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Evidence of a two-factor structure for Internet Gaming Disorder and Social Media Disorder: Psychometric properties of a new screening instrument for adolescents and adults

Jonas Burén[1] · **Sissela B Nutley**[1] · **Giulia Crisci**[2] · **Lisa B Thorell**[1]

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Abstract
Currently, there is no screening instrument available for assessing both internet gaming disorder (IGD) and social media disorder (SMD). This study aimed to examine the reliability and factor structure of a new screening instrument for adolescents and adults, the Gaming and Social Media Questionnaire (GSMQ-9), and to investigate its association with psychosocial outcomes (i.e., psychosomatic problems, self-concept, and social problems for adults and quality of life for adolescents). Survey data were collected from 995 university students and 626 adolescents. Results showed that a two-factor solution, representing Heavy Involvement and Negative Consequences, had a better model fit compared to a one-factor solution for both IGD and SMD and for both adolescents and adults. The internal consistency was acceptable, and the test-retest reliability was excellent. Negative Consequences were significantly more strongly related to all psychosocial outcomes compared to Heavy Involvement. The proportion of participants meeting the DSM-5 symptom criteria according to self-ratings on the GSMQ-9 was 1.4% (adolescents) and 1.8% (adults) for IGD and 2.6% (adolescents) and 4.0% (adults) for SMD. Conclusively, the GSMQ-9 appears to be a reliable two-factor screening instrument for IGD and SMD among adults and adolescents.

Keywords Internet gaming disorder · Social media disorder · Psychometric properties · Psychosocial problems · Factor analysis

Introduction

One of the primary leisure activities for people today is using digital media, with the two dominant digital media activities being gaming and social media use. Screen time has increased steadily during the past decade, and recent statistics show that adolescents and young adults now spend between 7 and 8 hours/day using screen media, with over 4 hours on gaming and social media (Kemp, 2022; Rideout et al., 2022). For most people, their digital media use is enjoyable and unproblematic, but there are concerns that an increasing number of people are developing addiction-like use (Meng et al., 2022). In the latest Diagnostic and Statistical Manual of Mental Disorders (DSM-5; American Psychiatric Association [APA], 2013), Internet Gaming Disorder (IGD) was presented as a diagnosis in need of further study. Given the potential of social media use to have negative psychosocial consequences, it has been suggested that Social Media Disorder (SMD) should also be considered as a diagnosis (van den Eijnden et al., 2016). A recent study indicated that the prevalence of SMD in adults is equal to or higher than IGD (e.g., Burén et al., 2021), and that the symptoms of both IGD and SMD are related to a range of negative outcomes, such as depression, anxiety, low self-esteem, and poor social relations (e.g., Pontes, 2017; Teng et al., 2021). Several previous instruments have been developed to measure problematic gaming or social media use. For gaming, a recent meta-analysis identified 32 measures (King et al., 2020). However, many of these instruments have limitations, and none include both IGD and SMD in the same measure, The present study therefore aimed to introduce a new rating instrument encompassing both gaming and social media, although providing separate measures for these two types of digital media addictions.

Defining IGD and SMD

According to the DSM-5 (APA, 2013), IGD is defined using the following nine symptoms, out of which at least five symptoms should be present to meet the criteria for IGD: 1)

✉ Jonas Burén
jonas.buren@ki.se

[1] Department of Clinical Neuroscience, Karolinska Institute, Nobels väg 6, 171 77 Stockholm, Sweden

[2] Department of Developmental Psychology and Socialization, University of Padua, Padua, Italy

preoccupation with gaming; 2) withdrawal symptoms when not allowed to game; 3) need to increase time spent gaming (i.e., tolerance); 4) Inability to reduce playing/unsuccessful attempts to quit gaming; 5) loss of interest/hobbies due to gaming; 6) continued excessive use of gaming despite psychological problems; 7) lying about the amount of time spent gaming; 8) using gaming to relieve negative moods; 9) jeopardizing relationships or career/educational opportunities due to gaming.

In a relatively recent meta-analysis that included 53 studies and over 225,000 participants from 17 countries, the pooled prevalence rate for IGD was 1.96% after adjusting for sample biases (Stevens et al., 2021). Several studies have also found IGD to be significantly associated with a range of comorbid conditions, including depression, anxiety, low self-esteem, poor social relations, and sleep problems (Cheng et al., 2018; Lam, 2014; Müller et al., 2015; Ostinelli et al., 2021; Teng et al., 2021).

When introducing IGD in the DSM-5, criticism was raised that other forms of compulsive digital media activities, such as social media use, were excluded (e.g., Kuss et al., 2017; Müller, 2017). One argument was that addictive use of games and social media is part of the same overarching construct of digital media addiction, with addictive gaming and social media users sharing underlying risk factors and comorbid conditions (Andreassen et al., 2016; Hussain & Griffiths, 2018; Wartberg et al., 2020; van den Eijnden et al., 2016). It has also been argued that the nine symptom criteria that are presented in the DSM-5 for IGD are applicable also for SMD if just replacing the word "gaming" with "social media use" (e.g., van den Eijnden et al., 2016). Using these or similar criteria, a relatively recent meta-analysis (Cheng et al., 2021) that included 63 samples with over 34,000 participants from 32 countries found that the pooled prevalence for SMD was 5%.

Regarding the co-occurrence of IGD and SMD, several studies have found a significant association between IGD and SMD symptom severity, but correlations have been small to medium in size (Andreassen et al., 2016; Pontes, 2017; van den Eijnden et al., 2018, but see Reer et al., 2021 for an exception). In addition, the overlap between individuals meeting the full symptom criteria for IGD or SMD is often relatively small (Wartberg et al., 2020). It has therefore been argued that social media addiction and gaming addiction should be regarded as separate but interrelated constructs (c.f., Andreassen et al., 2016; Griffiths, 2018).

