 230–236. https://doi.org/10.1176/appi.ajp.2016.16020224

R Core Team. (2023). *R: A Language and environment for statistical computing.* R Foundation for Statistical Computing, Vienna, Austria. https://www.R-project.org/

Razum, J., Baumgartner, B., & Glavak-Tkalić, R. (2023). Psychometric validity and the appropriateness of tolerance as a criterion for internet gaming disorder: A systematic review. *Clinical Psychology Review, 101,* Article 102256. https://doi.org/10.1016/j.cpr.2023.102256

Razum, J., & Huić, A. (2023). Understanding highly engaged adolescent gamers: Integration of gaming into daily life and motivation to play video games. *Behaviour & Information Technology*, *43*(11), 2566–2588. https://doi.org/10.1080/0144929X.2023.2254856

Reed, G. M., First, M. B., Billieux, J., Cloitre, M., Briken, P., Achab, S., Brewin, C. R., King, D. L., Kraus, S. W., Bryant, R. A. (2022). Emerging experience with selected new categories in the ICD-11: Complex PTSD, prolonged grief disorder, gaming disorder, and compulsive sexual behaviour disorder. *World Psychiatry, 21*(2), 189–213. https://doi.org/10.1002/wps.20960

Rehbein, F., King, D. L., Staudt, A., Hayer, T., & Rumpf, H. J. (2021). Contribution of game genre and structural game characteristics to the risk of problem gaming and gaming disorder: A systematic review. *Current Addiction Reports*, *8*(2), 263–281. https://doi.org/10.1007/s40429-021-00367-7

Revelle, W. (2024). _psych: Procedures for Psychological, Psychometric, and Personality Research_. Northwestern University, Evanston, Illinois. R package version 2.4.1. https://CRAN.R-project.org/package=psych

Rivera-Riquelme, M., Piqueras, J. A., & Cuijpers, P. (2019). The Revised Mental Health Inventory-5 (MHI-5) as an ultra-brief screening measure of bidimensional mental health in children and adolescents. *Psychiatry Research*, *274*, 247–253. https://doi.org/10.1016/j.psychres.2019.02.045

Rosseel, Y. (2012). lavaan: An R Package for Structural Equation Modeling. *Journal of Statistical Software, 48*(2), 1–36. https://doi.org/10.18637/jss.v048.i02

Rumpf, H.-J., Brandt, D., Demetrovics, Z., Billieux, J., Carragher, N., Brand, M., Bowden-Jones, H., Rahimi-Movaghar, A., Assanangkornchai, S., Glavak-Tkalic, R., Borges, G., Lee, H.-K., Rehbein, F., Fineberg, N. A., Mann, K., Potenza, M. N., Stein, D. J., Higuchi, S., King, D., … Poznyak, V. (2019). Epidemiological challenges in the study of behavioral addictions: A call for high standard methodologies. *Current Addiction Reports*, *6*(3), 331–337. https://doi.org/10.1007/s40429-019-00262-2

Russoniello, C. V., O'Brien, K., & Parks, J. M. (2009). The effectiveness of casual video games in improving mood and decreasing stress. *Journal of Cybertherapy and Rehabilitation, 2*(1), 53–66. https://psycnet.apa.org/record/2009-11993-007

Shiue, I. (2015). Self and environmental exposures to drinking, smoking, gambling or video game addiction are associated with adult hypertension, heart and cerebrovascular diseases, allergy, self-rated health and happiness: Japanese General Social Survey, 2010. *International Journal of Cardiology*, *181*, 403–412. https://doi.org/10.1016/j.ijcard.2014.12.071

Smith, R. L., Ager, J. W., & Williams, D. L. (1992). Suppressor variables in multiple regression/correlation. *Educational and Psychological Measurement*, *52*(1), 17–29. https://doi.org/10.1177/001316449205200102

Stevens, M. W., Dorstyn, D., Delfabbro, P. H., & King, D. L. (2020). Global prevalence of gaming disorder: A systematic review and meta-analysis. *Australian & New Zealand Journal of Psychiatry*, *55*(6), 553–568. https://doi.org/10.1177/0004867420962851

Strand, B. H., Dalgard, O. S., Tambs, K., & Rognerud, M. (2003). Measuring the mental health status of the Norwegian population: A comparison of the instruments SCL-25, SCL-10, SCL-5 and MHI-5 (SF-36). *Nordic Journal of Psychiatry*, *57*(2), 113–118. https://doi.org/10.1080/08039480310000932

