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# Problematic Video Game Use: Estimated Prevalence and Associations with Mental and Physical Health

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## Abstract

A nationwide survey was conducted to investigate the prevalence of video game addiction and problematic video game use and their association with physical and mental health. An initial sample comprising 2,500 individuals was randomly selected from the Norwegian National Registry. A total of 816 (34.0 percent) individuals completed and returned the questionnaire. The majority (56.3 percent) of respondents used video games on a regular basis. The prevalence of video game addiction was estimated to be 0.6 percent, with problematic use of video games reported by 4.1 percent of the sample. Gender (male) and age group (young) were strong predictors for problematic use of video games. A higher proportion of high frequency compared with low frequency players preferred massively multiplayer online role-playing games, although the majority of high frequency players preferred other game types. Problematic use of video games was associated with lower scores on life satisfaction and with elevated levels of anxiety and depression. Video game use was not associated with reported amount of physical exercise.

## Introduction

EXCESSIVE USE OF VIDEO games has given rise to concern among gamers, their families, and clinicians, although excessive video gaming is not yet recognized as a disorder by current diagnostic systems.<sup>1,2</sup>

Video games may be rewarding because it activates dopaminergic neurotransmission in the brain's reward circuits.<sup>3</sup> Males are reportedly overrepresented among individuals with video gaming problems.<sup>4-6</sup> These findings have been supported by an fMRI study in which males showed greater connectivity and activation in the mesocorticolimbic systems during video game playing<sup>7</sup> than females.

One genre of video games, which has received much attention with regard to excessive gaming, is massively multiplayer online role-playing games (MMORPGs). These games' mixture of social interaction and never-ending gameplay are often portrayed as particularly addictive.<sup>8-10</sup>

Much research has focused on the relationship between violent content in games and aggressive behavior in their users.<sup>11</sup> The issue of how video game use relates to measures of health has so far received little attention, with inconsistent results. Frequency of electronic game play has been found not to be related to body mass index or to grade point average in male college students.<sup>12</sup> A different survey<sup>10</sup> found that MMORPG players scored as healthier than the general

American population on body mass index, amount of exercise, self-reported health, and anxiety, but reported higher levels of depression and substance use. Other studies have related video game use to elevated drug and alcohol use, lower interpersonal relationship quality,<sup>13</sup> problems at school, reduced sleep time, limited leisure activities, and suicide ideation.<sup>6</sup> Finally, a survey of Norwegian adults found that self-reported sleep problems, depression, suicidal ideation, anxiety, obsessions, and compulsions as well as alcohol and substance abuse were positively related to the frequency of video game playing.<sup>14</sup>

Different studies investigating the prevalence of video game addiction reported a prevalence in the magnitude of 2–8.5 percent.<sup>5-6,14,15</sup> The inconsistency in prevalence estimates across studies might be related to differences in definitions as well as in the assessment of video game addiction.

The aim of our study was to investigate the use of video games in a representative sample of young Norwegian adults. A specific goal was to provide an estimate of the prevalence of video game-related problems and addiction among this demographic group. Further, we aimed to investigate whether high frequency players prefer MMORPGs compared with other types of games. We also wanted to assess how video game-related problems or addiction might be associated with specific outcomes on measures of physical and psychological health. Because of the mixed findings from

previous research into excessive use of video games and video game addiction, we did not state directional hypotheses regarding these relationships.

## Methods

### *Participants and procedure*

The survey population of the present study comprised 2,500 individuals aged 15–40, randomly selected from the Norwegian National Registry by the National Tax Authorities.

Written questionnaires were distributed by mail, and responses could be made through the mail by using an enclosed self-addressed stamped envelope or via a Web site. One reminder was sent to those who did not initially respond. We were unable to contact 101 of the individuals because of incorrect addresses. In total, 816 respondents completed and returned the questionnaire via post ( $n = 672$ ) or completed the survey on the Web site ( $n = 144$ ), resulting in a response rate of 34.0 percent. Initial tests revealed no differences in age between those who responded via post or via the Web site, respectively ( $t(814) = 1.32, p = 0.19$ ). However, there was a larger proportion of male respondents answering online (69.0 percent) compared with the post (47.2 percent) ( $\chi^2(1, n = 816) = 22.67, p < 0.001$ ). The data collection took place in the autumn of 2009.

