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Reframing video gaming and Internet use addiction: Empirical cross-national comparison of heavy use over time and addiction scales among young users

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Abstract

Background and aims. Evidence-based and reliable measures of addictive disorders are needed in general population-based assessments. One study suggested that heavy use over time (UOT) should be used instead of self-reported addiction scales (AS). This study empirically compared UOT and AS regarding video gaming and Internet use, using associations with comorbid factors.

Design. Cross-sectional data from the 2011 French ESCAPAD survey; cross-sectional data from the 2012 Swiss ado@internet.ch study; and two waves of longitudinal data (2010-2013) of the Swiss Longitudinal Cohort Study on Substance Use Risk Factors (C-SURF).

Setting. Three representative samples from the general population of French and Swiss adolescents, and young Swiss men, respectively aged around 17, 14, and 20.

Participants. ESCAPAD: n=22,945; ado@internet.ch: n=3,049; C-SURF: n=4,813 (baseline + follow-up).

Measurements. We assessed video gaming/Internet UOT (ESCAPAD and ado@internet.ch: number of hours spent online per week, C-SURF: latent score of time spent gaming/using Internet) and AS (ESCAPAD: Problematic Internet Use Questionnaire, ado@internet.ch: Internet Addiction Test, C-SURF: Gaming AS). Comorbidities were assessed with health outcomes (ESCAPAD: physical health evaluation with a single item, suicidal thoughts, and appointment with a psychiatrist; ado@internet.ch: WHO-5 and somatic health problems; C-SURF: SF12 and MDI).

Findings. UOT and AS were moderately correlated (ESCAPAD: r=0.40, ado@internet.ch: r=0.53, and C-SURF: r=0.51). Associations of AS with comorbidity factors were higher than those of UOT in cross-sectional (AS: $0.040 \leq |b| \leq 1.991$, UOT:

0.001≤|b|≤0.277) and longitudinal analyses (AS: 0.110≤|b|≤1.079, UOT: 0.034≤|b|≤0.329).

Conclusions. AS and UOT overlapped to a limited extend. AS was found more highly correlated with comorbidity factors than UOT.

Key-words: Addiction, Heavy use over time, Internet use, Measurement, Video gaming

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Introduction

Measuring the severity of addictive disorders is not easy and previous studies reported difficulties with the way these phenomena are operationalized (1). Indeed, while an extensive anamnesis conducted by an experienced clinician in a face-to-face interview may reveal a reliable diagnosis, such a costly and time-consuming procedure is not suitable for population-based assessments. Because there is a need for large-scale screenings in public health planning (e.g. establish prevalence rates, treatment planning, early intervention), self-reported questionnaires on addictive disorders are often used to assess addiction at the general population level. However, these self-reports suffer from several issues. For example, previous studies reported the misinterpretation of DSM diagnostic criteria (2), especially among young people who overreport physiological symptoms of withdrawal and tolerance (3), a lack of specificity (4), and problems in the structure and wording of questions (5). Consequently, the measurement of addictive disorders may be unreliable.

To overcome these issues, recent studies called for more evidence-based measures (1). Rehm et al. (1) suggested that heavy use over time (UOT) should be used instead of self-reported addiction scales (AS). According to these authors, heavy UOT is responsible for the symptoms, social consequences, and burden of disease associated with addictive disorders. They suggested that this reframing should be suitable for substance-related disorders. This debate also includes behavioral addictions, although they are scarcely mentioned (e.g. regarding gambling: 6, 7). While there is growing evidence that behavioral addictions resemble substance-related disorders (e.g.

phenomenology, comorbidity and adverse consequences, response to treatment, 8), such disorders may be uneasy to understand. Indeed, whereas physical signs are common in substance-related disorders, they are absent in behavioral addictions (9, 10). No studies investigated video gaming and Internet use, and thus it is unknown whether heavy UOT should be a suitable criterion for video gaming and Internet addiction.

The present study compared UOT with AS so as to test how they fitted empirical data in three large-scale surveys. The associations of comorbidity factors with self-reported video gaming/Internet AS were compared with the associations of comorbidity factors with self-reported video gaming/Internet UOT. Indeed, it is well known that addictive disorders are associated with detrimental consequences on psychological, social, and professional correlates. As a result, the best operationalization of addiction should display this relationship. Previous studies showed the association of video gaming/Internet addiction with comorbidity factors such as anxiety, depression (11, 12), sadness, and suicidal ideation (13).

