WHICH HEALTH-RELATED PROBLEMS ARE ASSOCIATED WITH PROBLEMATIC VIDEO-GAMING OR SOCIAL MEDIA USE IN ADOLESCENTS? A LARGE-SCALE CROSS-SECTIONAL STUDY

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Abstract

Objective: Problematic video-gaming or social media use may seriously affect adolescents' health status. However, it is not very well known which health-related problems are most strongly related to these issues. To inform the development of prevention and intervention strategies, this study aims to gain a better understanding of the health-related problems and demographical factors associated with problematic video-gaming or social media use in early adolescence.

Method: A cross-sectional analysis was performed on data collected by two Municipal Health Services in the Netherlands in 2013-2014. In this survey among youth, 21,053 students from secondary schools (mean age 14.4 years) completed a web-based questionnaire. Multivariate analyses were carried out to assess the strength of the associations between mental health problems, life-events, lifestyle and substance use as independent variables, and problematic video-gaming and problematic social media use as dependent variables.

Results: Of the participating students, 5.7% reported problematic video-gaming and 9.1% problematic social media use. Problematic video-gaming was most strongly associated with conduct problems, suicidal thoughts (all medium effect sizes, OR ≥2, $p<0.01$), sedentary behavior (large effect size, OR ≥3, $p<0.01$), and male gender (large effect size). Problematic social media use was highly associated with conduct problems, hyperactivity and sedentary behavior (all medium effect sizes). Additionally, female gender and non-Western ethnicity were relevant demographics (large and medium effect size).

Conclusions: Most mental health problems were consistently associated with both problematic video-gaming and problematic social media use, though associations were only practically relevant for conduct problems (both groups), suicidal thoughts (problematic video-gaming) and hyperactivity (problematic social media use). This study also highlights sedentary behavior as health risk as it was associated with both problematic video-gaming and problematic social media use. Interventions for young problematic video-gamers or social media users should take into account mental health and physical activity.

Key words: problematic video-gaming, problematic social media use, mental health, lifestyle, adolescents

Declaration of interest: none

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Introduction

Nowadays, adolescents grow up with plentiful Internet options to interact and communicate, making them digital natives (Correa et al. 2010, Wang et al. 2015). In the Netherlands, adolescents (12-15 years) mainly use the Internet for online games (15 hours per week for boys, 7 hours for girls) and social media (12 hours per week for girls, 10 hours for boys) (Van Rooij and Schoenmakers 2013). The present study focuses on video games and social media since these two types of new technologies are frequently used for various reasons (Granic et al. 2014, Spies Shapiro and Margolin 2014, Van Rooij et al. 2011). Positive consequences of video-gaming include enjoyment, feelings of achievement, mood enhancement, friendship and a sense of community (Granic et al. 2014, Sublette and Mullan 2012). In addition, social media are widely used for relationship maintenance, passing time, entertainment, companionship (Ryan et al. 2014), and can also stimulate self-presentation and self-disclosure in adolescence (Valkenburg and Peter 2011).

However, researchers have suggested that adolescents in particular may be at risk for problematic

Submitted May 2016, Accepted July 2016

use of these new technologies (Griffiths 2013), due to their limited capacity for self-regulation, their risk-taking behavior and susceptibility to peer pressure (O'Keeffe and Clarke-Pearson 2011). The current study views problematic use of these new technologies as addiction-like behavior. This has been conceptualized earlier by Griffiths in the biopsychosocial framework for the etiology of addictions (Griffiths 2013). According to this framework, a number of behaviors are potentially addictive and associated with symptoms that resemble substance-related addictions, namely mood modification, salience, tolerance, withdrawal symptoms, conflict and relapse (Griffiths 2005). In this article, we refer to 'problematic' behavior rather than 'addictive', as we reserve the latter term for clinical levels of impairment (Van Rooij et al. 2014).

Problematic video-gaming

In recent years, researchers have extensively studied problematic video-gaming. Studies on the health status of problematic video-gaming were mainly aimed at adolescents' mental health (Lam 2014, Sublette and Mullan 2012). Most studies showed that problematic video-gaming was associated with increased mental health problems such as anxiety, depression, insomnia (Kuss et al. 2013, Mentzoni et al. 2011), suicidal thoughts (Rehbein et al. 2010), and social, conduct problems and attention problems (Brunborg et al. 2014, Kuss and Griffiths 2012). Furthermore, a potential cause for problematic video-gaming is escapism, i.e. adolescents might excessively play games in order to avoid everyday problems in real life such as stressful life-events (Kuss and Griffiths 2012).