Previous Measures of IGD and SMD Symptom Severity

Several instruments assessing gaming have been presented, but many of them have important limitations. First of all, as shown in a relatively recent review (King et al., 2020), most instruments were created prior to the introduction of IGD in the DSM-5. Only eight measures included all nine symptom criteria. Second, several available scales use a yes/no response format, which may increase the risk of overestimating the prevalence of IGD (Pontes & Griffiths, 2015). Several reviews and meta-analyses (Fam, 2018; Paulus et al., 2018; Stevens et al., 2021) have shown large variations in the prevalence of IGD, with some studies reporting rates as high as 50% (Hur, 2006), which is unreasonably high for non-clinical samples. In addition, it has been argued (APA, 2013) that viewing psychiatric symptoms as varying along a dimensional rather than only as a discrete category is the most sensible approach, and this further emphasizes the need to not use a yes/no response format when assessing gaming.

Fewer instruments have been developed to assess SMD. The two most commonly used instruments are the six-symptom Bergen Social Media Addiction Scale (Andreassen et al., 2016) and the nine-symptom Social Media Disorder Scale (van den Eijnden et al., 2016). There is, to our knowledge, no instrument available that measures addictive use of both gaming and social media, which should be considered an important limitation. It has been argued that such an instrument should preferably measure IGD and SMD symptom severity using identical items as this would allow for a more direct comparison between these two types of digital media addiction (Reer et al., 2021; van Rooij et al., 2017). Most available scales only assess IGD, which is more common among males than females (Stevens et al., 2021). Thus, excluding assessments of social media addiction increases the risk of missing problematic use of digital media in females. Including both types of digital media use in the same measure would also allow researchers to assess the respective activities' differential associations with mental health problems. This may be important because previous research has suggested that the underlying deficits of IGD and SMD may be at least partially different. For example, it has been found that emotion dysregulation is more strongly related to problematic use of social media compared to gaming (Leménager et al., 2016). This finding was replicated in a more recent study investigating a broader number of neuropsychological deficits (i.e., executive deficits, delay aversion, and emotion dysregulation), although only for women (Soares et al., 2023). However, another study failed to find a significant group difference between internet gaming addicts and social network addicts with regard to emotional inhibitory control (Dieter, 2017).

IGD and SMD as Uni- or Multidimensional Constructs

IGD is today described as a unidimensional construct in the DSM-5 (APA, 2013). However, before IGD was formally introduced, it was suggested that it is important to distinguish between symptom criteria related to heavy

involvement in gaming (e.g., preoccupation and tolerance), which are common in the population, and symptom criteria related to negative consequences (e.g., displacement, and loss of interest), which may be less common but more indicative of problematic use (Charlton & Danforth, 2007). A few studies have found support for these two factors for IGD (Brunborg et al., 2015; Wichstrøm et al., 2019), but most studies have argued for a one-factor solution (e.g., Lemmens et al., 2015; Pontes & Griffiths, 2015; Poon et al., 2021). However, it has been stated (e.g., Billieux et al., 2019) that a limitation of previous studies is that they have only used factor analysis to confirm a one-factor structure without exploring alternative factor structures. Concerning SMD, a cross-cultural study using the nine-symptom Social Media Disorder Scale found support for a one-factor model in 34 out of 44 countries (Boer et al., 2022). In the other 10 countries, findings were inconsistent. In summary, there is a need for more studies examining several alternative factor structures for both IGD and SMD.

Sex and Age Differences

As mentioned above, males are more likely to develop IGD than females, with a recent meta-analysis showing a prevalence rate of 6.5% for males and 2.5% for females (Stevens et al., 2021). These sex differences have been argued to be explained by worse inhibitory control, higher craving for games, and higher reward sensitivity in males compared to females (Dong & Potenza, 2022). Regarding SMD, a Dutch study including over 6600 adolescents found that the prevalence rate of SMD was higher for females (4.1%) than males (2.9%; Boer et al., 2021). This is in line with a previous meta-analysis (not reporting prevalence rates), which found a significantly larger effect size for females compared to males (Su et al., 2020). However, another meta-analysis failed to find significant sex differences (Cheng et al., 2021). It has been speculated that females may be more at risk of SMD than males because they more often use social media to fill social needs and have a stronger inclination to invest in close social relationships (Andreassen et al., 2017; Krasnova et al., 2017).

Although many available scales assessing digital media addiction have been used for both adolescents and adults, the appropriateness of these scales for different age groups has not been assessed. This should be regarded as a limitation, as differences between adolescents and adults could influence their use of digital media and its potential negative consequences. Previous research has, for example, shown that compared to adults, adolescents' social life and digital media use are more intertwined; they more often use digital media to build their identity (Allen et al., 2014; Davis, 2013), they are more sensitive to peer pressure (Brown & Anistranski, 2020), and they are more inclined to take risks online (Prencipe et al., 2011). With regard to prevalence rates, a recent meta-analysis (Gao et al., 2022) found that IGD was slightly more common among young adults (10.4%) than among adolescents (8.8%). However, for social media addiction, a meta-analysis (Cheng et al., 2021) found that adolescent samples had a higher prevalence rate (35%) than both university students (23%) and adults (19%). The very high prevalence rates in these two meta-analyses are most likely a result of the included studies using many different scales, and many studies did not operationalize addiction according to the DSM-5 criteria (APA, 2013).