Methods

Participants and procedures

The data analyzed in this study come from three large-scale national surveys conducted in two different countries: 1) the seventh ESCAPAD survey (Survey on Health and Behavior), a cross-sectional survey designed to estimate drug use prevalence in France; 2) the ado@internet.ch study, a longitudinal survey designed to investigate Internet use among adolescents living in the canton of Vaud (French-speaking part of Switzerland); and 3) the Cohort Study on Substance Use Risk Factors

(C-SURF), a longitudinal study designed to assess substance use patterns among young Swiss men.

1) The ESCAPAD survey, conducted by the French Monitoring Centre for Drugs and Drug Addiction in association with the National Service department, took place during the national defense preparation day, a one-day session providing all seventeen-year-old French adolescents with civil and military information. Since this session is compulsory, the sample is highly representative of the seventeen-year-old French adolescents. Data collection took place in March 2011 in all the civilian or military centers across the national territory and overseas. The survey has obtained the Public Statistics general interest seal of approval from the National Council for Statistical Information, the approval of the ethics commission of the National Data Protection Authority. A complete description of the methodology has been published elsewhere (14). In 2011, a total of 32,249 French adolescents were surveyed, with a response rate exceeding 98%. The final sample comprised 27,402 French adolescents aged 17 living in metropolitan France. This study focused on the 23,509 teenagers who used Internet during the previous seven days. Missing values were listwise deleted, which left a final sample of n = 22,945 (97.6% of the teenagers who used Internet during the previous seven days). Participants with missing values on one health outcome were more likely to have bad results on the other health outcomes, but there was no significant difference with Internet use.

2) The ado@internet.ch study used a representative sample of 35 schools from the Canton de Vaud, the largest French-speaking canton of Switzerland, and invited all 8th graders to participate (n = 3,367). A total of 3,067 adolescents around 14 years old participated in the study (91.1% of the initial sample). This study focused on baseline data, collected in April and June 2012. More information about the sample was

published elsewhere (15). Participants filled in an online form in the schools' computer science rooms. The Ethics Committee of the canton of Vaud approved the study's protocol. Missing data were listwise deleted, which left a final sample of 3,049 participants (99.4% of the sample). The main reason for unit deletion was absence of the school the day the questionnaire was administered (n=230).

3) The C-SURF study used army recruitment centers to inform and enroll participants. Enrollment took place in three of Switzerland's six army recruitment centers covering 21 of the country's 26 cantons. Army recruitment procedure is mandatory for all young Swiss men without any pre-selection. The study was independent of the army and of individuals' eligibility for military service, and the assessment was carried out outside of the army environment. Thus, the sample is highly representative of the twenty-year-old Swiss men. Lausanne University Medical School's Clinical Research Ethics Committee approved the study protocol (No. 15/07). A total of 5,990 participants filled in the baseline questionnaire (September 2010 - March 2012), and among them 5,223 (87.2%) completed the follow-up questionnaire (January 2012 - April 2013). An average of 15 months separated the two assessments. This study focused on the 5,074 youths who used Internet or video gaming in the previous twelve months at both baseline and follow-up. Missing values were listwise deleted, which left a final sample of n = 4,813 (94.9% of the youths who used Internet or video gaming in the previous twelve months at both baseline and follow-up). There was no difference on health outcomes and video gaming/Internet use between respondents and non-respondents. A previous study about sampling and non-response bias reported a small non-response bias (16).

Measures

1) ESCAPAD survey

Internet addiction. The 12-item short version of the Problematic Internet Use Questionnaire (PIUQ) was used to assess Internet use during the previous seven days (17, 18). A mean score was computed based on answers collected on a five-point scale, with a higher score indicating more problems.

Internet UOT. Participants were asked how much time they had spent on Internet during the previous seven days. They answered with regard to four distinct dimensions: information (news, research, documentation), communication (chat, blog, social networks, discussion forums), online gaming, and "other". Answers were collected on a six-point close-ended scale. A total number of hours spent on Internet summing the four dimensions was created, using 'never' = 0, 'less than one hour' = 0.5, '1-2 hours' = 1.5, '2-5 hours' = 3.5, '5-10 hours' = 7.5, and 'more than 10 hours' = 10.

Comorbid measures.

Physical health. Participants answered a single item: "compared to people of your age, would you say your health is": "not satisfactory at all", "not satisfactory", "satisfactory", "very satisfactory".

Mental health. As a proxy to evaluate mental health, participants were asked whether they had consulted a psychologist, a psychiatrist, or a psychotherapist in the previous twelve months. Answers were collected on a six-point scale ("never", "once", "twice", "three times", "four times", and "five times or more").