Štimac Grbić, D. & Glavak Tkalić, R. (Eds.). (2020). *Uporaba sredstava ovisnosti u općoj populaciji Republike Hrvatske: 2019. I analiza trendova uporabe 2011–2019*. [Use of addictive substances in the general population of the Republic of Croatia: 2019 and analysis of usage trends 2011–2019]. Croatian Public Health Institute and Ivo Pilar Institute of Social Sciences. https://www.hzjz.hr/wp-content/uploads/2021/03/Publikacija_GPS_HZJZ.pdf

Ten Have, M., Van Bon-Martens, M. J. H., Schouten, F., Van Dorsselaer, S., Shields-Zeeman, L., & Luik, A. I. (2024). Validity of the five-item mental health inventory for screening current mood and anxiety disorders in the general population. *International Journal of Methods in Psychiatric Research*, *33*(3), Article e2030. https://doi.org/10.1002/mpr.2030

Wickham, H., François, R., Henry, L., Müller, K., & Vaughan, D. (2023). dplyr: A Grammar of Data Manipulation. R package version 1.1.4. https://CRAN.R-project.org/package=dplyr

Wittek, C. T., Finserås, T. R., Pallesen, S., Mentzoni, R. A., Hanss, D., Griffiths, M. D., & Molde, H. (2016). Prevalence and predictors of video game addiction: A study based on a national representative sample of gamers. *International Journal of Mental Health and Addiction*, *14*, 672–686. https://doi.org/10.1007/s11469-015-9592-8

World Health Organization (WHO). (2019). *Gaming disorder* (6C51). https://icd.who.int/browse11/l-m/en#/http://id.who.int/icd/entity/1448597234

Appendices

Appendix A: Factor Structure of IGDT-10 and Measurement Invariance Across Sex and Age Groups

Confirmatory factor analysis was conducted on the 10 items of the IGDT-10 scale. Since the item distribution was shown to be very skewed and the items were not measured on a continuous scale, similarly as in previous IGDT-10 validation studies (Király, Sleczka, et al., 2017; Király et al., 2019), items were treated as ordered categorical and the WLSMV estimator was used in estimating the model. As missing data were extremely scarce (0.3%), they were ignored listwise.

The model has shown to have a good fit to the data according to the commonly used fit indicators ($\chi^2(35) = 128.21$, $p < .001$, CFI = .987, TLI = .984, RMSEA = .046 (90% CI = .038, .055), SRMR = .035). The model fit the data in separate male and female subsamples, as well as in different age group subsamples: 15–34 and 35–64 years old. We proceeded to test for measurement invariance and followed the recommendations for invariance testing with ordered categorical variables by Svetina and associates (2020). We considered the fact that IGDT-10 items are ordered categorical variables with three or less categories where metric invariance cannot be tested because factor loadings alone cannot be constrained to be equal across groups (Muthén & Muthén, 2013). All models were created and tested by using the Mplus 8.10 (Muthén & Muthén, 2023) statistical software. We tested a model where factor loadings and thresholds were freely estimated across groups (configural invariance) and compared the fit of this model to the model with thresholds and loadings constrained across groups, which corresponds to scalar invariance in continuous variable models. The model achieved scalar invariance for males and females and between the two main age groups: 15–34 and 35–64 years old. The changes in CFI and RMSEA did not surpass the benchmarks set by Chen (2007), where a change of ≥ .01 in the CFI and a change of ≥ .015 in the RMSEA points out to non-invariance and were in accordance with other benchmarks as well (e.g., Svetina et al., 2020). The omega reliability (ω) of the scale was .87.

Table A1. *Model Fit Across Different Sex and Age Groups and Measurement Invariance Testing*.

	WLSMV χ^2 (*df*)	RMSEA	CFI	TLI	SRMR	ΔCFI	ΔRMSEA
CFA for each sex group						-	-
Male (*n* = 729)	82.57 (35)	.043	.991	.988	.034	-	-
Female (*n* = 510)	78.69 (35)	.049	.978	.972	.061	-	-
Sex invariance							
Configural	160.53 (70)	.046	.987	.984	.047	-	-
Threshold and loading (scalar)	204.06 (98)	.042	.985	.986	.054	.001	−.004
CFA for each age group							
15–34 (*n* = 828)	107.74 (35)	.049	.986	.982	.038	-	-
35–64 (*n* = 411)	75.42 (35)	.053	.979	.973	.073	-	-
Age invariance							
Configural	175.31 (70)	.049	.985	.981	.052	-	-
Threshold and loading (scalar)	203.71 (98)	.042	.985	.986	.059	.000	−.007

References

Chen, F. F. (2007). Sensitivity of Goodness of Fit Indexes to Lack of Measurement Invariance. *Structural Equation Modeling: A Multidisciplinary Journal*, *14*(3), 464–504. https://doi.org/10.1080/10705510701301834

