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ORIGINAL ARTICLE

Effects of adolescent online gaming time and motives on depressive, musculoskeletal, and psychosomatic symptoms

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Abstract

Aim. To investigate whether adolescent online gaming time and the additive effect of gaming motives were associated with depressive, musculoskeletal, and psychosomatic symptoms. The hypothesis was that adolescents who engage in online gaming with escape motives and increased online gaming time have higher probability for depressive, musculoskeletal, and psychosomatic symptoms compared to adolescents with other online gaming motives and/or less online gaming time.

Method. An anonymous and voluntary questionnaire was completed during class hours by 7,757 Swedish adolescents aged 13–18 years. The questionnaire included demographic background, gaming habits, and depressive, musculoskeletal, and psychosomatic symptoms.

Results. It was found that increased online gaming time during weekdays increased the probability of having depressive, musculoskeletal, and psychosomatic symptoms. However, these relations with time spent gaming were further explained by online gaming motives. Weekday online gaming for more than five hours a day, in combination with escape motives, was associated with an increased probability of depressive symptoms (odds ratio (OR) 4.614, 95% CI 3.230–6.590), musculoskeletal symptoms (OR 2.494, 95% CI 1.598–3.892), and psychosomatic symptoms (OR 4.437, 95% CI 2.966–6.637). The probability of ill health decreased when gaming was for fun or had social motives.

Conclusion. Excessive gaming time and escape motives were found to be associated with increased probability of ill health among adolescents. Gaming motives may identify gamers in need of support to reduce unhealthy gaming behaviour as well as identify individuals at risk for ill health.

Key words: *Adolescent, computer games, depression, health, musculoskeletal symptoms, psychosomatic symptoms*

Introduction

Health problems such as musculoskeletal and psychosomatic symptoms that appear during adolescence often persist into adulthood and may be explained in part by lifestyle and psychosocial factors (1-3). Online gaming is one of the most common leisure activities among adolescents (4,5). Most excessive gamers have a preference for massively multiplayer online role-playing games (MMORPGs) (6), often associated with negative consequences (7). Frequent computer-related activities have been suggested to be a new health risk factor (8) associated with psychosomatic and physical complaints (9-14). Negative consequences due to online gaming are reported by one third of gamers (15). In particular, excessive gaming (more than five hours per day) in adolescence appears to increase these risks (16). Excessive gamers and those experiencing problems due to gaming have lower life satisfaction scores and higher levels of negative symptoms such as depression and anxiety (6,17). Somatic complaints

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and excessive screen-based activity have both been suggested as causes of depressive symptoms and generally poor adaption to various stressful conditions (13). Furthermore, associations between gaming, anxiety, and depression have been found (17). Young males are more likely to become excessive gamers and experience negative consequences due to their gaming habits (17,18). However, previously contradictory findings on the associations between gaming and health outcomes may be partly explained by differences in response rates and reliability (8,12-14,17,19-21).

Gamers differ in their motivations for online gaming (22). Even if the gaming activities are the same, individual experiences of reinforcement from an activity may differ based on personality factors (23,24). Online gaming motives have therefore been suggested as another possible factor influencing the relation between excessive gaming and social consequences (22,25,26). Escapism, included in the Diagnostic and Statistical Manual of Mental Disorders, 5th edition (DSM-V) (27) criteria for Internet Gaming Disorder, is proposed to be independent of the socializing motives and used as a way to relax or relieve stress from the real world (22). A previous study by Hellström et al. (26), based on the same study population as the present study (though with other factors investigated), found that the most common motives for online gaming are: fun or social motives; gaming because of demands from others or to gain status; and to escape from other problems in one's ordinary life (26). Gaming to escape, to gain status, or because of demands from others led to a higher probability of negative social consequences, such as getting less sleep, not having time to do school assignments, and experiencing conflicts with parents and/or siblings because of online gaming. However, gaming for fun or social motives was related to reduced probability for negative social consequences (26). Previous research has suggested use of larger study samples to increase generalizability about different aspects of gaming (28).

Further information is needed about the association between online gaming habits and health issues among adolescents, particularly in the context of motives (26). The present study aimed to contribute important information by investigating adolescent online gaming time and the additive effect of gaming motives in relation to depressive, musculoskeletal, and psychosomatic symptoms in a large overall adolescent population in Sweden. The hypothesis was that adolescents who engage in online gaming with escape motives and increased online gaming time have higher probability for depressive, musculoskeletal, and psychosomatic symptoms compared to adolescents with other online gaming motives and/or less online gaming time.

Materials and methods

Participants and procedures

This study was population-based, cross-sectional, and used self-reported questionnaire data. The study was part of the Survey of Adolescent Life in Västmanland 2008 (SALVe 2008), a questionnaire distributed biennially by the County Council of Västmanland in Sweden to monitor the life situation, habits, and health of the county's adolescent population. Västmanland is located about 100 km west of Stockholm and is a medium-sized Swedish county of approximately 257,000 inhabitants. Västmanland is considered representative of Swedish society because of its distribution of educational, income, and employment levels as well as urban and rural areas (29).

The questionnaire included questions about demographic background, depressive, musculoskeletal, and psychosomatic symptoms, and gaming habits. All students in the 7th grade (13–14-year-olds) and 9th grade (15–16-year-olds) of compulsory school and the 2nd year of upper secondary school (17–18-year-olds) in Västmanland were the target population and were asked to complete a questionnaire during class hours. Teachers administered the questionnaire in the classroom during school days, and all students were informed that participation was voluntary and anonymous, and that they could end their participation at any time.