### *Measures*

**Video game use.** As a measure of whether and to what extent respondents used video games, they were asked to report the number of hours played per day and week (two items) as well as the frequency of play within 11 different game categories. The items were answered on a seven-point Likert scale (ranging from “never” to “every day”). We used these questions to investigate whether high frequency players were more likely to have MMORPGs as their preferred (most frequently played) type of game.

**Video game addiction.** The seven-item version of the Gaming Addiction Scale for Adolescents (GASA)<sup>5</sup> was adapted from Dutch to Norwegian by a translation-back-translation procedure. The scale includes one item for each of the seven criteria suggested as core components of video game addiction (salience, tolerance, mood modification, withdrawal, relapse, conflict, and problems). Each item comprises a problematic type of incident, with respondents indicating how often this has occurred over the past 6 months on a five-point Likert scale (“never” [1], “rarely,” “sometimes,” “often,” or “very often” [5]). Chronbach’s alpha for the GASA in the present study was 0.84. Lemmens et al.<sup>5</sup> highlighted that the cutoff point for video game addiction can be set in a number of different ways and suggested a monothetic approach wherein respondents have to endorse (i.e., score 3 or higher) all seven items to be classified as addicted. We adopted this approach to define video game addiction. Additionally, in line with the alternative and less-strict procedure suggested by Lemmens et al., we used a polythetic approach wherein respondents endorsing at least four of the items were categorized as problem gamers.

**Health outcomes.** Two scales were included to measure different aspects of mental health and to investigate how these relate to use of video games: the Satisfaction With Life

Scale (SWLS)<sup>16</sup> and the Hospital Anxiety and Depression Scale (HADS).<sup>17</sup> SWLS measures respondents’ general satisfaction with life and comprises five statements, with respondents being asked to indicate their level of agreement to each item on a seven-point Likert scale (ranging from “strongly disagree” to “strongly agree”). HADS measures anxiety (HADS-A) and depression (HADS-D; seven items each), with respondents indicating which of four response alternatives they agree with the most (ranging from 0 to 3). Chronbach’s alpha was 0.91, 0.75, and 0.77 for SWLS, HADS-A, and HADS-D, respectively.

Respondents were asked to indicate their frequency of engagement in sports or exercise (“never” [7], “less than once per month,” “1–3 days per month,” “1 day per week,” “2–3 days per week,” “4–6 days per week,” or “daily” [1]) as well as how frequently they exercised using video games such as Wii Fit (same alternatives as above). A previously validated method for obtaining self-reported health<sup>18</sup> was also used, wherein respondents were asked to rate their general health on a four-point Likert scale ranging from “bad” to “very good.”

### *Statistics*

The net sample was weighted according to the Norwegian demographic structure<sup>19</sup> to adjust for discrepancies between the population and the final sample in terms of age group and gender. See Table 1 for an overview of the resulting weights, applied in all analyses.

To investigate whether high frequency players were more likely than others to have MMORPGs as their preferred type of game, players were grouped into quartiles based on reported hours of video game use per week. We grouped players into quartiles because the reported hours of video game use was not normally distributed (skewness = 3.06, SE = 0.12; kurtosis = 11.51, SE = 0.23). The first quartile consisted of respondents with 0.01–1 hours of video game use per week. Those reporting 1.01–3 hours of play comprised the second quartile, 3.01–7 hours the third, and respondents with more than 7 hours of video game play per week comprised the fourth quartile. Respondents who did not use video games were excluded. Crude (unadjusted) and adjusted (multivariate) logistic regression analyses were then performed, with MMORPG preference (yes/no) as the dependent variable and gender (female as reference), age category (16–21, 22–27, 28–33, 34–40, 34–40 as reference), and frequency quartile (1–4, first quartile as reference category) as independent categorical variables.