Király, O., Sleczka, P., Pontes, H. M., Urbán, R., Griffiths, M. D., & Demetrovics, Z. (2017). Validation of the ten-item Internet Gaming Disorder Test (IGDT-10) and evaluation of the nine DSM-5 Internet Gaming Disorder criteria. *Addictive Behaviors*, *64*, 253–260. https://doi.org/10.1016/j.addbeh.2015.11.005

Király, O., Bőthe, B., Ramos-Diaz, J., Rahimi-Movaghar, A., Lukavska, K., Hrabec, O., ... & Demetrovics, Z. (2019). Ten-Item Internet Gaming Disorder Test (IGDT-10): Measurement invariance and cross-cultural validation across

seven language-based samples. *Psychology of Addictive Behaviors*, *33*(1), 91–103. https://doi.org/10.1037/adb0000433

Muthén, L. K., & Muthén, B. O. (2013). *Version 7.1 Mplus Language Addendum.pdf.* http://www.statmodel.com/download/Version7.1xLanguage.pdf

Muthén, L.K. and Muthén, B.O. (2023). *Mplus user's guide.* https://www.statmodel.com/html_ug.shtml

Svetina, D., Rutkowski, L., & Rutkowski, D. (2020). Multiple-group invariance with categorical outcomes using updated guidelines: An illustration using M plus and the lavaan/semtools packages. *Structural Equation Modeling: A Multidisciplinary Journal*, *27*(1), 111–130. https://doi.org/10.1037/adb0000433

Appendix B: Model Fit Indices of Models With Individual Internet Gaming Disorder Criteria Predicting Well-Being, Depression and Anxiety

Table B1. *Model Fit Indices of Models With Individual Internet Gaming Disorder Criteria Predicting Well-Being, Depression and Anxiety.*

IGD criterion used as predictor	WLSMV χ^2 (*df*)	RMSEA	CFI	TLI	SRMR
Preoccupation	367.81 (49)	.075	.967	.963	.039
Preoccupation (with age and sex as controls)	505.45 (65)	.076	.954	.961	.037
Withdrawal	379.59 (49)	.076	.966	.962	.039
Withdrawal (with age and sex as controls)	505.45 (65)	.076	.954	.961	.037
Tolerance	363.97 (49)	.074	.968	.964	.039
Tolerance (with age and sex as controls)	483.18 (65)	.075	.956	.963	.037
Loss of control	357.32 (49)	.074	.968	.965	.039
Loss of control (with age and sex as controls)	501.78 (65)	.076	.955	.962	.037
Giving up other activities	367.30 (49)	.075	.967	.963	.040
Giving up other activities (with age and sex as controls)	507.98 (65)	.077	.954	.961	.037
Continuation	365.77 (49)	.075	.967	.963	.040
Continuation (with age and sex as controls)	491.32 (65)	.075	.955	.962	.037
Deception	380.47 (49)	.076	.966	.961	.040
Deception (with age and sex as controls)	519.96 (65)	.078	.952	.959	.038
Escape	376.73 (49)	.076	.965	.961	.040
Escape (with age and sex as controls)	505.49 (65)	.076	.952	.960	.038
Negative consequences for significant relationships	390.65 (49)	.078	.964	.959	.040
Negative consequences for significant relationships (with age and sex as controls)	533.01 (65)	.079	.949	.957	.038
Negative consequences for work	387.71 (49)	.077	.965	.961	.040
Negative consequences for work (with age and sex as controls)	509.77 (65)	.077	.953	.960	.038

About Authors

Josip Razum, PhD, is a postdoctoral researcher at the Ivo Pilar Institute of Social Sciences and currently at the Faculty of Psychology, University of Iceland. His work focuses on gaming and gaming disorder research, and clinical psychology and psychotherapy research.

https://orcid.org/0000-0002-2633-3271

Renata Glavak-Tkalić, PhD, is a Research Advisor at the Ivo Pilar Institute of Social Sciences, Zagreb, Croatia, and an Assistant Professor of Psychology of Addiction in the Department of Psychology at the Croatian Studies at the University of Zagreb, Croatia. Her research interests focus on the psychology of drug (ab)use and addiction, gambling, gaming, psychopathology, adolescent problems, interpersonal acceptance and rejection, and cross-cultural research.

https://orcid.org/0000-0002-5749-0624

✉ **Correspondence to**
Renata Glavak-Tkalić, Ivo Pilar Institute of Social Sciences, 10000 Zagreb, Croatia. renata.glavak.tkalic@pilar.hr

© Author(s). The articles in Cyberpsychology: Journal of Psychosocial Research on Cyberspace are open access articles licensed under the terms of the Creative Commons BY-SA 4.0 International License which permits unrestricted use, distribution and reproduction in any medium, provided the work is properly cited and that any derivatives are shared under the same license.