Aims of the Present Study

To address the limitations of previous instruments assessing digital media addiction, the present study introduced a new brief screening instrument referred to as the Gaming and Social Media Questionnaire (GSMQ-9), which includes the nine symptom criteria for both IGD and SMD. As described above, addictive use of gaming and social media should be regarded as separate but interrelated constructs. The GSMQ-9 was therefore created to independently assess IGD and SMD symptom severity within the same rating instrument. More specifically, we aimed to examine the following issues:

1. The reliability and factor structure of the GSMQ-9 among adolescents and adults
2. Associations between IGD and SMD symptom severity, as measured by the GSMQ-9, and psychosocial outcomes (i.e., psychosomatic problems, self-esteem, social relations, and quality of life).
3. The proportion of the participants meeting the symptom criteria for IGD and SMD based on self-ratings on the GSMQ-9 and differences between a) adolescents versus adults, b) males versus females.

Based on theoretical formulations (Charlton & Danforth, 2007) and previous empirical research examining several alternative factor solutions (e.g., Brunborg et al., 2015; Wichstrøm et al., 2019), we hypothesized that a two-factor solution, one related to heavy involvement and one related to negative consequences, would provide the best fit to our data. Second, we hypothesized that higher IGD and SMD symptom severity would be associated with higher psychosomatic and social problems, as well as lower self-concept and lower quality of life (e.g., Pontes, 2017; Teng et al., 2021). Third, we hypothesized that males would have higher rates of IGD than females (Stevens et al., 2021), whereas

females would have higher rates of SMD than males (e.g., Boer et al., 2021; Su et al., 2020). Finally, regarding age differences, too few studies have examined differences in prevalence rates between adolescents and university students to allow for any a priori hypotheses.

Study 1: Measure Development

The Gaming and Social Media Questionnaire (GSMQ-9) aimed to be a self-report instrument for adolescents and adults, measuring addictive use of gaming and social media. The main idea was to create a short screening instrument with identical items for both two types of digital media addiction, although allowing the participants to provide separate ratings for gaming and social media. Responses were made on a 5-point Likert scale ranging from 0 ("Strongly disagree") to 4 (Strongly agree"), with higher scores indicating higher symptom severity. The aim was to derive one item for each one of the nine criteria for IGD as presented in the DSM-5 (APA, 2013). For each item, the participants were considered to meet a symptom criterion if they obtained a score of ≥ 3.0 on the scale ranging from 0 to 4. In accordance with the DSM-5 (APA, 2013), five out of nine symptoms were required to meet the full criteria for IGD or SMD.

When developing the instrument, we first generated 30 items related to the nine DSM-5 criteria for IGD (APA, 2013). These were then discussed with clinical psychologists ($n = 5$), three of whom were also researchers. All of them had more than 10 years of previous experience working with patients with behavioral addictions. We also conducted interviews with young adults and parents ($n = 12$). During these interviews, each one of the 30 items were presented one at a time and the persons being interviewed were asked to provide comments regarding the relevance and clarity of each item. The list of 30 items were presented and the persons being interviewed were asked to judge the clarity and relevance of each item. In addition, a small survey ($n = 22$) was conducted with university students to determine how long the survey took to complete. These students were also instructed to provide written feedback if they found any of the questions difficult to answer or irrelevant. Finally, we selected the nine items that 1) best captured the content of the nine criteria for IGD as they are presented in the DSM-5 (APA, 2013); 2) were unambiguous (i.e., easy for the participants to interpret; not having multiple meanings), and 3) had observed scores that covered the full range of possible values on the 5-point Likert scale. The selection of the final items was based on discussion and consensus decision within the research group (the final version of the questionnaire is presented in Supplementary Material). The items for the criteria "loss of interest" and "jeopardizing career/relationships" were different for the adult- and the adolescent versions to ensure the age appropriateness of the instrument (e.g., we asked about jeopardizing work/studies for young adults, whereas we asked about jeopardizing relations with family members for adolescents).

The GSMQ-9 was originally made in Swedish and Italian, which are the native languages of the authors. There was no significant difference between the Italian and the Swedish participants with regard to SMD symptom severity, $t(993) = 0.18$, $p = .86$). However, for IGD symptom severity, the Swedish sample exhibited a higher mean score compared to the Italian sample, $t(692.40) = 2.11$, $p = .035$, although the effect size was small, $d = 0.14$). The final version of the GSMQ-9 is presented in Table 2 (English translation), and Supplementary Material.

Study 2: Principal Component Analysis and parallel analysis

Participants and Procedure

For this study, a random subsample of 202 participants from the total adult sample ($n = 995$) was used (see Table 1 for demographic data on this subsample). The subsample was obtained by asking SPSS to provide us with approximately 20% random cases. This share of participants from the main sample both ensured a sufficient number of participants for the PCA and also provided a sufficient number of participants ($n = 793$) for the subsequent Confirmatory Factor Analysis (CFA), thereby maintaining statistical power and precision for the main analysis (Study 3). No significant group differences were found between the two university subsamples with regard to age, sex, IGD/SMD symptom severity, country of origin, and study area.

The participants were recruited in Sweden and Italy via social media, flyers, face-to-face interaction on university campuses, and through contact with university professors. The questionnaire was available via pen-and-paper (face-to-face recruitment) and online; responses were anonymous. The participants received information about the study before completing the questionnaire, and they also provided final consent for participation in the study before submitting their answers. No reimbursement was offered for taking part in the study. The study was conducted in line with the local ethical guidelines for research on human subjects.