Regarding important lifestyle factors, some studies indicate that video-gaming in general is associated with low levels of physical activity (Marshall et al. 2004) and problematic video-gaming with poor dietary habits (Kim et al. 2010). Furthermore, inconsistent results have been found in studies that examined the co-occurrence of problematic video-gaming and substance use, particularly alcohol use (Brunborg et al. 2014, Van Rooij et al. 2014). In addition, only a few studies have investigated the relationship between problematic video-gaming and multiple health-related determinants. These studies found indications of a poorer health status, but primarily in adult gamers (Mentzoni et al. 2011, Wittek et al. 2015).

Problematic social media use

Despite the fact that there is much concern among parents, teachers and professionals about harmful health effects of social media use, research addressing problematic social media use is still in its infancy (Bell et al. 2015, Kuss and Griffiths 2011, Ryan et al. 2014). In this article we assume that problematic social media use may be viewed as addiction-like behavior and might be associated with symptoms comparable to those found in problematic video-gamers (Van Rooij et al. 2015). Several studies have indicated that (young) adults who were socially anxious, emotionally unstable, as well as those who exhibited symptoms of depression or ADHD, were more likely to use social media (Andreassen et al. 2016, Correa et al. 2010, Lee-Won et al. 2015, Pantic 2014 ,). However, to date, no studies have discussed problematic social media use linked directly to multiple health-related problems. Furthermore, most empirical evidence is available from studies on problematic Facebook use (Pantic 2014) while the majority of adolescents use different types of social media tools (Van Rooij and Schoenmakers 2013). Lastly, there is an urgent need for using large-scale, representative samples and reliable measurements (Griffiths 2013, Van den Eijnden et al. 2016).

Present study

The present study aims to identify which health-related problems are most important for adolescents that are at risk for problematic video-gaming or social media use. Attention for the health status of problematic video-gamers and social media users is important, largely because risky health behaviors developed during adolescence have the potential to persist through adulthood (Do et al. 2013). In doing so, this article builds on the insights into mental health-related factors recently provided by Andreassen et al. (2016) in a large-scale adult population. It adds to it by examining a wide range of health-related problems simultaneously in a large representative sample of adolescents. This study also explores demographical factors that are related to problematic video-gaming or social media use in adolescence in order to inform the design of effective prevention and intervention strategies for specific risk groups. Although this relationship has previously been studied (Kuss et al. 2014), this is one of the first studies exploring demographical risk factors of problematic video-gaming and social media use within the same sample (Andreassen et al. 2016, Van Rooij et al. 2015). Based on previous research, it is expected that problematic video-gaming is associated with mental health problems, life-events, substance use, low levels of physical activity and male gender (Andreassen et al. 2016, Kuss and Griffiths 2012, Marshall et al. 2004, Sublette and Mullan 2012, Van Rooij et al. 2014). Given our assumption that problematic social media use may be viewed as addiction-like behavior, we expect it to be associated with the same health-related problems as problematic video-gaming. Contrary to video-gaming being female is hypothesized as risk factor (Andreassen et al. 2016, Kuss and Griffiths 2011, Pantic 2014, Ryan et al. 2014).

Method

Participants and procedures

Data for this study were obtained from the Youth Monitor 'Elektronische Monitor en Voorlichting' (EMOVO; Electronic Monitoring and Education). This cross-sectional study aimed to provide insight into the physical health, mental health and lifestyle risks of adolescents in the Netherlands. In secondary schools across the country, second- and fourth graders, were invited to complete a web-based questionnaire while being supervised by a teacher. For this study we used the anonymous data of students living and receiving education in the region of two Municipal Health Services (GGD Hollands-Noorden and GGD Kennemerland). Data were collected between October 2013 and February 2014. In total, 73 schools participated and 21,329 students filled in a questionnaire. Cases were excluded when less than 25% of the basic questions were answered (n=36), or when the answers were extreme and unreliable (n=240). The remaining 21,053 students represented 72% of the total number of second- and fourth graders living within the region; they were representative regarding age, while educational level

was a little higher than the student population. Under Dutch law, ethical review was not necessary for this secondary analysis of anonymous data.