Suicidal thoughts. Suicidal thoughts were used as proxy to assess the level of depression. Participants were asked whether they had suicidal thoughts in the previous twelve months (coded "1" in case of suicidal thoughts, else "0").

Covariates. Age, gender, situation (‘student’, ‘apprenticeship’, ‘work’, ‘no response’), and parental professional level (‘independent, ‘executive, ‘intermediate occupations’, ‘employees’, ‘manual workers’, ‘farmer’, ‘jobless’, ‘unknown) were assessed.

2) ado@internet.ch study

Internet addiction. Internet addiction was assessed using the French version of the Internet Addiction Test (IAT, 19), with 20 items on a 6-point scale. A total score was computed, and a higher score indicated more problems (range 0-100).

Internet UOT. A reliable quantity-frequency measure of Internet use during the previous 30 days was computed by multiplying Internet use frequency and quantity of Internet use (time spent on average on Internet during days of use) (20).

Comorbid measures.

Somatic health problems. Six somatic health problems were assessed: back pain, weight problems, headaches, musculoskeletal pain, sleep problems, and sight problems. Answer s were dichotomised as “at least weekly,” coded 1, and “less than weekly,” coded 0. A sum-score of the number of somatic health problems was computed.

Wellbeing. Participants’ wellbeing was assessed using the World Health Organization Five Well-Being Index (WHO-5; 21). Answers were collected on a 6-point scale, and a sum-score of wellbeing was computed, with a higher score indicating a better wellbeing (range 0-100).

Covariates. Demographic covariates included gender, age, school type (VSB for students who expect to continue on to higher education, VSG for students who may continue in apprenticeship or academic studies, and VSO for students who expect to continue in apprenticeship), and perceived family income as a proxy for

socioeconomic status (“well above average,” “above average,” “average,” and “below average”).

3) C-SURF study

Video gaming/Internet addiction. The 7-item short version of the Game Addiction Scale (GAS, 22) was used to assess the use of online and offline video games in the previous six months. We extended the original set of questions with a particular hint to Internet use. Five-point scale answers were used, and a mean score was computed, with a higher score indicating more problems.

Video gaming/Internet UOT. Three questions adapted from the pan-European ESPAD project (European School Survey Project on Alcohol and Other Drugs, 23) were used to assess UOT. Participants were asked whether they had done the following things in the previous twelve months: “use Internet for leisure activities (chats, looking for music, playing games, etc.)”, “play computer games online (e.g. World of Warcraft)”, and “play computer games on a console (e.g. Play Station, X-Box, Wii) or a PC (not online)”. Participants answered on a five-point scale (“never”, “a few times a year”, “once to 3 times a month”, “at least once a week”, and “almost every day”). In order to create a total score with this ordinal scale, we computed a latent score using a single factor confirmatory factor analysis (CFA) for ordinal data with weighted least squares means and variance (WLSMV) adjusted estimation (24).

Comorbid measures.

Physical health. Physical health was assessed using the Short Form Health Survey (SF-12, 25), including the subscale of physical component summary. This subscale was calculated according to the standard scoring, giving a composite score ranging from 0 (physical health problem) to 100 (no physical health problem) with an average score of 50.

Mental health. Mental health was also assessed using the Short Form Health Survey (SF-12, 25), with the subscale of the mental component summary for mental and social health, which primarily covers sadness, nervousness and depression. According to the standard scoring, a composite score ranging from 0 (mental health problem) to 100 (no mental health problem) with an average score of 50 was computed.

Depression. The Major Depressive Inventory (ICD-10)–WHO-MDI was used to assess levels of depression (26, 27). This is a ten-item questionnaire that screens answers on a six-point scale ranging from 0 (never) to 5 (all the time). A continuous scale ranging from 0 to 50 was used.

Covariates. Demographic covariates included age, language (French- or German-speaking), level of education attained ('lower secondary', 'upper secondary', 'tertiary'), and perceived family income as a proxy for level of income because participants were mostly students without any income representative of their socio-economical level ('below average income', 'average income', 'above average income').

Except for covariates (assessed at baseline), all variables were assessed at baseline and follow-up.

Statistical analyses

First, descriptive statistics for video gaming/Internet UOT and AS were carried out.