Analyses

Missing data on the full sample were imputed using the Expectation-Maximization (EM) algorithm. This was considered an acceptable approach given that Little's MCAR test indicated that data were missing completely

at random (IGD: χ^2 (29, n = 995) = 39.26, p = .010; SMD: χ^2 (55, n = 995) = 33.94, p = .989). The EM algorithm was also considered acceptable given that only 1% of the participants had missing values, with no participant having missing data on more than one item (Dong & Peng, 2013).

The factor structure of the GSMQ-9, with separate analyses for IGD and SMD, was explored using Principal Component Analyses (PCA) with the Direct Oblimin rotation method. Kaiser's-Meyer-Olkin measure of sampling adequacy was .79 for IGD and .85 for SMD, and Bartlett's test of sphericity was significant (< .001), which indicates that the data was suitable for PCA (Field, 2013; Hutcheson & Sofroniou, 1999). We also used parallel analysis to determine the number of dimensions to retain for IGD and SMD.

Results

In the PCA, eigenvalues and scree plots indicated that a two-factor solution was most suitable for both IGD and SMD. Parallel analysis indicated that two factors should be extracted for IGD, but only one factor for SMD. The items that loaded on the first factor included the symptom criteria related to Heavy Involvement and the items that loaded on the second factor included the symptom criteria related to Negative Consequences (see Table 2). However, escape loaded on Negative Consequences for both IGD and SMD. The correlation between the two factors was .55 for IGD and .53 for SMD. The correlation between IGD and SMD symptom severity was r = .27 (r = .25 for heavy involvement and r = .32 for negative consequences). In summary, considering the combined information from the PCA and Parallel analyses, we proceeded with the two-factor solution for both IGD and SMD. However, due to the conflicting results for SMD, we also compared a one-factor model with the two-factor model for both IGD and SMD.

Study 3: Confirmatory Factor Analysis

Participants and procedure

For the confirmatory analyses, we included the remaining adult participants (n = 793) and excluded the participants that were included in the PCA (Study 2) in order to minimize issues with overfitting (Fokkema & Greiff, 2017; see Table 1 for more information about the sample). These participants were recruited in the same way as described for the subsample included in Study 2. In addition, we included a sample of adolescents (aged 15 years). They were recruited via contact with schools, and questionnaires were filled out online in the classroom after providing informed written consent. In total, data were collected from 626 (54.2% females) adolescents.

Table 1 Demographics data for the different samples and information about what sample that was included in each analysis

	University students (Sample 1)	University students (Sample 2)	Adolescents (Sample 3)
Number of participants	202	793	626
Age (years, [*SD*])	25.21 (6.16)	24.94 (6.35)	15.00 (0.00)
Sex (% women)	72.8	67.7	54.3
IGD symptom severity (*m* [*SD*])	0.28 (0.49)	0.34 (0.56)	0.35 (0.66)
SMD symptom severity (*m* [*SD*])	0.78 (0.62)	0.82 (0.69)	0.88 (0.63)
Country of origin (%)			
Sweden	67.8	68.6	100
Italy	32.2	31.4	0
Area of study (%)			
Medicine	14.3	16.6	-
Natural/technical sciences	12.7	14.2	-
Social sciences	16.4	20.8	-
Psychology	34.4	29.2	-
Education	13.2	9.5	-
Economy	4.2	4.7	-
Law	4.8	5.1	-
Included in analyses			
Exploratory factor analysis	yes	no	no
Confirmatory factor analysis	no	yes	yes
Psychosocial outcomes	yes	yes	yes

Table 2 Items included in the GSMQ-9 and results of the PCA and the CFA[a]

	Factor loadings							
	PCA[b] Subsample (n =202)				CFA Adults (n =793)		CFA Adolescents (n =626)	
	IGD		SMD		IGD	SMD	IGD	SMD
	1	2	1	2				
Heavy Involvement								
1. Preoccupation: Using digital media is one of the most important activities in my life right now	.80		.81		.75	.68	.86	.77
2. Withdrawal: I would feel bad if I was not allowed to/couldn't use digital media for a whole day	.79		.69		.74	.67	.85	.73
3. Tolerance: I need to use digital media more and more to feel satisfied	.82		.80		.79	.77	.87	.79
4. Unsuccessful attempts to control: Reducing how much I use digital media seems impossible to me	.90		.68		.71	.71	.84	.70
Negative Consequences								
5. Loss of interest: I don't bother seeing friends so that I can instead use digital media (I skip or have quit free-time activities so I can use digital media)		.90		.54	.59	.45	.65	.45
6. Continued excessive use: My use of digital media has had negative consequences, but this hasn't made me reduce it		.56	.32	.59	.78	.77	.71	.72
7. Deception: I lie about how much I use digital media		.66		.63	.55	.71	.65	.61
8. Escape: I use digital media as a way to escape reality		.77		.66	.70	.58	.66	.62
9. Jeopardizing career/relationship: My use of digital media has had negative consequences for my studies/job (My use of digital media has caused problems with my family)		.58		.83	.76	.69	.78	.58
Explained variance (%)	48.3	14.1	39.6	12.5				

[a]For items that differed between the adult and the adolescent version, the adolescent version of the item is presented within parentheses

[b]Only factor loadings above .30 are presented

Analyses

Missing data were handled in the same way as describe for the subsample included in Study 2. The factor structure of the GSMQ-9 was evaluated using Confirmatory Factor Analysis (CFA), with Maximum Likelihood (ML) being used as the estimation method. The CFA was run separately for the adult (n = 793) and the adolescent sample (n = 626). Given ML's sensitivity to non-normal data (Brown, 2015), robust standard errors and Satorra-Bentler scaled test statistics were used (Satorra & Bentler, 1994). In addition to evaluating whether the chi-square value was significant, the goodness-of-fit (GOF) for the models was evaluated using the Root Mean Square Error of Approximation (RMSEA; < .09 considered acceptable; Browne & Cudeck, 1992) and the Comparative Fit Index (CFI; .90 to .95 indicated good model fit, and values > .95 indicated exceptional fit (Bentler, 1990; Hu & Bentler, 1999), and the Standardized Root Mean Square Residual (SRMR; < .08 considered acceptable; Hu & Bentler, 1999).