A total of 7,906 students (78.2% of those enrolled) participated. After exclusion of 41 participants who did not state their sex and 108 who did not complete the questionnaire, 7,757 participants were available for analyses. The present analyses were based on a fraction of the data from the extensive SALVe 2008 questionnaire.

Ethical considerations

The study followed Swedish guidelines for studies of social sciences and humanities according to the Declaration of Helsinki. According to Swedish law (Ethical Review Act 2003:460), this type of anonymous study is not required to apply for ethical approval by a medical faculty.

Measures

Sex. Participants were asked whether they were a boy (=1) or a girl (=2).

Parents' country of birth. If both parents were born in Sweden or Scandinavia, the participant was classified as being of Scandinavian ethnicity (=0); if at least one parent was born outside Scandinavia, the participant was classified as non-Scandinavian ethnicity (=1).

Subjective socio-economic status (SES). Subjective socio-economic status (SES) was reported on a 7-point Likert scale adapted from Goodman et al. (30) and previously reported (31). Participants were asked to rank their family's SES: 'Imagine society as being like a ladder. At the bottom are those with the least money, at the top are those with the most. If you think about how wealthy your own family is compared with the rest of society, where would you place your family on this scale?' The range was 1 (lowest status) to 7 (highest status). We divided responses into three categories: 1) steps 1–3 were categorized as low status; 2) steps 4 and 5 were categorized as medium status; and 3) steps 6 and 7 were categorized as high status.

Physical activity was classified as at least 30 min of exercise at least once a week (=1) or less than once a week (=2).

Body mass index (BMI), originally from the World Health Organization (32), was calculated for each participant. BMI was calculated as an individual's weight divided by height squared, kg/m^2. Participants were divided into four groups: ≤16.99 = underweight; 17.00–24.99 = normal weight; ≥25–25.99 = overweight; ≥30.00 = obese (33-35).

Single player gaming frequency. Participants were asked, 'How often do you play single player computer games, such as The Sims, Resident Evil, Super Mario, Tomb Raider, Quake, Doom, Tetris, or similar?' The response options were as follows: Never (=1); A few times a year (=2); Occasionally every month (=3); 2–4 times a month (=4); 2–3 days a week (=5); 4–5 days a week (=6); and 6–7 days a week (=7).

Multiplayer online gaming frequency. Participants were asked, 'How often do you play multiplayer online computer games, such as World of Warcraft, Counter-Strike, Guild Wars, EverQuest, Starcraft, Battlefield, or similar?' The response options were as follows: Never (=1); A few times a year (=2); Occasionally every month (=3); 2–4 times a month (=4); 2–3 days a week (=5); 4–5 days a week (=6); and 6–7 days a week (=7).

Online gaming time on weekdays. Participants were asked, 'If you play an online computer or other game on the Internet, how long do you play on average on an ordinary weekday (Monday to Friday)?' The response options were as follows: Do not play (=1); Less than one hour (=2); 1–2 hours (=3); 2–5 hours (=4); and More than five hours (=5). Participants who did not play were considered non-gamers. Responses 2 and 3 were classified as ≤2 hours. Response 4 was classified as >2–5 hours, and response 5 was classified as >5 hours.

Online gaming time on weekends. Participants were asked, 'If you play an online computer or other game on the Internet, how long do you play on average on an ordinary weekend (Saturday and Sunday)?' The response options were as follows. Do not play (=1); Less than one hour (=2); 1–2 hours (=3); 2–5 hours (=4); and More than five hours (=5). Participants who did not play were considered non-gamers. Responses 2 and 3 were classified as ≤2 hours. Response 4 was classified as >2–5 hours, and response 5 was classified as >5 hours.

Online gaming motives. We used 15 affective statements, extracted from a qualitative study (36) as previously described (26). Participants were asked, 'If you play online computer or other multiplayer games on the Internet, what are your reasons for doing so?' The response options were as follows: It's fun (=1); It's relaxing (=2); My friends play (=3); Demands from other players that I have to play (=4); It's exciting (=5); It's social (=6); I have many friends in the game (=7); I get away from all the problems in my ordinary life (=8); I have nothing more fun to do (=9); To earn money (=10); My ordinary life is so boring (=11); I gain status among other players (=12); I gain status among my friends in real life (=13); I become restless and irritated when I'm not gaming (=14); and I don't have to think about all the worries in my ordinary life (=15).

The following response options were used to assess aspects that predicted participants' motives for gaming (26): Strongly disagree (=1); Disagree to some extent (=2); Neither agree nor disagree (=3); Agree to some extent (=4); and Strongly agree (=5). As previously reported, a factor analysis revealed three components: Fun/Social, Demand/Status, and Escape (26). Each summation index was divided into quartiles. The lowest quartile within the Fun/Social index was defined as low Fun/Social. The highest quartiles within the Demand/Status and Escape indexes were defined as high Demand/Status and high Escape, respectively.

Depressive symptomatology. We used the Depression Self-Rating Scale (DSRS) of the Diagnostic and

Statistical Manual of Mental Disorders, 4th Edition (DSM-IV) to measure depressive symptoms. The general A-criterion for major depression is defined as two weeks of dysphoric mood or loss of interest or pleasure in most activities. In children and adolescents, it also includes irritated mood accompanied by at least four other symptoms such as sleep disturbances, feelings of worthlessness or guilt, concentration disturbances, weight loss or gain/appetite disturbances, fatigue, or loss of energy and suicidal thoughts. We used a depression index as a summation of the DSRS-reported symptoms, with each symptom category counting only once (0–9 points). A dichotomous variable was also created, in which subjects fulfilling the DSM-IV A-criterion were classified as depressed. Cronbach's α for the DSRS was 0.84. The A-criterion has a reported sensitivity of 96.1% and a specificity of 59.4% for major depression (37,38).