TABLE 1. EXPECTED AND OBSERVED RATIO FOR GENDER AND AGE GROUP AND RESULTING WEIGHT

Category	Expected percent	Observed percent	Weight
Male			
16–21	12.0	10.0	1.20
22–27	11.2	8.9	1.25
28–33	11.8	11.4	1.04
34–40	16.0	13.5	1.19
Female			
16–21	11.4	15.6	0.73
22–27	10.8	11.4	0.95
28–33	11.4	13.1	0.87
34–40	15.3	16.1	0.95

To investigate the relationships of gender and age group to problem video game use, crude and adjusted logistic regression analyses were conducted with "problem video game use" (yes/no) as the dependent variable and "gender" and "age group" as independent categorical variables. If the 95 percent confidence interval of the odds ratios (OR) in these analyses included 1.0, the association was not significant.

The low number of respondents (unweighted  $n = 4$ ) classified as addicted to video games precluded us from further statistical analysis of this group of respondents.

To test for associations between video game use and health, respondents were categorized as nongamers, gamers, or problem gamers. A multivariate analysis of variance (MANOVA) was conducted, with the following five dependent variables: HADS-A, HADS-D, SWLS, self-reported health, and level of exercise. Gamer category (three levels: nongamer/gamer/problem gamer) comprised the independent variable. The MANOVA was followed up by univariate ANOVAs. Bonferroni adjusted pairwise comparisons were used for *post hoc* analysis. Outliers were checked univariately and multivariately. The univariate analyses comprised calculation of the  $z$ -adjusted score on all of the dependent variables. In cases where the  $z$ -score was outside the  $\pm 3.3$  interval, the specific score on that variable was adjusted to the most extreme value with a corresponding  $z$ -score within the  $\pm 3.3$  interval. This led to the adjustment of nine scores on the HADS-D and five scores on the SWLS. In terms of multivariate outliers, Mahalanobis distance scores were calculated and values greater than 25 were excluded from the analysis. This led to the exclusion of two respondents. Further, equality of variances, homogeneity of variance-covariances, and absence of multicollinearity were checked with no violations of assumptions.

## Results

### Video game use by gender and age

In total, 56.3 percent of respondents used video games regularly (hours per week  $>0$ ), whereas the remaining 43.7 percent were nongamers (hours per week = 0). There was a significant gender difference in the use of video games. The majority of male respondents (68.6 percent) reported using video games regularly, whereas the majority of female respondents (56.6 percent) were nongamers ( $\chi^2(1, n = 816) = 52.73, p < 0.001$ ). Further, a  $2 \times 4$  ANOVA with gender and age group (16–21, 22–27, 28–33, and 34–40) as independent factors and hours of video game play per week as the dependent variable showed a significant effect of gender ( $F(1,790) = 67.96, p < 0.001$ ) and age group ( $F(3,790) = 16.38, p < 0.001$ ) as well as a significant age group by gender interaction effect ( $F(3,790) = 9.30, p < 0.001$ ). *Post hoc* tests revealed that the 16–21 age group played significantly more than the two oldest age groups ( $p < 0.01$ ), but no more than the 22–27 age group. Figure 1 illustrates the interaction effect, showing that the effect of age on gaming time is mainly present among the male respondents.

### MMORPG preference

A total of 37.2 percent of the gamers in the fourth quartile had MMORPGs as their preferred type of game, compared with 5.9 percent of gamers in the first quartile. The logistic regression analyses showed that gender and gaming frequency quartile were significant predictors for MMORPG