Instruments

Problematic video-gaming and problematic social media use

In this study we use the general term video-gaming for any type of video game on devices such as computer, tablet, smartphone or game console (e.g. Playstation, Wii, Xbox, DS). The general term social media refers to any type of social networking site or instant messengers (e.g. Facebook, Skype, Ping, Whatsapp, Twitter). We used two abbreviated versions of the validated Compulsive Internet Use Scale (CIUS) (Meerkerk et al. 2009) to measure problematic video-gaming and problematic social media use (Van Rooij et al. 2015, Van Rooij and Schoenmakers 2013). These brief measures contain six items to assess the following core symptoms of problematic ('addictive') use: loss of control, preoccupation, withdrawal symptoms, coping, social problems and problems fulfilling responsibilities in school. Students were asked to rate each core symptom on a 5-point Likert scale from 'never' (1) to 'very often' (5). For example: 'How often do you find it difficult to stop *gaming/using social media*?'. The internal consistency was good in our study sample (For problematic video-gaming Cronbach's α=.88, for problematic social media use Cronbach's α=.82). Mean scores were computed for problematic video-gaming or social media use, provided that students completed at least four items. The scores were dichotomized into 'problematic video-gaming/ social media use' (mean score ≥3), and 'no problematic video-gaming/social media use' (Van Rooij et al. 2015, Van Rooij and Schoenmakers 2013). The questionnaire about problematic video-gaming was completed by students who (sometimes) played games (of any type of game) only. We added the group that never played games to the group of 'no problematic video-gaming'.

General health

A single-item question was used to measure general self-rated health (DeSalvo et al. 2006). Students were asked: 'How do you rate your health in general?', with answers ranging from 'very good' (1) to 'very bad' (5). Responses were dichotomized and 'poor health status' (answers fair to (very) bad) was defined as the risk group.

Mental health

Psychosocial problems were assessed using the validated Dutch version of the 25-item Strengths and Difficulties Questionnaire (SDQ). The SDQ uses a 3-point Likert scale to measure five important domains of child psychopathology: 'emotional symptoms', 'conduct problems', 'hyperactivity and attention deficit problems', 'peer relationship problems' and 'prosocial behavior' (Murris et al. 2003). The internal consistency in our sample was acceptable with Cronbach's α varying between .49 (conduct problems) to .75 (hyperactivity/ inattention). The cut-off values suggested by Goodman were used to classify students in risk groups, i.e. 'moderate or high score' of a specific subscale (Bourdon et al. 2005).

Suicidal thoughts were measured using the single-item question: 'Have you seriously thought about putting an end to your life in the past 12 months?', with answers ranging from 'never' (1) to 'very often' (5). Scores were dichotomized, and we defined 'had at least one suicidal thought this year' (sometimes to very often) as risk group.

Bullying was measured using the single-item question: 'How often have you been bullied at school in the past three months?', with answers ranging from 'never' (1) to 'several times a week' (5). Scores were dichotomized, and we defined 'was bullied at least once in the past 3 months' as risk group.

Life-events

Two major life-events were measured, i.e. divorce and financial problems of parents (including foster or step-parents). For each life-event separately, students were asked the single-item question: 'Have you ever experienced this life-event or do you experience it now?', and the answer 'Yes' was defined as risk group.

Lifestyle

Physical activity was measured using eight questions that assessed the frequency and duration of four different physical activities during the past week: 1) walking or cycling to school, 2) physical education, 3) sports at sports clubs, and 4) leisure-time sports. The frequency was defined as the number of days per week, and the duration as the number of minutes or hours per day, categorized in five time units. Total minutes per week spent on different physical activities were calculated by multiplying duration and frequency. Physical activity was dichotomized based on the Dutch recommendations for healthy exercise among adolescents (Kemper et al. 2000). The risk group comprised those 'physically active for on average less than one hour per day'.

Sedentary behavior was measured using four questions that assessed the frequency and duration of two sedentary behaviors: 1) watching TV or DVD, 2) using the computer, laptop, tablet or game console for reasons other than schoolwork. Total minutes of sedentary behavior per week were calculated by multiplying duration and frequency. Sedentary behavior was dichotomized based on international recommendations for sedentary behavior (American Academy of Pediatrics 2001). The risk group was defined as being 'sedentary for on average at least two hours per day'.

Breakfast habits were assessed using a single-item question asking how many days a week students ate breakfast (Martens et al. 2005). Answers ranged from '(almost) never' (1) to 'every day' (8). Breakfast habits were dichotomized, and the risk group was 'eats breakfast less than five times per week'.