Musculoskeletal symptoms. Participants were asked, 'How often during the last three months have you had the following symptoms: 1) Pain in the shoulders/neck; 2) Pain in the back/hips; 3) Pain in the hands/knees/legs/feet?' The response options were as follows: Never (=0); Seldom (=1); Occasionally (=2); Often (=3); Always (=4). The internal consistency (Cronbach's α) of the questions about musculoskeletal pain symptoms was 0.68. The use of this measurement has been previously reported (39,40). A summation index was created with a range of 0–12 points. The index was divided based on standard deviations, where –1 SD was the cut-off point for few musculoskeletal symptoms, + 1 SD was the cut-off for many musculoskeletal symptoms, and the intermediate group was classified as having a medium number of musculoskeletal symptoms. We also created a dichotomous variable, with few to medium symptoms (=0) and many symptoms (=1).

Psychosomatic symptoms. Participants were asked, 'How often during the last three months have you had the following symptoms? 1) Headache; 2) Stomach-ache; 3) Feelings of nervousness; 4) Feelings of irritation; and 5) Sleep problems'. The response options were as follows: Never (=0); Seldom (=1); Occasionally (=2); Often (=3); and Always (=4). The internal consistency (Cronbach's α) of the psychosomatic symptoms questions was 0.75. Use of this measurement has previously been reported (39,40). A summation index was created with a range of 0–20 points. The index was divided by standard deviations, where –1 SD was the cut-off point for few psychosomatic symptoms, + 1 SD was the cut-off for many psychosomatic symptoms, and the intermediate group was classified as having a medium number of psychosomatic symptoms. We created a dichotomous variable with few to medium symptoms (=0) and many symptoms (=1).

Statistical analyses

Demographic data were analysed with Pearson's chi-square. We used Spearman's rho to determine the correlations between age, sex, BMI, physical activity, parents' country of birth, SES, gaming time, gaming motives, and depressive, musculoskeletal, and psychosomatic symptoms. Cramer's V was used to analyse nominal data. Multivariate binary logistic regression analyses were used to investigate online gaming time on weekdays and weekends, motives for gaming, and their relations with depressive, musculoskeletal, and psychosomatic symptoms. To study the combined effects of motives for gaming and time spent gaming, three separate six-quadrant models were created by combining the two levels of each motive for gaming (high–medium Fun/Social and low Fun/Social; low–medium Demand/Status and high Demand/Status; low–medium Escape and high Escape) with the three levels of time spent gaming (≤2 h, >2–5 h, and >5 h). The six-quadrant models were analysed in three separate univariate categorical binary logistic regressions adjusted for age, sex, BMI, physical activity, parents' country of birth, and SES to investigate the associations with depressive, musculoskeletal, and psychosomatic symptoms.

The significant level for all tests was set at $P < 0.05$, and analyses were performed using IBM SPSS Statistics, versions 20 and 22 (IBM Corporation, Armonk, NY, USA).

Results

A majority (82.8%) of participants in all age groups were of Scandinavian ethnicity and belonged to a medium SES family background (Table I). Depressive, musculoskeletal, and psychosomatic symptoms were significantly more common among girls than among boys. Among the boys, 10.7% spent more than five hours a day gaming on weekdays, and twice as many spent more than five hours a day gaming on weekends (19.3%). Girls spent less time gaming than boys.

Compared to girls, boys more often reported gaming because of demands, to gain status, and to escape other problems in their ordinary lives (Table I). Among the total sample, 22.8% of adolescents reported gaming for Escape motives. Medium-sized correlations were found between Fun/Social motives

Table I. Descriptive statistics for the sample of adolescents aged 13 to 18 years.

	Total *n* (%)	Boys *n* (%)	Girls *n* (%)	Chi-square	*P*
Age:					
13–14	2,745 (35.4)	1,351 (34.9)	1,394 (35.9)		
15–16	2,605 (33.6)	1,291 (33.3)	1,314 (33.8)		
17–18	2,407 (31.0)	1,230 (31.8)	1,177 (30.3)	2.022	0.364
Ethnicity:					
Scandinavian	6,345 (82.8)	3,152 (82.6)	3,193 (83.0)		
Non-Scandinavian	1,319 (17.2)	664 (17.4)	655 (17.0)	0.193	0.661
Socio-economic status:					
Low	1,150 (15.1)	537 (14.2)	613 (16.1)		
Medium	5,637 (74.2)	2,766 (73.1)	2,871 (75.4)		
High	805 (10.6)	482 (12.7)	323 (8.5)	38.320	<0.001
Body mass index:					
Underweight	211 (2.9)	75 (2.1)	136 (3.8)		
Normal weight	6,276 (87.3)	3,084 (85.0)	3,192 (89.6)		
Overweight	566 (7.9)	375 (10.3)	191 (5.4)		
Obese	138 (1.9)	93 (2.6)	45 (1.3)	95.461	<0.001
Physical activity:					
At least once a week	5,944 (79.1)	2,975 (80.2)	2,969 (77.9)		
Less than once a week	1,575 (20.9)	735 (19.8)	840 (22.1)	5.704	0.017
Depressive symptom:					
No depression	5,883 (75.8)	3,256 (84.1)	2,627 (67.6)		
Depression (DSM-IV, A-criterion)	1,874 (24.2)	616 (15.9)	1,258 (32.4)	287.169	<0.001
Musculoskeletal pain:					
Few–medium symptoms	6,671 (86.7)	3,473 (90.8)	3,198 (82.7)		
Many symptoms	1,022 (13.3)	351 (9.2)	671 (17.3)	111.273	<0.001
Psychosomatic symptoms:					
Few–medium symptoms	6,303 (81.8)	3,486 (90.9)	2,817 (72.8)		
Many symptoms	1,404 (18.2)	351 (9.1)	1,053 (27.2)	421.874	<0.001
Single player frequency:					
Never	2,477 (33.7)	927 (25.3)	1,550 (42.2)		
A few times a year	1,290 (17.6)	434 (11.8)	856 (23.3)		
Occasionally every month	970 (13.2)	477 (13.0)	493 (13.4)		
2–4 times a month	792 (10.8)	455 (12.4)	337 (9.2)		
2–3 days a week	990 (13.5)	690 (18.8)	300 (8.2)		
4–5 days a week	413 (5.6)	324 (8.8)	89 (2.4)		
6–7 days a week	410 (5.6)	359 (9.8)	51 (1.4)	831.304	<0.001
Multiplayer online frequency:					
Never	3,884 (52.9)	911 (24.8)	2,973 (80.9)		
A few times a year	633 (8.6)	312 (8.5)	321 (8.7)		
Occasionally every month	422 (5.7)	288 (7.8)	134 (3.6)		
2–4 times a month	362 (4.9)	270 (7.3)	92 (2.5)		
2–3 days a week	507 (6.9)	437 (11.9)	70 (1.9)		
4–5 days a week	535 (7.3)	500 (13.6)	35 (1.0)		
6–7 days a week	1,005 (13.7)	956 (26.0)	49 (1.3)	2726.933	<0.001