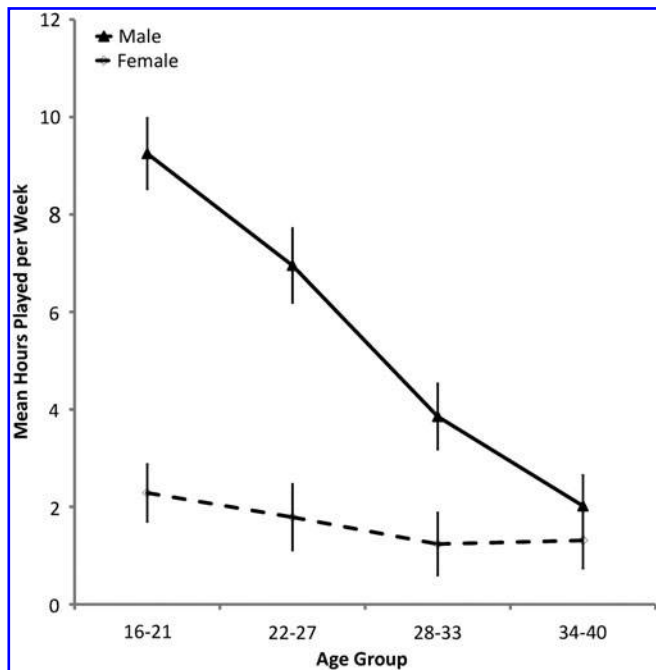


FIG. 1. Mean number of hours played per week for each age group and gender. Error bars represent standard errors.

preference in both the crude and adjusted analyses. Age group was not a significant predictor in either analysis. OR, shown in Table 2, indicates that being male and being in the fourth quartile of gaming frequency were the factors most strongly associated with having MMORPGs as preferred type of game.

### Prevalence of video game addiction

There was no significant association between response time (before or after the reminder) and video game addiction or problem video game use ( $\chi^2(1) = 0.92, p = 0.34$  and  $\chi^2(1) = 0.04, p = 0.84$ , respectively). Similarly, no significant association was found between response mode (post vs. Web site) and video game addiction or problem video game use ( $\chi^2(1) = 0.01, p = 0.91$  and  $\chi^2(1) = 0.71, p = 0.40$ , respectively).

The weighted prevalence of video game addiction was 0.6 percent ( $n = 5$ ; 95% CI, [0.1%, 1.2%]). Unadjusted for population weights, four respondents were classified as addicted to video games. They were all male, aged 17, 20, 23, and 36. For problem video game use, the weighted prevalence was 4.1 percent ( $n = 33$ ; 95% CI, [2.7%, 5.5%]). The logistic regression revealed that gender and age group were significant predictor categories in both the crude and adjusted analyses. As shown in Table 3, being male and in the youngest age group were the strongest predictors of problem video game use. Table 4 shows the prevalence of problem video game use by gender and age group.

### Video game use and health

The MANOVA revealed a significant overall main effect of gamer category (nongamer, gamer, or problem gamer;  $F(10, 1576) = 3.83, p < 0.001$ ). Univariate followup ANOVAs to the multivariate test showed a significant main effect of gamer category on the health outcome variables in the following way: HADS-A,  $F(2, 792) = 6.45, p < 0.01$ ; HADS-D,  $F(2,$

TABLE 2. LOGISTIC REGRESSION ANALYSIS COMPRISING GENDER, AGE GROUP, AND GAMING FREQUENCY AS PREDICTOR VARIABLES AND MASSIVELY MULTIPLAYER ONLINE ROLE-PLAYING GAME PREFERENCE AS CRITERION VARIABLE

	Crude		Adjusted <sup>a</sup>	
	$\beta$ (SE)	OR (95% CI)	$\beta$ (SE)	OR (95% CI)
Gender				
Female		1.00 <sup>b</sup>		1.00 <sup>b</sup>
Male	1.84 (0.47)	6.31 (2.52–15.80)**	1.71 (0.52)	5.53 (1.98–15.43)**
Age group				
34–40		1.00 <sup>b</sup>		1.00 <sup>b</sup>
16–21	0.29 (0.42)	1.33 (0.59–3.00)	–0.49 (0.49)	0.95 (0.37–2.48)
22–27	0.69 (0.41)	1.99 (0.89–4.46)	0.43 (0.48)	1.54 (0.60–3.98)
28–33	–0.57 (0.49)	0.94 (0.36–2.47)	–0.132 (0.55)	0.88 (0.30–2.56)
Gaming frequency quartile				
1		1.00 <sup>b</sup>		1.00 <sup>b</sup>
2	0.34 (0.55)	1.40 (0.48–4.15)	0.43 (0.57)	1.54 (0.51–4.69)
3	–0.07 (0.58)	0.93 (0.30–2.88)	–0.24 (0.59)	0.79 (0.25–2.49)
4	1.87 (0.43)	6.46 (2.79–14.99)**	1.65 (0.45)	5.22 (2.14–12.75)**