Substance use

Smoking was assessed using two questions: 1) 'Have you ever smoked at least one cigarette?', and 2) 'How often do you smoke now?'. An affirmative answer to the first question led to the second, with the following answers: 'I don't smoke', 'less than once per week', 'at least once per week, but not every day' and 'every day'. Smoking was dichotomized and 'smoked recently' (smokes less than once per week to every day) was defined as risk group.

Alcohol consumption was assessed using the single-item question 'How often have you consumed alcohol in

the past four weeks? We mean the number of occasions such as a party or a night out'. Answers ranged from '0 times' (1) to '20 times or more' (13). Alcohol consumption was dichotomized and the risk group was 'used alcohol at least once this past month'.

Cannabis use was measured using a question similar to that for alcohol consumption, and was dichotomized with 'used cannabis at least once this past month' as risk group.

Demographics

Demographic variables included age (continuous), gender (boy or girl), educational level (low: lowest levels of vocational training; middle: highest level of vocational training; high: pre-college or university training), ethnicity (native, non-native/Western or non-native/non-Western) and family type (two biological parents or other family types: blended family, single parent and adoptive parents).

Statistics

All analyses were performed using SPSS 21.0. First, the prevalence of problematic video-gaming or social media use and health-related problems was calculated. Next, we conducted multiple logistic regression analyses in three steps to determine the associations between the health-related problems and the dependent variable (problematic video-gaming/social media use). We started with a series of bivariate analyses to assess the Odds Ratio of each factor one by one (bivariate model). Then we repeated the analyses with all factors entered into the model simultaneously (complete model), including all potential confounders (age, gender, educational level, ethnicity and family type). Lastly, we simplified the complete model by retaining only those factors that were statistically the most significant ($p<.01$), eliminating the factors that were not significant or only modestly significant ($p<.05$) (the parsimonious model). We also classified the effect sizes of the final factors as minimal ($OR<1.5$), small ($1.5\leq OR<2$), medium ($2\leq OR<3$) and large ($OR\geq 3$) (Sullivan and Fein 2012), and we considered medium and large effect sizes as 'practically' relevant (Ferguson 2009).

Results

Sample characteristics

Table 1 presents the characteristics of the study population. The study sample comprised 21,053 students, of whom 50.6% were girls and the average age was 14.4 years (SD=1.3). Of the participating students, 5.7% reported some (addictive) problems with video-gaming and 9.1% with social media use. **Table 1** shows further information on sample characteristics.

Table 1. *Characteristics of the study population*

	Study sample (N=21,053)
Demographics (risk group)	**Mean (SD)/Proportion**
Age	14.4 (1.3)
Gender (girls)	50.6
Educational level (low)	19.4
Educational level (middle)	22.5
Ethnicity (non-native/Western)	7.0
Ethnicity (non-native/non-Western)	11.2
Family type (no two biological parents)	24.9
Health-related problems (risk group)	
General health	
Health status (poor)	17.8
Mental health	
Emotional symptoms (moderate/high)	11.6
Conduct problems (moderate/high)	11.7
Hyperactivity/inattention (moderate/high)	27.2
Peer problems (moderate/high)	10.7
Prosocial behavior problems (moderate/high)	11.9
Suicidal thoughts (≥1 time past year)	18.4
Bullied at school (≥1 time past 3 months)	12.1
Life-events	
Divorced parents (yes)	22.2
Financial problems parents (yes)	16.0
Lifestyle	
Physical activity (<1 hour/day)	32.8
Sedentary behavior (≥2 hours/day)	52.2
Breakfast (<5 times/week)	14.6
Substance use	
Smoking (recent)	13.1
Alcohol use (≥1 time past month)	35.7
Cannabis use (≥1 time past month)	6.0
Video-gaming/Social media use	
Video-gaming (problematic)	5.7
Social media use (problematic)	9.1

Problematic video-gaming: associated health-related problems

Bivariate analyses indicated that all health-related problems except smoking and alcohol use were significantly related to problematic video-gaming (see **table 2**, bivariate model). When all factors were entered simultaneously, life-events, breakfast and cannabis use were no longer significantly associated with problematic video-gaming (see **table 2**, complete model). In the parsimonious and final model, poor health status (OR=1.45; 95% CI: 1.24 ~ 1.70), conduct problems (2.08; 1.78 ~ 2.43), hyperactivity/inattention (1.78; 1.56 ~ 2.04), problems with prosocial behavior (1.89; 1.63 ~ 2.19), suicidal thoughts (2.28; 1.96 ~ 2.65), low level of physical activity (1.39: 1.22 ~ 1.59), high level of sedentary behavior (4.77; 3.99 ~ 5.70), and recent smoking (0.62; 0.51 ~ 0.76) were most strongly associated with problematic video-gaming. In addition, of the demographical factors, only gender was strongly related to problematic video-gaming (p<.01, see **table 2**). Associations were only practically relevant (medium or large effect size) for conduct problems, suicidal thoughts, sedentary behavior and male gender. Finally, C-statistics measured with a ROC-curve showed a good model fit for the parsimonious model (.85).