Table I. (*Continued*).

	Total *n* (%)	Boys *n* (%)	Girls *n* (%)	Chi-square	*P*
Online gaming time on weekdays:					
Do not play	3,415 (47.9)	1,107 (31.0)	2,308 (65.0)		
Less than one hour	1,306 (18.3)	649 (18.2)	657 (18.5)		
1–2 hours	1,042 (14.6)	708 (19.8)	334 (9.4)		
>2–5 hours	914 (12.8)	730 (20.4)	184 (5.2)		
More than 5 hours	450 (6.3)	381 (10.7)	69 (1.9)	1099.083	<0.001
Online gaming time on weekends:					
Do not play	2,438 (34.5)	638 (18.0)	1,800 (51.1)		
Less than one hour	1,342 (19.0)	529 (14.9)	813 (23.1)		
>2–5 hours	1,217 (17.2)	918 (25.9)	299 (8.5)		
More than 5 hours	766 (10.8)	684 (19.3)	82 (2.3)	1451.883	<0.001
Fun/Social motives to play:					
Medium–high Fun/Social	2,915 (68.2)	2,345 (81.5)	570 (40.9)		
Low Fun/Social	1,357 (31.8)	534 (18.5)	823 (59.1)	711.579	0.240
Demand/Status motives to play:					
Low–medium Demand/Status	3,282 (79.0)	2,107 (74.3)	1,175 (89.4)		
High Demand/Status	870 (21.0)	730 (25.7)	140 (10.6)	123.446	<0.001
Escape motives to play:					
Low–medium Escape	3,207 (77.2)	2,122 (74.9)	1,085 (82.3)		
High Escape	945 (22.8)	712 (25.1)	233 (17.7)	28.366	<0.001

and Demand/Status motives, Demand/Status motives and Escape motives, depressive and psychosomatic symptoms, and musculoskeletal and psychosomatic symptoms (Table II). The strongest correlation between gaming motives and health variables was found between Escape motives and depressive symptoms. Furthermore, the higher the Fun/Social score, the lower the scores for depressive, musculoskeletal, and psychosomatic symptoms. The control variables correlated with most dependent variables (Table II).

In univariate logistic regression models, single player frequency was not significantly associated with any of the ill health variables. However, multiplayer online gaming was associated with depressive symptoms (OR 1.066, 95% CI 1.028–1.104, $P < 0.001$), musculoskeletal symptoms (OR 1.081, 95% CI 1.034–1.129, $P = 0.001$), and psychosomatic symptoms (OR 1.058, 95% CI 1.014–1.104, $P = 0.009$) (not shown in tables). Furthermore, in a multivariate binary logistic regression, neither single player frequency (i.e. gaming occasions per week/month/year) nor multiplayer online gaming frequency was associated with depressive, musculoskeletal, or psychosomatic symptoms (Table III). However, increased gaming time (i.e. gaming hours per day) on weekdays elevated the probability of depressive, musculoskeletal, and psychosomatic symptoms. However, there were no such associations for online gaming time on weekends. Moreover, there were increased probabilities for depressive symptoms when the motives for gaming were characterized as low Fun/Social, high Demand/Status, and high Escape (Table III). In addition, playing for high Escape motives was associated with increased probability of musculoskeletal and psychosomatic symptoms. The most explained variance in the multivariate models in Table III was for depressive symptoms ($R^2 = 0.212$) followed by psychosomatic symptoms ($R^2 = 0.185$).

We further investigated the combined effects of motives for gaming and time spent gaming on weekdays (Table IV) and weekends (Table V). Non-gamers were held as the reference group in Tables IV and V. Depressive, musculoskeletal, and psychosomatic symptoms generally increased with extended gaming time, but these associations depended on the motives for gaming. On weekdays, individuals who played for more than five hours with high–medium Fun/Social motives had more than double the

Table II. Spearman's rho correlations between study variables.