Second, we performed cross-sectional associations between 1) AS and comorbidity factors, and 2) UOT and comorbidity factors using generalized linear models (GLM, linear, Poisson, binary logistic and ordinal logistic regressions according to the distribution of the outcome). AS and UOT were used as predictors, and comorbidity factors successively as dependent variables. We ran three models for each

comorbidity factor. AS and UOT were first entered separately (models 1 and 2), and then together (model 3). We controlled for socio-demographic covariates. These analyses were carried out in all surveys. Correlations between AS and UOT were also computed, using Pearson and Spearman correlations. The results were very similar, so Pearson correlations are reported. The population distribution of school track and gender was available for ado@internet.ch, so we used this information to compute sampling weights.

Third, longitudinal associations were performed in the C-SURF study. Associations of AS and UOT at baseline with comorbidity factors at follow-up were carried out using GLM (linear and Poisson regressions according to the distribution of the outcome). Again, AS and UOT were used as predictors, and comorbidity factors successively as dependent variables. We ran three models for each comorbidity factor. AS and UOT were first entered separately (models 1 and 2), and then together (model 3). We controlled for socio-demographic covariates and level of the comorbidity factor at baseline.

Since the distributions of UOT were not normal, we performed all analyses using transformed measures of UOT (ESCAPAD survey: log transformation, ado@internet.ch: root square transformation, C-SURF study: cubic transformation). The results remained the same in direction and magnitude.

All analyses were performed using Stata version 14, except for CFA, which were carried out using Mplus 7 (24).

Results

Preliminary results

Descriptive statistics are summarized in Table 1.

The participants of the ESCAPAD survey reported average levels of Internet use (UOT = 7.41 hours per week), whereas the participants of ado@internet.ch reported a higher number of weekly hours spent on Internet (UOT = 22.75). Among the participants of the C-SURF study, Internet use was more frequent than online gaming and offline gaming (daily use: 65.6%). Scores on AS were not high for the three samples.

Insert Table 1 about here

Cross-sectional associations

Bivariate cross-sectional associations are reported in Table 2. Comorbidity factors were significantly associated with video gaming/Internet AS (models 1). The higher participants scored on AS, the higher their health problems they had. Video gaming/Internet UOT was also negatively related to most comorbidity factors (models 2), except physical health (C-SURF study). Overall, associations of comorbidity factors with AS were greater than associations with UOT (AS: $0.040 \leq |b| \leq 1.991$, UOT: $0.001 \leq |b| \leq 0.277$). Models 3 including both measures showed that AS still significantly predicted worse comorbidity factors. The results of UOT were inconsistent: its association with depression, physical health, and mental health became positive (C-SURF study), non-significant for health evaluation and RV with a psychiatrist (ESCAPAD survey), and well-being (ado@internet.ch), and remained significantly negative but lower than the association of AS for suicidal thoughts (ESCAPAD survey) and somatic health problems (ado@internet.ch).

The correlations between addiction and use over time were quite moderate (ESCAPAD: r = 0.40, p < .001; ado@internet.ch: r = 0.53, p < .001; C-SURF: r = 0.51, p < .001).

Insert Table 2 about here

Longitudinal associations

Longitudinal associations found in the C-SURF study are reported in the last panel of Table 2. Results showed significant association of AS with comorbidity factors (models 1). Reversely, associations between UOT and comorbidity factors were non-significant for mental health and physical health, and weaker than those with AS for depression (models 2). Models 3 including both measures showed a significant relationship of AS with comorbidity factors, whereas the associations with UOT remained non-significant and even became positive for depression.

Discussion

This study aimed to compare different operationalizations of addiction empirically, i.e. heavy UOT and AS, regarding a behavioral addiction, i.e. video gaming and Internet addiction. The associations of comorbidity factors with self-reported video gaming/Internet AS were compared with the associations of comorbidity factors with self-reported video gaming/Internet UOT.

First of all, the associations of UOT and AS were moderate (ESCAPAD: r=0.40, ado@internet.ch: r=0.53, C-SURF: r=0.51). Therefore, UOT and AS were associated, but the two measures only slightly overlap. This result was in line with previous studies reporting such associations regarding substance-related addiction (e.g. alcohol

use: (1, 28-31) as well as behavioral addiction (e.g. gambling: 32, gaming: 33). Interestingly, part of addictive video gaming/Internet use was captured by heavy UOT (7). Such moderate correlations were also found regarding the relationship between nicotine dependence and number of cigarettes smoked ($r<0.50$, (1, 34, 35). Therefore, heavy users and dependent users overlap to a limited extend (1), and the results regarding video gaming/Internet use were in line with these studies.