Problematic social media use: associated health-related problems

Bivariate analyses indicated that all health-related problems were significantly related to problematic social media use (see **table 3**, bivariate model). The multivariate analysis showed that life-events, physical activity and cannabis use were no longer significantly associated with problematic social media use (see **table 3**, complete model). In the parsimonious model, poor health status (OR=1.25; 95% CI: 1.11 ~ 1.41), emotional symptoms (1.60; 1.40 ~ 1.83), conduct problems (2.08; 1.82 ~ 2.38), hyperactivity/inattention (2.15; 1.93 ~ 2.39), problems with prosocial behavior (1.38; 1.18 ~ 1.60), suicidal thoughts (1.79; 1.59 ~ 2.01), high level of sedentary behavior (2.12; 1.90 ~ 2.37), low breakfast frequency (1.31; 1.15 ~ 1.48), recent smoking (1.35; 1.17 ~ 1.56), and alcohol use (1.65; 1.45 ~ 1.88) were most strongly associated with problematic social media use. In addition, age, gender, educational level, and ethnicity were strongly related to problematic social media use (p<.01, see **table 3**). Associations were practically relevant for conduct problems, hyperactivity/inattention, sedentary behavior, female gender and non-Western ethnicity. Finally, C-statistics showed a good model fit for the parsimonious model (.80).

Table 2. *The association of health-related problems with problematic video-gaming*

Problematic video-gaming – yes or no (N=20,741, problematic video-gaming N=1,174)				
	Bivariate model	**Complete model**	**Parsimonious model[a,b]**	**Effect Size[b]**
	OR (95%CI)	**OR (95% CI)**	**OR (95% CI)**	
Demographics (risk group)				
Age	0.98 (0.93-1.02)	0.93 (0.88-0.99)*		
Gender (boys)	8.15 (6.83-9.73)**	9.70 (7.91-11.91)**	8.71 (7.19-10.56)**	Large
Educational level (low)	1.46 (1.26-1.69)**	0.90 (0.76-1.07)		
Educational level (middle)	1.31 (1.13-1.51)**	0.97 (0.83-1.14)		
Ethnicity (non-native/Western)	1.01 (0.80-1.27)	1.02 (0.79-1.32)		
Ethnicity (non-native/non-Western)	1.19 (0.99-1.42)	1.24 (1.01-1.51)*		
Family type (no two biological parents)	1.22 (1.07-1.39)**	0.95 (0.73-1.23)		
Health-related problems (risk group)				
General health (poor)	1.63 (1.42-1.86)**	1.34 (1.13-1.58)**	1.45 (1.24-1.70)**	Small
Mental health				
Emotional symptoms (moderate/high)	1.27 (1.07-1.50)**	1.30 (1.03-1.63)*		
Conduct problems (moderate/high)	3.79 (3.32-4.32)**	1.90 (1.61-2.24)**	2.08 (1.78-2.43)**	Medium
Hyperactivity/inattention (moderate/high)	2.23 (1.98-2.51)**	1.77 (1.54-2.03)**	1.78 (1.56-2.04)**	Small
Peer problems (moderate/high)	2.57 (2.22-2.98)**	1.25 (1.04-1.50)*		
Prosocial behavior problems (moderate/high)	3.70 (3.24-4.23)**	1.87 (1.61-2.18)**	1.89 (1.63-2.19)**	Small
Suicidal thoughts (≥1 time past year)	2.12 (1.86-2.41)**	2.06 (1.75-2.42)**	2.28 (1.96-2.65)**	Medium
Bullied at school (≥1 time past 3 months)	1.91 (1.65-2.22)**	1.27 (1.06-1.53)*		
Life-events				
Divorced parents (yes)	1.15 (1.00-1.32)*	0.96 (0.73-1.25)		
Financial problems parents (yes)	1.31 (1.13-1.53)**	1.14 (0.95-1.36)		
Lifestyle				
Physical activity (<1 hour/day)	1.36 (1.20-1.53)**	1.42 (1.24-1.63)**	1.39 (1.22-1.59)**	Minimal
Sedentary behavior (≥2 hours/day)	6.62 (5.57-7.86)**	4.91 (4.09-5.90)**	4.77 (3.99-5.70)**	Large
Breakfast (<5 times/week)	1.28 (1.10-1.50)**	1.14 (0.95-1.37)		
Substance use				
Smoking (recent)	1.06 (0.90-1.26)	0.69 (0.55-0.88)**	0.62 (0.51-0.76)**	Small
Alcohol use (≥1 time past month)	1.08 (0.95-1.22)	1.04 (0.89-1.23)		
Cannabis use (≥1 time past month)	1.37 (1.09-1.70)**	0.96 (0.72-1.27)		
	*p≤.05, **p≤.01			