Results

For adults, the chi-square difference test indicated that the two-factor solution was superior to the one-factor solution for both IGD and SMD (see Table 3). The GOF indices also showed that the two-factor solution for IGD and SMD had an acceptable fit, while the RMSEA for the one-factor solution for IGD was above the recommended threshold. Like the adult version, the chi-squared difference test for the adolescent version indicated that the two-factor solution was superior to the one-factor solution for both IGD and SMD. For IGD, GOF indices indicated that the two-factor solution had an acceptable fit, while the one-factor solution had an acceptable fit for CFI and SRMR, but not for RMSEA. For SMD, the two-factor solution had an acceptable model fit, while the model fit for the one-factor solution was poor. All standardized loadings from the CFAs for the two-factor solution are presented in Table 2.

Table 3 Goodness-of -fit indices for the one- and two-factor solutions for the GSMQ-9 for both adults and adolescents

	χ^2	*df*	χ^2 diff[a]	RMSEA (CI 90%)	CFI	SRMR
GSMQ-9 adults						
IGD						
One-factor solution	100.20*	27		.102 (.081, .124)	.922	.048
Two-factor solution	61.09*	26	18.66*	.070 (.048, .093)	.964	.037
SMD						
One-factor solution	164.86*	27		.100 (.085, .115)	.898	.052
Two-factor solution	65.38*	26	74.78*	.054 (.038, .071)	.971	.035
GSMQ-9 adolescents						
IGD						
One-factor solution	68.70*	27		.099 (.070, .129)	.950	.041
Two-factor solution	55.05*	26	9.65*	.084 (.053, .114)	.966	.036
SMD						
One-factor solution	183.00*	27		.122 (.106, .139)	.852	.072
Two-factor solution	50.97*	26	46.08*	.048 (.028, .067)	.978	.032

χ^2 Chi-Square, *df* Degrees of Freedom, *RMSEA* Root Mean Square Error of Approximation, *CI* Confidence Interval, *CFI* Comparative Fit Index, *SRMR* Standardized Root Mean Square

*$p < .001$

[a]Satorra and Bentler (2001) scaled chi-square difference test.

Study 4: Reliability and association with psychosocial outcomes and SMD

Participants and Procedure

For this study, all the adult ($n = 995$) and adolescent ($n = 626$) participants were included. To obtain test-retest data, all Swedish online participants ($n = 683$) were asked to complete the same survey one week later. The test-retest data were connected to the first survey by a code generated by the survey program, which meant that the data remained anonymous. A total of 287 participants (42.0%) agreed to be contacted a second time, and 115 of these (40.0%) completed the second survey. The test-retest subsample did not differ significantly from the other participants in terms of gender ($\chi^2 = 3.01$, $p = .08$), or IGD and SMD symptom severity ($ts < 0.71$, $p > .48$). However, the participants in the test-retest sample were significantly older than the other participants, although the effect size was small ($t = 3.00$, $p < .001$, $d = .39$).

Materials

Adults

For adults, psychosocial difficulties were measured with self-ratings measuring three related constructs: psychosomatic problems, self-concept, and social problems. Psychosomatic problems were measured with nine items, out of which five items (i.e., feeling irritated/bad mood, feeling nervous/anxious, feeling down, having headaches, and having stomach aches) were obtained from the Health Behavior in School-Aged Children (HBSC) checklist used by the WHO in wellbeing surveys (Inchley et al., 2020). The remaining four items were created within the present study, of which two items measured sleep ("difficulty falling asleep" and "daytime tiredness"), one item measured loneliness ("feeling lonely"), and one item measured stress ("feeling stressed"). Responses were made on a 6-point scale with the following response alternatives: 0 = never, 1 = sometimes, 2 = once a week, 3 = twice a week, 4 = at least three times a week, 5 = every day. We used the mean of the nine items as a measure of psychosomatic problems. The participants' observed mean scores ranged from 0.00 to 5.00. Cronbach's alpha, calculated within the present study, indicated good internal reliability for the nine items ($\alpha = .89$; $\omega = .87$), and the test-retest reliability was excellent (ICC = .94).

Self-ratings on the Weiss Functional Impairment Rating Scale (WFIRS-S; Weiss, 2000) was used to assess self-concept and social problems. We used the mean of the five items assessing self-concept (e.g., "feeling bad about yourself") and the mean of the six items assessing social problems (e.g., "trouble getting along with other people"). Responses were made on a 5-point Likert scale ranging from 0 ("not correct at all") to 4 ("correct to a large degree"). For both self-concept and social problems, the participants' observed mean scores ranged from 0.00 to 4.00. Internal consistency, calculated within the present study, was good for both self-concept ($\alpha = .91$; $\omega = .91$), and social problems ($\alpha = .87$; $\omega = .88$). A previous review has also shown good psychometric properties (including high test-retest reliability) for the WFIRS-S (Weiss et al., 2018).