In cross-sectional analyses, the results of our study showed that associations of video gaming/Internet AS with comorbidity factors were all greater than those of UOT in the models considering separately AS and UOT. Models including both measures showed a significant association of AS with comorbidity factors, whereas associations of UOT with comorbidity factors were inconsistent (only two out of eight were negative and significant, but lower than the association of AS). The results were similar in longitudinal analyses, with AS showing a negative and significant relationship with comorbidity factors.

Overall, these results showed different associations of AS and UOT with comorbidity factors, in favor of AS. This result seemed quite robust, since it was replicated in three large-scale survey using different assessments of video gaming/Internet AS (PIUQ, IAT, and GAS), different lengths of time regarding video gaming/Internet use (seven days, 30 days, six months), and different questions regarding heavy UOT. Thereby, the concept of addiction may not only reflect the magnitude of use but something different in definition and type of use (36). Moreover, heavy UOT may not be a sufficient sensitive indicator of behavioral addictions such as video gaming/Internet use disorders. Indeed, UOT did not show strong enough detrimental associations with health, which may not be in favor of the suggestion of Rehm et al. (1), at least as far as behavioral addictions are concerned. More studies are needed for substance-related

disorders, because daily substance users are more probably addicted in comparison with daily video gamers/Internet users.

However, some limitations should be mentioned regarding this first empirical comparison. Most importantly, the measure of video gaming/Internet addiction by means of self-reported assessment of addictive disorders may be unreliable. Indeed, showing associations may not be enough to question the accuracy of self-reported measures of addictive disorders. For example, a recent study showed that self-reported measures of alcohol use disorder were overstated by depressive people (37). Therefore, the associations between comorbidity factors and video gaming/Internet AS as highlighted in this study may be artificially increased by this bias. Additionally, self-reported measures may be crude in comparison with other kinds of assessments. Therefore, studies using clinical diagnoses are needed. Another shortcoming was that problematic video gaming and Internet use are not yet recognized as addictive disorders, and thus they have no consensus-based criteria. Therefore, the results of this study should be interpreted cautiously. Moreover, the measure of AS in the C-SURF study mixed video gaming and Internet use. This may have been a problem, since video gaming and Internet use are two different disorders, which may overlap but are separate. However, the use of two other studies confirmed the robustness of the results. The measure of video gaming/Internet UOT also suffered from biases. Indeed, no validated measure of UOT are yet available, and even if the scale used in the ado@internet.ch study has been described as reliable (20), more studies are needed using validated measures, to provide convincing evidence that AS are better than UOT. Another limitation was that the questions used as proxies of health outcomes in the ESCAPAD survey were crude. Fortunately, the C-SURF and ado@internet.ch studies used valid and reliable scales to assess health, and the

different ways of measuring health showed similar results. Finally, the participants of the ESCAPAD survey answered to the questionnaire during the day of information process in the army environment, and therefore it may have biased the results, especially regarding sensitive questions. However, the questionnaire was anonymous and the participants knew that they could stop completing the questionnaire if they want.

Conclusion

In conclusion, this study stepped further into the recent debate over addictive disorder, the usefulness of the measure by means of self-reported AS, and the resort to heavy UOT as its proxy. Results were contrasted, since moderate correlations between these indicators were reported, showing that part of addictive video gaming/Internet use was captured by heavy UOT but without overlapping to a large extend, while AS more strongly related to comorbidity factors than heavy UOT.

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Table 1. Descriptive statistics of covariates, video gaming/Internet use, and health outcomes