[a] The most significant factors of the complete model were included in the parsimonious model (p<.01)
[b] Effect Size was classified as minimal (OR <1.5), small (OR≥1.5), medium (OR≥2) or large (OR≥3)

Table 3. *The association of health-related problems with problematic social media use*

Problematic social media use – yes or no (N=20,771, problematic social media use N=1,897)				
	Bivariate model OR (95%CI)	**Complete model OR (95% CI)**	**Parsimonious model[a,b] OR (95% CI)**	**Effect Size[b]**
Demographics (risk group)				
Age	1.07 (1.03-1.11)**	0.93 (0.89-0.98)**	0.92 (0.87-0.96)**	Minimal
Gender (girls)	3.06 (2.75-3.40)**	3.20 (2.83-3.63)**	3.18 (2.81-3.60)**	Large
Educational level (low)	1.94 (1.73-2.17)**	1.27 (1.11-1.45)**	1.22 (1.08-1.38)**	Minimal
Educational level (middle)	1.52 (1.35-1.71)**	1.11 (0.97-1.26)		
Ethnicity (non-native/Western)	1.25 (1.04-1.49)*	1.13 (0.92-1.38)		
Ethnicity (non-native/non-Western)	1.90 (1.68-2.16)**	2.09 (1.80-2.43)**	2.05 (1.77-2.37)**	Medium
Family type (no two biological parents)	1.36 (1.23-1.51)**	0.88 (0.72-1.09)		
Health-related problems (risk group)				
General health (poor)	2.75 (2.48-3.04)**	1.23 (1.09-1.40)**	1.25 (1.11-1.41)**	Minimal
Mental health				
Emotional symptoms (moderate/high)	3.93 (3.52-4.39)**	1.63 (1.42-1.88)**	1.60 (1.40-1.83)**	Small
Conduct problems (moderate/high)	3.58 (3.20-4.00)**	2.12 (1.85-2.44)**	2.08 (1.82-2.38)**	Medium
Hyperactivity/inattention (moderate/high)	3.28 (2.98-3.61)**	2.11 (1.89-2.35)**	2.15 (1.93-2.39)**	Medium
Peer problems (moderate/high)	1.66 (1.45-1.90)**	0.84 (0.71-0.99)*		
Prosocial behavior problems (moderate/high)	1.52 (1.34-1.73)**	1.41 (1.21-1.65)**	1.38 (1.18-1.60)**	Minimal
Suicidal thoughts (≥1 time past year)	3.60 (3.26-3.98)**	1.76 (1.56-1.99)**	1.79 (1.59-2.01)**	Small
Bullied at school (≥1 time past 3 months)	1.99 (1.76-2.25)**	1.21 (1.04-1.40)*		
Life-events				
Divorced parents (yes)	1.35 (1.22-1.51)**	1.02 (0.82-1.26)		
Financial problems parents (yes)	2.08 (1.86-2.32)**	1.06 (0.92-1.21)		
Lifestyle				
Physical activity (<1 hour/day)	1.41 (1.28-1.55)**	0.95 (0.85-1.06)		
Sedentary behavior (≥2 hours/day)	2.08 (1.88-2.30)**	2.14 (1.91-2.39)**	2.12 (1.90-2.37)**	Medium
Breakfast (<5 times/week)	2.75 (2.47-3.06)**	1.31 (1.15-1.49)**	1.31 (1.15-1.48)**	Minimal
Substance use				
Smoking (recent)	2.61 (2.33-2.92)**	1.42 (1.22-1.65)**	1.35 (1.17-1.56)**	Minimal
Alcohol use (≥1 time past month)	1.95 (1.77-2.15)**	1.65 (1.44-1.88)**	1.65 (1.45-1.88)**	Small
Cannabis use (≥1 time past month)	1.83 (1.55-2.15)**	0.83 (0.67-1.02)		
	*p≤.05, **p≤.01			