Factors	1	2[a]	3[a]	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Age groups	1	–0.015 ns	0.033**	–0.083***	0.193***	0.055***	–0.095***	–0.056***	0.128***	–0.136***	0.032*	–0.041**	0.024ns	0.055***	0.041***	0.071***
2. Sex[a]		1	0.005 ns	–0.065***	–0.115***	0.028*	–0.304***	–0.604***	–0.389***	–0.449***	–0.447***	–0.317***	–0.125***	0.238***	0.174***	0.345***
3. Parents' country of birth[a]			1	–0.062***	–0.008 ns	0.023*	–0.011 ns	–0.023 ns	–0.014 ns	0.001 ns	–0.028ns	–0.003ns	–0.035*	0.058***	0.027*	0.013ns
4. Socio-economic status				1	–0.066***	–0.120***	0.000 ns	0.050***	–0.005 ns	0.034**	0.045**	–0.003 ns	–0.113***	–0.159***	–0.096***	–0.170***
5. Body mass index					1	0.017 ns	0.048***	0.080***	0.116***	0.055***	0.049**	0.057***	0.072***	0.038***	0.026*	–0.001 ns
6. Physical activity						1	0.019 ns	0.016 ns	0.082***	0.043***	–0.011 ns	0.022 ns	0.121***	0.107***	0.010 ns	0.112***
7. Single player frequency							1	0.349***	0.257***	0.349***	0.171***	0.106***	0.121***	–0.059***	–0.028*	–0.103***
8. Multiplayer online frequency								1	0.598***	0.689***	0.565***	0.379***	0.248***	–0.101***	–0.085***	–0.170***
9. Online gaming time weekdays									1	0.713***	0.415***	0.339***	0.284***	0.053***	0.021 ns	–0.013 ns
10. Online gaming time weekends										1	0.501***	0.365***	0.273***	–0.034**	–0.049***	–0.096***
11. Fun/Social, gaming motive index											1	0.556***	0.410***	–0.048**	–0.052***	–0.120***
12. Demand/Status, gaming motive index												1	0.631***	0.144***	0.073***	0.043**
13. Escape, gaming motive index													1	0.293***	0.159***	0.210***
14. Depressive symptoms														1	0.365***	0.575***
15. Musculoskeletal symptoms index															1	0.466***
16. Psychosomatic symptoms index																1

[a]Cramer's V was used for nominal data.
*$P \leq 0.05$ level (2-tailed).
**$P \leq 0.01$ level (2-tailed).
***$P \leq 0.001$ level (2-tailed).
ns = Non-significant.

Table III. Multivariate binary logistic regression analyses of gaming time and motives to play in relation to depressive, musculoskeletal, and psychosomatic symptoms.

	Depressive symptoms (DSM-IV)			Musculoskeletal symptoms			Psychosomatic symptoms		
	OR[a]	*P*	95% CI	OR[a]	*P*	95% CI	OR[a]	*P*	95% CI
Single player frequency	1.013	0.575	(0.967–1.060)	1.030	0.304	(0.974–1.089)	1.003	0.927	(0.950–1.058)
Multiplayer online frequency	0.960	0.164	(0.906–1.017)	0.987	0.707	(0.921–1.057)	0.951	0.134	(0.891–1.016)
Online gaming time on weekdays	1.217	<0.001	(1.106–1.339)	1.173	0.005	(1.048–1.313)	1.326	<0.001	(1.191–1.477)
Online gaming time on weekends	0.911	0.081	(0.821–1.011)	0.960	0.521	(0.847–1.087)	0.895	0.063	(0.797–1.006)
Low Fun/Social motive	1.261	0.040	(1.011–1.572)	0.940	0.650	(0.719–1.229)	1.129	0.331	(0.884–1.443)
High Demand/Status motive	1.758	<0.001	(1.396–2.213)	0.937	0.659	(0.702–1.250)	1.235	0.127	(0.942–1.619)
High Escape motive	3.382	<0.001	(2.723–4.200)	1.960	<0.001	(1.511–2.543)	2.460	<0.001	(1.920–3.152)
	$R^2 = 0.212$			$R^2 = 0.067$			$R^2 = 0.185$		

[a]Odds ratio; adjusted for sex, age, body mass index, physical activity, parents' country of birth, and socio-economic status.

probability for depressive symptoms compared with non-gamers, whereas the probability for individuals who played for the same amount of time with low Fun/Social motives increased by more than three times (Table IV). Individuals who played for more than five hours with low–medium Demand/Status motives had nearly twice the probability of depressive symptoms compared with non-gamers, whereas individuals who played for the same amount of time with high Demand/Status motives had nearly four times higher probability of depressive symptoms (Table IV). Individuals who played for more than five hours with low–medium Escape motives had no increased probability for depressive symptoms compared with non-gamers, whereas individuals who played for the same duration with high Escape motives increased their probability by more than four times (Table IV). Similar patterns were found for musculoskeletal symptoms and psychosomatic symptoms. The explained variance was Nagelkerke R^2 = 0.123–0.156 for depression symptoms, R^2 = 0.053–0.058 for musculoskeletal symptoms and R^2 = 0.143–0.156 for psychosomatic symptoms among weekday gamers (Table IV).

Among the weekend gamers, the highest probabilities for depressive symptoms were within the high Escape group. Compared to non-gamers, the increased symptom probabilities for these players were double to quadruple for depressive symptoms, double for musculoskeletal symptoms, and double to triple for psychosomatic symptoms. However, among high Escape weekend gamers, the association with time spent gaming was less apparent (Table V). The associations between gaming time and motives for gaming in relation to depressive, musculoskeletal, and psychosomatic symptoms were more evident among the weekday gamers than among weekend gamers (Tables IV and V).