ESCAPAD survey (n = 22,945)		ado@internet.ch survey (n = 3,048)		C-SURF study (n = 4,813)		
					Baseline	Follow-up
Covariates		**Covariates**		**Covariates**		
Age[1]	17.37 (0.25)	Age[1]	14.23 (0.01)	Age[1]	19.95 (1.19)	21.25 (1.22)
Gender[2]		Gender[2]		Language[2]		
Boy	47.4 (10,885)	Boy	50.0	French	54.0 (2,600)	-
Girl	52.0 (12,060)	Girl	50.0	German	46.0 (2,213)	-
Situation[2]		School type[2]		Level of education[2]		
Student	87.8 (20,145)	VSB	38.2	Lower secondary	49.2 (2,370)	-
Apprenticeship	8.7 (1,997)	VSG	31.5	Upper secondary	23.7 (1,143)	-
Work	2.4 (557)	VSO	30.3	Tertiary	27.0 (1,300)	-
Non-response	1.1 (246)	Perceived family income[2]		Perceived family income[2]		
Parental professional level[2]		Below average	11.0	Below average	14.0 (674)	-
Entrepreneur	16.8 (3,847)	Average	26.2	Average	40.8 (1,966)	-
Cadre	30.1 (6,913)	Above average	56.4	Above average	45.1 (2,173)	-
Intermediate occupation	25.4 (6,913)	Well above average	6.4	**Video gaming/Internet use**		
Employee	12.3 (2,819)	**Internet use**		Internet use over time[2]		
Manual worker	8.4 (1,934)	Use over time (hours per week)[1]	22.75 (0.36)	Never	0.7 (36)	0.9 (44)
Farmer	3.2 (742)	Addiction (0-100)[1]	29.41 (0.30)	A few times a year	2.9 (141)	3.7 (180)
Jobless	0.2 (34)	**Health outcomes**		Once to 3 times a month	6.9 (330)	8.5 (408)
Unknown	3.6 (835)	Well-being (0-100)[1]	65.49 (0.31)	At least once a week	23.9 (1,150)	24.8 (1,193)
Internet use		No. of somatic problems (0-6)[1]	1.01 (0.02)	Almost every day	65.6 (3,156)	62.1 (2,988)
Use over time (hours per week)[1]	7.41 (5.61)			Online gaming over time[2]		
Addiction (1-5)[1]	1.73 (0.59)			Never	60.0 (2,887)	60.1 (2,893)

Health outcomes		
Health evaluation (1-4)[1]	3.43 (0.61)	
Suicidal thoughts[2]		
Yes	10.7 (2,458)	
No	89.3 (20,487)	
Appointment with a psychiatrist[2]		
Never	91.4 (20,977)	
1	2.7 (630)	
2	1.2 (266)	
3	1.0 (218)	
4	0.5 (123)	
5 and more	3.2 (731)	
A few times a year	13.0 (626)	12.8 (615)
Once to 3 times a month	9.2 (441)	9.7 (467)
At least once a week	10.2 (492)	10.8 (518)
Almost every day	7.6 (367)	6.6 (320)
Offline gaming over time[2]		
Never	18.7 (899)	19.3 (931)
A few times a year	18.7 (898)	20.0 (964)
Once to 3 times a month	25.8 (1,241)	26.6 (1,278)
At least once a week	26.5 (1,276)	25.7 (1,237)
Almost every day	10.4 (499)	8.4 (403)
Latent score use over time[1]	0.01 (0.23)	0.01 (0.20)
Addiction (1-5)[1]	1.67 (0.70)	1.61 (0.66)
Health outcomes		
Depression (0-50)[1]	7.00 (6.95)	7.84 (7.10)
Mental health (0-100)[1]	47.33 (9.08)	45.30 (9.53)
Physical health[1]	53.19 (6.15)	53.55 (6.34)

[1] Means and standard errors are given.

[2] Percentages and n are given, excepted for ado@internet.ch because of sampling weights.

Table 2. Cross-sectional associations of video gaming/Internet use and health outcomes

			Health outcomes (DV)								
			Depression			Physical health			Mental health/well-being		
			Suicidal thoughts[1]/ Depression[2]			Health evaluation[3]/ Somatic problems[2]/ Physical health[4]			RV with a psychiatrist[2]/ Well-being[4]/ Mental health[4]		
			Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Cross-sectional associations	ESCAPAD survey	AS	0.436***	-	0.398***	-0.182***	-	-0.180***	0.040***	-	0.039***
		UOT	-	0.277***	0.104***	-	-0.080***	-0.005	-	0.020***	0.003
	ado@internet.ch survey	AS	-	-	-	0.006***	-	0.005***	-0.086***	-	-0.084***
		UOT	-	-	-	-	0.004***	0.001**	-	-0.049***	-0.005
	C-SURF study	AS	0.213***	-	0.241***	0.621***	-	-0.724***	-1.991***	-	-2.500***
		UOT	-	0.071***	-0.062***	-	-0.163	0.201*	-	-0.257*	1.000***
Longitudinal associations	C-SURF study	AS	0.093***	-	0.110***	-0.227**	-	-0.244*	-0.905***	-	-1.079***
		UOT	-	0.020***	-0.037***	-	-0.088	0.034	-	-0.207	0.329

[1] Logistic regression, [2] Poisson regression, [3] ordinal logistic regression, [4] linear regression

Standardized beta are given. Analyses were performed controlling for socio-demographic covariates (cross-sectional and longitudinal associations), and level of the health outcome at baseline (longitudinal associations).