[a] The most significant factors of the complete model were included in the parsimonious model (p<.01)
[b] Effect Size was classified as minimal (OR <1.5), small (OR≥1.5), medium (OR≥2) or large (OR≥3)

Discussion

The present study showed that a substantial number of adolescents reported some (addictive) problems with video-gaming (5.7%) or social media use (9.1%). Our multivariate analyses yielded four main findings. First, most mental health problems were consistently associated with both problematic video-gaming and problematic social media use, though associations were only practically relevant for conduct problems (problematic video-gaming/social media use), suicidal thoughts (problematic video-gaming) and hyperactivity (problematic social media use). The second main finding is that problematic video-gaming or social media use were not significantly associated with life-events, and only weakly associated with substance use. Third, sedentary behavior was the only lifestyle factor that was strongly associated with problematic video-gaming or social media use. Lastly, gender was the most relevant demographical factor since boys were evidently at higher risk for problematic video-gaming and girls for problematic social media use.

Strengths and limitations

The current study has a number of strengths. It is one of the first to examine the relationship between a wide range of health-related problems and problematic video-gaming or social media use in a large representative sample of adolescents. A main advantage of our approach is that associated health-related problems could be explored and compared for both problematic video-gaming and problematic social media use in a single sample using comparable measures, by using two brief measures deriving from a single parent scale. While many speculate about social media addiction, the debate is not always empirically grounded and the current study aims to contribute to the fact base.

However, the study also has several limitations. First, we cannot determine the causality of associations, owing to our cross-sectional study design. Another potential limitation is that we dichotomized most variables in order to indicate risk groups, which may have reduced the opportunity to find strong associations for some health-related outcomes. However, all cut-off scores were based on commonly used Public Health guidelines for problematic behavior or emotional states and these results are easier to interpret than continuous variables. Furthermore, we used a shortened version of a validated scale for problematic Internet use (CIUS), which may have resulted in a higher degree of false-positives in our study sample, but was necessary because of the length of the questionnaire and participant

burden. Lastly, future research might also include other problem indicators, such as insufficient sleep as a consequence of problematic video-gaming or social media use. Sleep quality, for example, is important for healthy participation in daily life (Vernon et al. 2015).

Interpretation of key findings

The empirical findings presented here fit with previous studies on the mental health profile of problematic video-gaming, including characteristics such as depressed mood, hyperactivity, conduct and problems with pro-social behavior (Andreassen et al. 2016, Brunborg et al. 2014, Du et al. 2010). Although we cannot draw any conclusions about causality, previous findings suggest that poorer psychological well-being can be viewed as both an antecedent and a consequence of problematic video-gaming in adolescence (Gentile et al. 2011, Lemmens et al. 2011). In line with our expectations we also found a strong relationship between mental health problems and problematic social media use, which corresponds with previous findings on ADHD-related behaviors and mental health problems (Andreassen et al. 2016, Nikkelen et al. 2014, Pantic 2014). In addition, ADHD is also associated with alexithymia, which is in turn related to Internet addiction (Scimeca et al. 2014).

The strong, positive relationship that was found between sedentary behavior and problematic video-gaming expands previous research demonstrating that computer activities in general driving sedentary behaviors (Fotheringham et al. 2000, Ho and Lee 2001). In addition, this research confirmed our hypothesis that problematic video-gaming was significantly associated with low levels of physical activity, though the effect size was low. Scientific literature has consistently shown that physical inactivity increases the risk of all-cause mortality, and recent findings showed an even higher mortality risk than was found for obesity (Ekelund et al. 2015). Furthermore, screen-based sedentary behaviors are an important risk factor for cardiometabolic diseases in children (Saunders et al. 2014). Consequently, the displacement of physical activities seems to cause harmful health effects rather than the video-gaming activities themselves (Bell et al. 2015).

Contrary to our expectations, results showed that life-events were only significantly related to problematic video-gaming or social media use in the bivariate analyses. This finding is consistent with a previous study which showed that parents' divorce and poor economic circumstances were not significantly related to internet addiction in a multivariate context (Tang et al. 2014). These results may support the idea that only life-events that induce chronically mild stress, such as school-related problems, are relevant risk factors for problematic internet use (Tang et al. 2014).