Discussion

The highest probability for depressive, musculoskeletal, and psychosomatic symptoms was found among weekday gamers, especially those who played for high Escape motives and spent an excessive amount of time gaming (i.e. gaming for more than five hours a day). Furthermore, among individuals driven by positive motives, time spent gaming was of high importance in relation to ill health, whereas among the negative motives the time spent gaming was less important.

We separated the monthly or weekly amount of gaming (frequency) and hours of gaming a day (time spent gaming) since it seemed plausible that these measures would differ in relation to the health variables. Time spent gaming was associated with depressive, musculoskeletal, and psychosomatic symptoms. However, in multivariate analyses no associations were found for gaming frequency, supporting our expectations that, depending on how gaming time is measured, different effects and negative consequences might be revealed. We categorized those who did not play as non-gamers and used this group as the reference in Tables IV and V. The highest probabilities for depressive, musculoskeletal, and psychosomatic symptoms were found among weekday gamers and were less apparent among weekend gamers, indicating that weekday and weekend

Table IV. Binary logistic regression analyses for the motives for playing combined with gaming time on weekdays in relation to depressive, musculoskeletal, and psychosomatic symptoms. The three different motives for playing models are presented in three separate analyses.

	Depressive symptoms			Musculoskeletal symptoms			Psychosomatic symptoms		
	%[a]	*P*	OR (95% CI)[b]	%[a]	*P*	OR (95% CI)[b]	%[a]	*P*	OR (95% CI)[b]
Fun/Social motive:									
Non-gamers	22.2		1.0	12.3		1.0	17.7		1.0
High–medium Fun/Social, ≤2 h	20.7	<0.001	1.630 (1.338–1.986)	11.8	0.001	1.488 (1.171–1.891)	13.4	<0.001	1.504 (1.197–1.890)
High–medium Fun/Social, >2–5 h	20.1	<0.001	1.661 (1.306–2.112)	13.1	<0.001	1.814 (1.365–2.409)	12.1	0.002	1.582 (1.187–2.110)
High–medium Fun/Social, >5 h	25.1	<0.001	2.501 (1.851–3.399)	12.1	0.001	1.882 (1.280–2.765)	18.6	<0.001	3.075 (2.176–4.345)
Low Fun/Social, ≤2 h	28.7	<0.001	1.491 (1.192–1.865)	12.7	0.543	1.094 (0.819–1.462)	22.5	0.001	1.489 (1.167–1.900)
Low Fun/Social, >2–5 h	39.2	<0.001	2.746 (1.656–4.551)	18.9	0.034	1.927 (1.051–3.532)	29.7	0.001	2.618 (1.515–4.525)
Low Fun/Social, >5 h	44.2	<0.001	3.693 (1.926–7.081)	30.2	<0.001	4.266 (2.147–8.477)	30.2	<0.001	3.576 (1.757–7.277)
			R^2 = 0.123			R^2 = 0.054			R^2 = 0.143
Demand/Status motive:									
Non-gamers	22.2		1.0	12.3		1.0	17.7		1.0
Low–medium Demand/Status, ≤ 2 h	21.2	<0.001	1.381 (1.159–1.646)	12.4	0.009	1.326 (1.074–1.637)	16.7	<0.001	1.512 (1.248–1.832)
Low–medium Demand/Status, >2–5 h	18.6	0.006	1.434 (1.106–1.859)	13.2	<0.001	1.693 (1.259–2.275)	12.6	0.007	1.510 (1.120–2.038)
Low–medium Demand/Status, >5 h	23.5	0.003	1.882 (1.246–2.843)	13.6	0.015	1.830 (1.126–2.976)	16.7	0.002	2.133 (1.334–3.412)
High Demand/Status, ≤2 h	32.6	<0.001	3.749 (2.724–5.158)	9.8	0.323	1.263 (0.795–2.006)	14.4	0.002	1.907 (1.263–2.880)
High Demand/Status, >2–5 h	32.1	<0.001	3.773 (2.639–5.396)	14.3	0.002	2.027 (1.288–3.191)	16.8	<0.001	2.569 (1.655–3.986)
High Demand/Status, >5 h	31.0	<0.001	3.930 (2.756–5.606)	14.2	<0.001	2.281 (1.460–3.564)	23.5	<0.001	4.617 (3.115–6.843)
			R^2 = 0.140			R^2 = 0.053			R^2 = 0.146
Escape motive:									
Non-gamers	22.2		1.0	12.3		1.0	17.7		1.0
Low–medium Escape, ≤2 h	18.4	0.056	1.196 (0.995–1.437)	10.6	0.217	1.151 (0.921–1.440)	14.0	0.018	1.278 (1.043–1.566)
Low–medium Escape, >2–5 h	14.7	0.294	1.164 (0.887–1.544)	10.7	0.035	1.418 (1.025–1.961)	9.4	0.315	1.190 (0.848–1.669)
Low–medium Escape, >5 h	18.1	0.077	1.472 (0.958–2.262)	11.9	0.040	1.674 (1.025–2.734)	15.8	<0.001	2.340 (1.481–3.698)
High Escape, ≤2 h	42.9	<0.001	4.264 (3.224–5.641)	18.0	<0.001	2.079 (1.481–2.920)	27.1	<0.001	3.107 (2.269–4.254)
High Escape, >2–5 h	39.9	<0.001	4.165 (3.020–5.744)	20.2	<0.001	2.695 (1.851–3.923)	24.4	<0.001	3.266 (2.259–4.723)
High Escape, >5 h	37.3	<0.001	4.614 (3.230–6.590)	16.1	<0.001	2.494 (1.598–3.892)	25.0	<0.001	4.437 (2.966–6.637)
			R^2 = 0.156			R^2 = 0.058			R^2 = 0.156

[a]Percentages within each subgroup within each model with depressive symptoms, many musculoskeletal symptoms, and many psychosomatic symptoms.
[b]Odds ratio; adjusted for sex, age, body mass index, physical activity, parents' country of birth, and socio-economic status.

gaming should be separated in future research. Not distinguishing between these factors might lead to false conclusions, which may partly explain the contradictory results from previous research. Moreover, in previous contradictory findings of gaming and health variables, combined effects of motives for gaming and gaming time have rarely been investigated.