Adolescents

For adolescents, psychosocial difficulties were assessed using KIDSCREEN-10 (Ravens-Sieberer et al., 2014), which is a self-rating measure of health-related quality of life (e.g., "Have you felt sad?" "Have you felt lonely?"). Responses were made on a 5-point Likert scale ranging from 1 ("never/not at all") to 5 ("always/extremely"). Scores on the 10 items were averaged into a mean, with higher scores indicating poorer quality of life. The participants' observed mean scores ranged from 1.00 to 5.00. Internal consistency, calculated within the present study, was good ($\alpha = .83$; $\omega = .83$). Previous research has found that KIDSCREEN-10 has good to excellent psychometric properties (e.g., Ravens-Sieberer et al., 2014).

Analyses

First, the reliability of the GSMQ-9 was examined by investigating a) internal consistency of the subscales using Cronbach's alpha and McDonald's Omega, and b) test-retest reliability using intraclass-correlations (ICC) with a subsample of 115 Swedish university students. The ICCs were calculated using the mean rating (k =2), absolute agreement, and two-way random-effects models (Koo & Li, 2016).

Second, Pearson's correlations were used to investigate associations with psychosocial outcomes. To determine whether the correlation coefficients between subscales to the psychosocial outcomes were statistically different, we used Fisher's r to z transformations with Steiger's (1980) equations for asymptotic covariance of the estimate.

Third, the proportion of participants meeting the criteria for IGD and SMD were calculated. Chi-square tests were used to investigate differences in the proportion meeting the criteria for IGD and SMD between 1) males versus females and 2) adolescents versus adults.

Results

Internal Consistency and Test-retest Reliability

For both adults and adolescents, the internal consistency (i.e., measured using alpha and omega) was acceptable for both Heavy Involvement (.83–.92 for IGD and .79–.86 for SMD) and Negative Consequences (.76–.79 for IGD and .72–.75 for SMD). Test-retest reliability was assessed with a subsample of adults (n = 115) who completed the questionnaire 1-2 weeks apart. The ICC was excellent for both Heavy Involvement (.92–.93) and Negative Consequences (.91–.95).

Association with Psychosocial Outcomes

For both IGD and SMD, the subscales Heavy Involvement and Negative Consequences were associated with all psychosocial outcomes for both adults and adolescents, with associations being significantly stronger for Negative Consequences compared to Heavy Involvement (see Table 4). In addition, associations were generally higher for SMD symptom severity compared to IGD symptom severity. The exception was the association between quality of life and IGD symptom severity for adolescents, which was non-significant.

Proportion Meeting the Symptom Criteria for IGD and SMD

As shown in Table 5, the proportion meeting the symptom criteria (i.e., ≥ 5 symptoms) for IGD was 1.4% for adults and 1.8% for adolescents. The corresponding numbers for SMD were 4.0% for adults and 2.6% for adolescents. None of the differences between adolescents and adults were statistically significant, both $\chi^2 \geq 2.47$, $ps \geq .05$. Regarding sex differences, both adult and adolescent males were significantly more likely than females to meet the criteria for IGD,

Table 4 Associations between IGD/SMD symptom severity and psychosocial outcomes and results of analyses comparing the strength of associations between heavy involvement and negative consequences

	IGD symptom severity			SMD symptom severity		
	Heavy involvement	Negative consequences	z	Heavy involvement	Negative consequences	z
Adults						
Psychosomatic problems	.13**	.26***	6.49***	.32***	.44***	5.12**
Low self-concept	.20***	.32***	5.93***	.25***	.39***	5.73**
Social problems	.18***	.25***	3.25**	.21***	.29***	2.98*
Adolescents						
Poor quality of life	-.01	.09*	3.86***	.25***	.35***	2.75**

*$p < .05$; **$p < .01$; ***$p < .001$

Table 5 Sex differences in the proportion meeting the criteria for IGD and SMD and results of chi-square tests and effect sizes as measured by Cramer's V

	Total	Men *n* (%)	Women *n* (%)	$\chi^2(df\ 1)$	*V*
IGD					
GSMQ-9 adults	14 (1.4)	9 (2.9)	5 (0.7)	7.20*[a]	0.09
GSMQ-9 adolescents	11 (1.8)	9 (3.3)	2 (0.6)	6.31*[a]	0.10
SMD					
GSMQ-9 adults	40 (4.0)	17 (5.5)	23 (3.4)	2.44	0.05
GSMQ-9 adolescents	16 (2.6)	5 (1.8)	11 (3.2)	1.17	0.04

χ^2 Chi-Square, *df* Degrees of Freedom *V* Cramér's V

[a]Fisher's Exact Test

*$p < .05$

but no significant sex differences were found for SMD (see Table 5). Regarding differences in the proportion of participants meeting the cut-off for IGD versus SMD, results showed that both adolescent and adult females were more likely to meet the criteria for SMD compared to IGD (both $\chi^2 \geq 5.82$, $ps < .05$). However, the proportion meeting IGD and SMD did not differ for adolescent and adult males (both $\chi^2 \leq 2.23$, $ps \geq .05$).

Discussion

The present study indicated that the GSMQ-9 appears to be a reliable screening instrument for assessing IGD and SMD in adolescents and adults. For both age groups, two factors were identified: Heavy Involvement and Negative Consequences. The proportion of participants meeting symptom criteria for IGD was 1.4% for adults and 1.8% for adolescents, whereas the proportion of participants meeting the criteria for SMD was 4.0% for adults and 2.6% for adolescents. For adults, the two factors for IGD and SMD were positively related to all three psychosocial outcomes. Significantly stronger positive associations were found for Negative Consequences compared to Heavy Involvement. For adolescents, higher levels of Negative Consequences for gaming, but not Heavy Involvement, were significantly associated with poorer quality of life. For social media, higher levels of both Heavy Involvement and Negative Consequences were significantly associated with poorer quality of life. Similarly to what was found for adults, associations were significantly stronger for Negative Consequences compared to Heavy Involvement.