<sup>a</sup>OR adjusted for all variables in the table.<sup>b</sup>Reference category.\*\* $p < 0.001$ .

OR, odds ratio.

792) = 9.87,  $p < 0.001$ ; SWLS,  $F(2, 792) = 14.16$ ,  $p < 0.001$ ; and self-reported health,  $F(2, 792) = 5.86$ ,  $p < 0.01$ . There was no main effect of gamer category on level of exercise ( $F(2, 792) = 0.50$ ,  $p = 0.78$ ). *Post hoc* tests revealed that problem video gamers had higher levels of anxiety and depression and lower life satisfaction compared with both nongamers and no-problem gamers. The no-problem gamers had worse self-reported health compared with nongamers, but were not different from the problem video gamers. As there was no overall significant effect of gamer category on level of exercise, no *post hoc* tests were performed for this pair of variables. Table 5 shows the mean scores for all three groups of video game users on each of the five outcome variables.

## Discussion

Our results show that the majority of young Norwegian adults use video games on a regular basis. Further, for the

vast majority of gamers, this activity appears to serve a purely recreational purpose, with our data indicating that video game addiction is a relatively low-prevalence phenomenon. In total, only 0.6 percent could be classified as addicted, whereas 4.1 percent met the criteria for problem video game use. Young age and male gender were the strongest predictors of problem video game use. Our estimated prevalence of video game addiction was lower than the previously estimated prevalence of video game addiction in Norway by 2 percent.<sup>14</sup> However, that study defined video game addiction purely by self-reported frequency of play. Even though problematic use of video games is likely to be associated with more time spent playing, frequency of play alone should not be regarded as an indicator of video game addiction,<sup>5</sup> because doing so might yield inflated estimates of prevalence. Our estimated prevalence was also lower than those reported by other previous studies, including one applying the same scale to a Dutch sample of

TABLE 3. LOGISTIC REGRESSION ANALYSIS COMPRISING AGE AND GENDER AS PREDICTOR VARIABLES AND PROBLEM VIDEO GAME USE AS CRITERION VARIABLE

	Crude		Adjusted <sup>a</sup>	
	$\beta$ (SE)	OR (95% CI)	$\beta$ (SE)	OR (95% CI)
Gender				
Female		1.00 <sup>b</sup>		1.00 <sup>b</sup>
Male	1.72 (0.49)	5.57 (2.14–14.52)**	1.76 (0.49)	5.80 (2.21–15.22)**
Age group				
34–40		1.00 <sup>b</sup>		1.00 <sup>b</sup>
16–21	1.49 (0.50)	4.43 (1.65–11.87)*	1.52 (0.51)	4.57 (1.69–12.37)*
22–27	0.95 (0.54)	2.59 (0.89–7.53)	0.96 (0.55)	2.62 (0.89–7.68)
28–33	–1.39 (1.08)	0.25 (0.03–2.039)	–1.42 (1.08)	0.24 (0.03–2.00)

<sup>a</sup>OR adjusted for all variables in the table.<sup>b</sup>Reference category.\* $p < 0.01$ .\*\* $p < 0.001$ .