Previous studies have argued that gaming duration of more than five hours a day seems to increase the probability of negative consequences (16); this is

Table V. Binary logistic regression analyses for the motives for playing combined with gaming time on weekends in relation to depressive, musculoskeletal, and psychosomatic symptoms. The three different motives for playing models are presented in three separate analyses.

	Depressive symptoms			Musculoskeletal symptoms			Psychosomatic symptoms		
	%[a]	*P*	OR (95% CI)[b]	%[a]	*P*	OR (95% CI)[b]	%[a]	*P*	OR (95% CI)[b]
Fun/Social motive:									
Non-gamers	27.5		1.0	14.7		1.0	22.3		1.0
High–medium Fun/Social, ≤ 2 h	19.2	0.181	1.154 (0.935–1.425)	10.9	0.344	1.134 (0.874–1.470)	12.2	0.868	0.979 (0.767–1.251)
High–medium Fun/Social, >2–5 h	14.3	0.562	0.930 (0.728–1.188)	9.8	0.347	1.151 (0.858–1.544)	11.1	0.318	1.151 (0.874–1.517)
High–medium Fun/Social, > 5 h	24.9	<0.001	1.947 (1.520–2.494)	13.9	<0.001	1.832 (1.352–2.483)	15.2	<0.001	1.842 (1.372–2.473)
Low Fun/Social, ≤ 2 h	24.1	0.851	1.020 (0.829–1.255)	12.1	0.638	0.939 (0.721–1.222)	18.8	0.676	0.953 (0.759–1.196)
Low Fun/Social, >2–5 h	30.0	0.037	1.546 (1.027–2.328)	12.3	0.884	1.042 (0.602–1.803)	21.5	0.169	1.381 (0.872–2.189)
Low Fun/Social, > 5 h	37.8	0.016	2.245 (1.164–4.332)	20.0	0.054	2.119 (0.986–4.552)	24.4	0.069	1.998 (0.948–4.211)
			R^2 = 0.115			R^2 = 0.050			R^2 = 0.139
Demand/Status motive:									
Non-gamers	27.5		1.0	14.7		1.0	22.3		1.0
Low–medium Demand/Status, ≤ 2 h	18.8	0.518	0.942 (0.788–1.128)	10.7	0.684	0.955 (0.765–1.192)	14.4	0.350	0.910 (0.747–1.109)
Low–medium Demand/Status, >2–5 h	16.0	0.949	1.008 (0.791–1.284)	10.4	0.356	1.145 (0.859–1.527)	12.0	0.475	1.104 (0.842–1.448)
Low–medium Demand/Status, > 5 h	19.1	0.076	1.327 (0.971–1.813)	14.2	0.002	1.765 (1.242–2.509)	13.4	0.040	1.457 (1.017–2.088)
High Demand/Status, ≤ 2 h	38.6	<0.001	3.695 (2.654–5.143)	15.1	0.014	1.701 (1.115–2.596)	18.4	0.005	1.795 (1.197–2.690)
High Demand/Status, >2–5 h	18.0	0.029	1.592 (1.049–2.417)	8.4	0.855	1.054 (0.597–1.861)	14.0	0.007	1.903 (1.191–3.042)
High Demand/Status, > 5 h	34.9	<0.001	3.734 (2.749–5.071)	14.1	0.001	1.907 (1.288–2.823)	19.1	<0.001	2.667 (1.853–3.839)
			R^2 = 0.139			R^2 = 0.053			R^2 = 0.144
Escape motive:									
Non-gamers	27.8		1.0	14.7		1.0	22.3		1.0
Low–medium Escape, ≤ 2 h	16.9	0.070	0.843 (0.701–1.014)	9.7	0.273	0.880 (0.700–1.106)	12.6	0.039	0.806 (0.656–0.989)
Low–medium Escape, >2–5 h	11.9	0.029	0.743 (0.569–0.969)	8.4	0.668	0.934 (0.682–1.278)	9.8	0.658	0.936 (0.698–1.255)
Low–medium Escape, > 5 h	16.2	0.442	1.138 (0.818–1.583)	11.3	0.068	1.425 (0.974–2.085)	10.2	0.495	1.148 (0.772–1.706)
High Escape, ≤ 2 h	47.5	<0.001	3.955 (2.935–5.330)	19.9	<0.001	1.955 (1.369–2.791)	28.6	<0.001	2.364 (1.698–3.293)
High Escape, >2–5 h	31.7	<0.001	2.534 (1.804–3.559)	16.1	0.004	1.836 (1.211–2.786)	22.0	<0.001	2.315 (1.573–3.406)
High Escape, > 5 h	38.6	<0.001	3.827 (2.842–5.153)	17.9	<0.001	2.346 (1.633–3.371)	23.2	<0.001	2.997 (2.128–4.221)
			R^2 = 0.159			R^2 = 0.060			R^2 = 0.157

[a]Percentages within each subgroup within each model with depressive symptoms, many musculoskeletal symptoms, and many psychosomatic symptoms.
[b]Odds ratio; adjusted for sex, age, body mass index, physical activity, parents' country of birth, and socio-economic status.