In the multivariate analyses we did not find strong relationships with any of the substance use indicators either. Problematic video-gaming was significantly associated with smoking, but the effect size was relatively low and non-smoking was associated with problematic video-gaming. Problematic social media use was significantly associated with smoking and alcohol use, but again, associations were below practically relevant effect sizes. Our multivariate approach might explain this lack of evidence as the logistic regression analyses with one factor (i.e. our bivariate model) showed that, in line with previous research, cannabis use was significantly related to problematic video-gaming (OR=1.37) (Van Rooij et al. 2014). Moreover, smoking, alcohol and cannabis use were strongly associated with problematic social media use when examined as single factor in the regression analysis (i.e. bivariate model; OR=2.61, OR=1.95 and OR=1.83, respectively). These findings warrant further research, as problematic video-gaming or social media use and substance use might both be induced by the same underlying vulnerability to addictive behaviors (Van Rooij et al. 2014).

As expected, gender differences were also present in this study and replicate the results of previous research (Andreassen et al. 2016) indicating that girls are the most vulnerable to possible negative influences of social media and boys to possible negative outcomes of video-games. The higher vulnerability of boys to problematic use of video-games has been explained by the content and design of video-games, e.g. violence, stereotypical role models and limited meaningful social interactions, which presumably attract male players and discourage female players (Hartmann and Klimmt 2006). Besides, the competitive structure might be more appealing for boys than girls (Hartmann and Klimmt 2006). With regards to social media previous studies on Facebook use demonstrated some gender differences. Women preferred to use Facebook to maintain their existing social networks, while men mainly used it to expand their social networks (Ryan et al. 2014). The social pressure to maintain numerous (online) friendships might explain why women fail to regulate their communications, but more research is needed to explain why girls are heavier social media users. On the positive side, it may be possible that social media use may help adolescents to overcome their emotional and behavioral problems with peers by controlling time in terms of preparing messages, choosing when to log on and off, and the possibility to rewrite and modify their communications.

Unlike earlier research on problematic Internet use (Kuss et al. 2014) we did not find that in adolescents a higher school age was associated with problematic use. In contrast, for problematic social media use the inverse relationship was found although the effect size proved to be minimal. In addition, in this study educational level did not appear to be a relevant demographical factor which is in line with previous research among online-gamers in the same age category (Van Rooij et al. 2014). Finally, the preliminary finding that being a non-Western migrant is associated with problematic social media use coincides with earlier research (Kuss et al. 2014), though this understudied area needs further research to replicate and understand this demographical risk factor.

Practical implications

This study provides a clear picture of the health status of problematic video-gamers and problematic social media users in early adolescence. The results can inform practice in several ways. Firstly, video-games and social media create positive experiences along with social and cognitive benefits (Bell et al. 2015). However, results of the current study suggest that for a minority of users, co-occurring mental health problems should be taken seriously. The strong associations found with conduct problems (both groups), suicidal thoughts (problematic video-gaming) and hyperactivity (problematic social media use) imply that screening for psychopathological symptomatology might be beneficial for young problematic users. Secondly, parents, teachers and significant others

should be attentive to mental problems in adolescents that show symptoms of addiction-like behavior such as difficulties quitting or interference with school and social activities. Parents and teachers should actively discuss mental health problems or encourage adolescents to seek professional treatment if needed. Third, this study found a strong link between sedentary behavior and both problematic video-gaming and social media use, which underlines the serious public health challenge of a 'westernized' lifestyle in which time spent on physical activity decreases and time spent on screen-based sedentary behavior increases (Altenburg et al. 2012). Adolescents spend a substantial amount of time in school, which is an ideal setting for health promotion efforts. Therefore, national and other policies should encourage effective school-based intervention programs aimed at promoting physical activity and sport activities during teenage years.

Conclusions

By means of multivariate analyses, this study showed that mental health problems are consistently associated with problematic video-gaming and problematic social media use in Dutch adolescents. Contrary to our expectations, substance use was only weakly associated with problematic video-gaming or social media use. This study also highlights the relevance of sedentary behavior as it is associated with both problematic video-gaming and problematic social media use and therefore considered a health risk. Moreover, this study provides some evidence that the health status of problematic video gamers and problematic social media users may be more alike than different, though boys are at higher risk for problematic video-gaming and girls for problematic social media use. Finally, it seems important that prevention and intervention strategies for problematic video gamers or social media users should also promote mental health and physical activity in early adolescence.

Acknowledgements

The authors would like to thank 73 secondary schools and their students in the North-West of the Netherlands for their willingness to participate in the data collection for the Youth Monitor EMOVO.

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