TABLE 4. PREVALENCE OF PROBLEM VIDEO GAME USE BY GENDER AND AGE GROUP

Category	Problem VGU %
Male	
16–21	15.4
22–27	9.7
28–33	1.1
34–40	2.8
Female	
16–21	2.5
22–27	1.1
28–33	0
34–40	1.6

VGU, video game use.

adolescents,<sup>5</sup> a study using a sample of German ninth graders,<sup>6</sup> and a study of American adolescents.<sup>15</sup> The discrepancy between the results from the present study and those from the studies referred to above can probably to some extent be explained by the inclusion of older age groups in our study. Indeed, we did find a higher prevalence of problematic use of video games in the younger age groups when compared with older ones, a finding that has also been reported by others.<sup>15</sup> The marked predominance of males among problem gamers, which has been reported by previous studies,<sup>5,6,14,20</sup> was replicated in our study. Finally, it should be noted that the monothetic method of measuring video game addiction represents a conservative approach. Polythetic methods are less strict and more commonly used by clinical classification systems. Employing such an approach would yield a higher estimated prevalence.

Our data did show that a significantly greater proportion of high frequency gamers confirm MMORPGs as their favorite type of game, in comparison to the less frequent gamers. However, the vast majority (72.8 percent) of high frequency gamers reported other types of game as their favorite. Thus, high frequency video gaming is not a phenomenon exclusively related to MMORPGs.

With regard to health, our data showed that video gamers obtained lower scores on self-reported health than respon-

dents who did not use video games. Further, problem gamers had elevated scores on measures of anxiety and depression and lower scores on satisfaction with life. In other words, our data show a clear and consistent pattern in which video game problems are associated with poorer health. This supports findings from other recent surveys.<sup>6,14</sup> However, mean scores of the video game problems group were still within the normal range for the health measures employed by our study, and thus, a pathologization of this group may actually be unjustified. It is also interesting to note that there is nothing in our data to indicate that problem gamers play video games at the expense of exercise, as there were no differences between gaming frequency groups on this outcome variable.

In our sample, the small number of respondents categorized as addicted to video games prevented us from estimating how video game addiction may be associated with measures of mental and physical health. Future studies are therefore needed to examine potential relationships between gaming addiction and various health outcomes.

### Strengths and Limitations

A major strength of our study lies in its nationwide cross-sectional design that allows for the estimation of video gaming prevalence in the general Norwegian adult population. Another asset of the present study was the use of a validated scale of game addiction.

A limitation of our study is the relatively low response rate. However, a low response rate does not necessarily have a significant impact on results,<sup>21,22</sup> and our data showed no difference in the prevalence of video game addiction or problem video game use between those who responded before and after a reminder. Further, a strength of our study is the relatively large number of respondents.

Our study is, to the best of our knowledge, the first to use a validated scale to measure the prevalence of video game addiction and its associations with mental and physical health, in a nationwide representative sample of young adults.

### Conclusions

The results from this study suggest that video game addiction is a relatively low-prevalence phenomenon among Norwegian young adults, but a significant proportion displays some problems related to their use of video games. Problematic use of video games is especially prevalent among young males and is associated with poorer self-reported physical and mental health.

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### Disclosure Statement

No competing financial interests exist.

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TABLE 5. MEAN HEALTH OUTCOME SCORES BY GAMER GROUP

	Nongamer M (SD)	Gamer M (SD)	Problem gamer M (SD)
HADS anxiety <sup>a,b</sup>	4.74 (3.08)	5.15 (2.98)	6.81 (2.53)
HADS depression <sup>a,b</sup>	2.56 (2.82)	3.11 (2.75)	4.81 (2.80)
SWLS <sup>a,b</sup>	5.34 (1.23)	5.07 (1.22)	4.13 (0.90)
Self-reported health <sup>c</sup>	1.94 (0.76)	2.13 (0.80)	2.19 (0.85)
Exercise	3.46 (1.38)	3.49 (1.42)	3.65 (1.55)

Note: Superscript letters denote significant differences between the groups of gamers on the health outcome scores in the following ways: <sup>a</sup>problem gamer > gamer; <sup>b</sup>problem gamer > no gamer; <sup>c</sup>gamer > no gamer.

HADS, Hospital Anxiety and Depression Scale; SWLS, Satisfaction With Life Scale.

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