supported by our findings. A possible explanation for the relation between time spent gaming and musculoskeletal symptoms could be consecutive periods of gaming, leading to sustained muscle tension and no time for recovery. Even if excessive gaming time elevates the number of gaming-related problems, the relations vary depending on the gaming motives. For example, the association between time spent gaming and ill health was noticeably less evident among the gamers who played for Fun/Social motives. Moreover, individuals who played for high Escape and Demand/Status motives had the highest probability of depressive, musculoskeletal, and psychosomatic symptoms with little variation accounted for by time spent gaming. It is important to acknowledge that high involvement in a game does not necessarily

lead to a negative effect on the gamer's daily life (26,41). Regardless of the form or type of activity, however, it seems plausible that if a lot of time is spent on one activity (i.e. gaming), less time is available for other things. In a previous study, we found that excessive gaming might have a negative influence on schoolwork, sleep, relations with friends and family, and other leisure activities (26). In previous research, we also found that gaming for Fun/Social motives may actually reduce the probability of negative consequences (26). Following these findings, we suggest that gaming time should not be used as a single measure for problems due to gaming behaviour, but rather in combination with the motives for gaming.

Social interaction and communication within the gaming experience play an important role for many gamers (15). However, other gamers play online games because it provides anonymity; within the virtual life, the gamer can chose another identity to help cope with everyday life (15,42,43). Moreover, loneliness is associated with problematic Internet use (19). If the gamer has pre-existing problems such as depression, gaming may enhance these symptoms because the depressed individual may become isolated due to gaming and subsequently spend even more time alone. Individuals under psychosocial distress may develop a preference for online social interactions, which may result in further negative outcomes that are associated with problematic Internet use (44). Results from the present study indicate that depressive symptoms are more common among gamers than they are among non-gamers. Although the direction of this relationship is not clear, the finding may be of importance for identifying depressed individuals within adolescent groups. Similar results were found for psychosomatic symptoms, which were more common among those who played to escape problems in their ordinary lives. It seems possible that excessive gaming may be related to stressors such as social problems in the family, school, or peer group in the gamer's life; gaming may be an escape strategy that helps the gamer to cope with real-life problems. Of note, depression symptoms and psychosomatic symptoms are partially overlapping constructs, with feeling of nervousness common to both.

Strengths and limitations

These results should be understood in the context of several limitations. First, self-reporting always involves a risk that the participant misunderstood the questions or provided false answers. Second, since the design was cross-sectional, our ability to predict causality was limited. It is unclear whether gaming leads to problems or if individuals with pre-existing problems engage more easily in gaming as an escape strategy (19,45). Third, online gaming is not a leisure activity exclusive to adolescents; many adults also play online games. However, the sample used for this study cannot be considered representative of a non-adolescent population. Fourth, gaming activities are more common among boys, whereas girls more often suffer from ill health. However, the analyses were controlled for potential confounding variables such as sex, age, BMI, physical activity, parents' country of birth, and SES, and no major interference was seen. The use of BMI cut-off scores for adolescents has been previously discussed (32-34) and can differ based on age and sex. However, BMI was only used as a covariate, and consequently cut-off scores should only have had a minimal impact on our results (32). If BMI had been our independent variable, developmentally modified cut-off scores would have been important. There is also the risk of influence from confounding factors not controlled for in the study, such as other major diseases, school situations and pressures, family problems, and peer relations, as well as gamers' personalities and other potential mental disorders such as ADHD and autism. These confounding factors were not controlled for in the present study, so the results must be interpreted with care. Fifth, the response options for the gaming time questions were overlapping in content. An adolescent who plays online games for exactly two hours each day might not have been able to choose between the response options. However, although this is a major limitation, we expect that most adolescents were able to respond correctly to whether they usually game for up to two hours or for more than two hours.

There are also several study strengths. To our knowledge, the combined effects of time spent gaming and motives for gaming have not been previously studied in relation to depressive, musculoskeletal, and psychosomatic symptoms. Furthermore, as previously reported (26) we found similar results when investigating negative social consequences due to gaming, further strengthening the direction of our findings. In previously reported results (26) we further highlighted the value of using an exploratory design. That study used data from the same study population to investigate negative social consequences due to gaming, as compared with the present study investigating relations between gaming and ill health. In previous research, gamers have often been investigated as a stereotypical group (22), which might result in misleading conclusions because individuals choose to play for many different reasons and because in-game experiences and effects vary substantially (22). While separating gamers based on time spent gaming and different playing motives, results revealed that some gamers have a higher probability of ill health than others do.

Moreover, earlier studies have been criticized for their small study samples and failure to account for the potentially confounding factors (26,28). The high response rate in the present study, among a large population-based sample considered fairly representative of Sweden as a whole, means that we can generalize these findings to other adolescent populations from countries with similar cultures and living conditions.

Conclusions and implications

These data suggest that excessive gaming time and escape motives are associated with increased probability of ill health among adolescents. In the DSM-V, Internet Gaming Disorder (IGD) is classified under the conditions for further studies of Section III with the postulation that more evidence is needed before it can be included as a standard disorder in the DSM system (27). IGD may be influenced by other mental health issues (46) and could be a maladaptive strategy to cope with psychiatric disorders such as depression or ADHD (11,47).

The present study also adds to the body of knowledge regarding the combined effects of time spent gaming and gaming motives in relation to depressive, musculoskeletal, and psychosomatic symptoms. Moreover, gaming motives may identify gamers in need of support to reduce unhealthy gaming behaviour as well as identify individuals at risk for ill health. These results may be of interest to parents, teachers, psychologists, social workers, and others who are involved in adolescent health and development.

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