In line with our hypothesis, the results of the present study provided strong initial support for a two-factor solution, one related to heavy involvement and one related to negative consequences, for both IGD and SMD. However, more studies with different samples are needed to further validate the factor structure of the GSMQ-9. Although our two-factor solution is in line with findings from a few previous studies (Brunborg et al., 2015; Charlton & Danforth, 2007; Wichstrøm et al., 2019), most previous research (e.g., Boer et al., 2021; Lemmens et al., 2015; Poon et al., 2021; Paulus et al., 2018; van den Eijnden et al., 2016) has argued that IGD and SMD should be regarded as a unidimensional construct. The reason for this view appears to be largely based on the description of IGD in the DSM-5 (APA, 2013), which has led many researchers to only use confirmatory approaches rather than comparing alternative models (Billieux et al., 2019). Based on both our own findings and previous theoretical formulations (Charlton & Danforth, 2007), we argue that there are some advantages to viewing IGD and SMD as involving two dimensions – one related to heavy involvement and one related to negative consequences. First, taking both these separate but overlapping phenomena into consideration when screening for IGD and SMD could possibly lower the risk of over-diagnosing these two types of digital media addictions. For example, previous research (Burén et al., 2021; Rehbein et al., 2015; Wichstrøm et al., 2019) has shown that symptoms of heavy involvement are common among individuals with IGD, but also among those not meeting the symptom criteria, whereas symptoms of negative consequences are less common but highly predictive of digital media addictions once present. Second, as both the present study and previous research (Deleuze et al., 2018) have shown that symptoms related to negative consequences are more strongly related to negative psychosocial outcomes, individuals with these symptoms may have a greater need for support than those who only have symptoms related to heavy involvement. Third, it could be argued that our two-factor solution is in line with the DSM-5 (APA, 2013) as both symptoms and negative consequences are required to meet the diagnostic criteria for many psychiatric disorders (e.g., Attention Deficit Hyperactivity Disorder). It has even been proposed, and our results could be taken to be in line with this proposition, that symptoms related to heavy involvement and negative consequences should be regarded as two separate domains within DSM-5 and that symptoms within both domains should be required for a diagnosis (cf. Wichstrøm et al., 2019). Fourth, research conducted during the COVID-19 pandemic has shown an increase in the use of screens but not necessarily an increase in the negative consequences associated with social media use (e.g., Cauberghe et al., 2021; Pandya & Lodha, 2021). This further emphasizes the need to distinguish between heavy usage and negative consequences and shows that, at least during some circumstances, a high screen time may even provide benefits.

If acknowledging that IGD and SMD can be divided into two factors, a related issue concerns to what extent

this needs to be considered when screening and diagnosing IGD and SMD. This issue has been highly debated, with some researchers arguing that heavy involvement in digital media use is not a good indication of addiction (Billieux et al., 2019; Charlton & Danforth, 2007). In a Delphi study including 29 international experts from 21 countries addressing diagnostic validity, clinical utility, and prognostic value for IGD, the symptom criteria related to heavy involvement were viewed as being less important for the disorder compared to those related to negative consequences (Castro-Calvo et al., 2021). The results of the present study cannot solve this debate but emphasize the need to regard symptoms related to heavy involvement and negative consequences as separate but related constructs. An important avenue for future research would be longitudinal studies investigating the relative importance of these two factors for identifying individuals at risk of developing IGD or SMD.

The criteria loading on the factor Heavy Involvement found in the present study are similar to those identified in previous studies (e.g., Deleuze et al., 2018; Wichstrøm et al., 2019). However, in the present study, escape loaded on the factor Negative Consequences, whereas two previous Norwegian studies investigating IGD (Brunborg et al., 2015; Wichstrøm et al., 2019) found that it loaded on Heavy Involvement. We do not find this inconsistency across studies very surprising, as one can easily consider that this symptom criterion is related to both factors, or that it constitutes a factor of its own. In the DSM-5 (APA, 2013), the symptom criterion escape is defined as using digital media to relieve negative feelings. As such, escape may function as a form of "self-medication" for psychological distress (Király et al., 2015). Others have suggested that digital media may function as a tool for satisfying basic psychological needs that are impossible to satisfy in real life, such as having many friends or being competent (Bender et al., 2020). Thus, using digital media as an escape may not lead to negative consequences, but rather vice versa (i.e., that negative consequences in life lead to digital media use). Similarly, escape is not a direct example of heavy involvement in digital media, but an individual who is using digital media as an escape is likely to have larger incentives to have heavy involvement in this activity compared to those who only use digital media because they offer pleasurable activities. It has previously been argued that escapism motives are common in humans and may, therefore, not indicate disordered use of digital media (Király et al., 2015). Escape has also been questioned for its clinical relevance to IGD due to mixed views concerning its clinical and diagnostic utility, as well as prognostic value (Castro-Calvo et al., 2021).

The sample sizes in the present study were too small to determine the prevalence of IGD and SMD. However, we still considered it important to investigate what proportion of the participants met the symptom criteria for IGD and SMD as a further test of our new instrument. The proportion meeting the symptom criteria ranged between 1.4% and 1.8% for IGD and between 2.6% and 4.0% for SMD, figures that are comparable to those presented in relatively recent meta-analyses (Cheng et al., 2021; Stevens et al., 2021). This indicates that the GSMQ-9 most likely does not over- or underestimate prevalence rates for IGD or SMD, whereas high heterogeneity in prevalence rates (i.e., 0.16-50%) have been reported for IGD in previous studies using other rating instruments (Fam, 2018; Paulus et al., 2018; Stevens et al., 2021).

In line with our hypothesis and previous research, the proportion of males meeting the symptom criteria for IGD was higher than females (e.g., Stevens et al., 2021). However, we did not find significant sex differences for SMD. Previous studies examining sex differences have shown mixed results, with one meta-analysis failing to find significant sex differences (Cheng et al., 2021), whereas other studies have shown that social media addiction is more prevalent among females compared to males (e.g., Boer et al., 2021; Su et al., 2020). One explanation for these inconsistencies in findings might be differences in how social media addiction was operationalized, with sex differences often being found when examining SMD symptom severity, whereas sex differences are not found for SMD diagnosis (e.g., Burén et al. 2021). It is also possible that sex differences in social media use have decreased over time as more and more gamers are using social media to discuss gaming experiences, which might have led to increased use of social media among males. Further research using larger sample sizes is needed to explore sex differences for SMD diagnosis.

The present study did not find any differences in prevalence rates between adolescents and adults for SMD or IGD. As few previous studies have examined age differences, we did not form an a priori hypothesis regarding this issue. However, there are indications that the prevalence of IGD is higher among adolescents compared to adults (Gao et al., 2022), whereas the prevalence of SMD is higher for adults compared to adolescents (Cheng et al., 2021). Differences in findings could perhaps be explained by the fact that we included university students (primarily 20–30 years old), whereas previous studies have used a larger age range. Differences could also result from the small number of participants meeting the diagnostic cut-off, especially for IGD, which limited our statistical power to detect differences between adolescents and adults.

Finally, in line with our hypothesis, higher IGD and SMD symptom severity were associated with higher levels of psychosomatic and social problems, and lower levels of self-concept and quality of life. It is interesting to note that SMD symptom severity was also shown to be equally or even more

strongly related to the negative psychosocial outcomes compared to IGD symptom severity. Although it is important to take into consideration that correlations do not imply causation, previous experimental research suggests that social media has an immediate causal effect on emotional distress (e.g., Lee et al., 2020). Benefits from reducing use or taking a break from social media on mental health measures have also been reported (Allcot et al., 2020; Hunt et al., 2018; Tromholt, 2016). We, therefore, believe that it is important to question why IGD, but not SMD, has been recognized within the DSM-5.

Limitations and Directions for Further Studies

Some limitations of the study need to be acknowledged. First, the study used convenience samples which may limit the generalizability of our findings. Second, the use of self-report measures might have introduced biases and led to an overestimation of the associations between digital media and psychosocial outcomes. Third, although the present study found prevalence rates that were similar to those presented in other studies, further studies are needed to determine the best cut-off when using items measured on a Likert scale. Fourth, as we wanted to minimize responder fatigue, we chose not to include other established measures of IGD or SMD. Further research investigating the validity of the GSMQ-9 is therefore needed. Fifth, regarding the last DSM-5 criterion for IGD (i.e., "jeopardizing relationships or career/educational opportunities"), the GSMQ-9 only includes family conflicts for adolescents and study/work problems for adults. The reason for this is that our previous experience of research in this area and the pilot data collected while developing the GSMQ-9 show that these aspects are most indicative of problematic use of gaming or social media for the respective age groups. However, this could be seen as a limitation because it means that the GSMQ-9 does not fully capture this criterion as it is stated in the DSM-5 (APA, 2013). In sum, the present study provides initial support for the two-factor structure of the GSMQ-9 across two countries and among adolescents and young adults. However, additional studies are needed to validate the GSMQ-9 in other samples, including clinical samples. It would also be valuable to create a parent rating for use with younger children.

Conclusion

The present study found support for a two-factor solution for both IGD and SMD as measured by the GSMQ-9, a new rating instrument. The identified factors were not only found to be distinguishable using factor analysis, but also showed differential relations to psychosocial outcomes. The reliability of the GSMQ-9 was found to be excellent, and the proportion meeting the symptom criteria for IGD/SMD were similar to those obtained in previous studies. The GSMQ-9 has the advantage of only including nine items based on the DSM-5 criteria for IGD (APA, 2013), with identical items used to assess SMD. As the respondent is asked to respond twice for each item, once for gaming and once for social media, the GSMQ-9 measures two independent constructs within one rating instrument. It also has the advantage of being able to distinguish between Heavy Involvement and Negative Consequences of both gaming and social media. Regarding clinical implications, the relatively strong associations found between IGD/SMD symptom severity and psychosocial functioning suggest that screening for digital media addiction should be important. Our results also indicate that both SMD and IGD should be considered official diagnoses in future iterations of the DSM. Given that the GSMQ-9 is a brief and easily administered instrument with good psychometric properties, it has the potential to become a valuable tool for both researchers and health care professionals such as psychologists, psychiatrists, and school nurses.

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Authors' Contributions All authors contributed to the study conception and design.The first draft of the manuscript was written by Jonas Burén and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

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Data Availability Material preparation, data collection and analysis were performed by Jonas Burén, Sissela B Nutley, Giulia Crisci and Lisa B Thorell.

Declarations

Ethical Approval All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2000 (5)

Informed Consent Informed consent was obtained from all patients for being included in the study.

Conflict of Interest Jonas Burén, Sissela Bergman Nutley, Giulia Crisci and Lisa B Thorell declare that they have no conflict of interest.

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