Adding Clinical Validity to the Statistical Power of Large-Scale Epidemiological Surveys on Internet Addiction in Adolescence: A Combined Approach to Investigate Psychopathology and Development-Specific Personality Traits Associated With Internet Addiction

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ABSTRACT

Objective: Research has indicated that internet addiction is associated with psychosocial maladjustment in adolescence. Many epidemiologic surveys are lacking representativeness, and knowledge on disorder-specific risk factors is scarce. One weakness of epidemiologic studies often regards their lack of generalizability to clinical reality. The aim of this study was to provide a detailed description of internet addiction among adolescents, focusing on its prevalence in a population-based context, psychopathological correlates, and predisposing factors.

Methods: The main analyses were based on 2 large representative samples of German adolescents (N = 9,293; 12–19 years) collected in 2012, and the results were validated on a consecutive sample of 237 treatment-seeking adolescents (from 2009–2014). The Scale for the Assessment of Internet and Computer Game Addiction (AICA-S), Strengths and Difficulties Questionnaire (SDQ), Symptom Checklist-90 Revised (SCL-90R), and NEO-Five Factor Inventory (NEO-FFI) were administered.

Results: Internet addiction occurred in 2.6% of adolescents, with almost comparable rates in both genders, whereas female patients (1.3%) were underrepresented among the treatment seekers. Internet-addicted adolescents from the clinical and the nonclinical setting displayed higher psychopathology (SDQ: $P < .001$) and functional impairment (Global Assessment of Functioning: $P < .001$) than adolescents with nonproblematic internet use. Low conscientiousness (in boys: $\beta = -0.161$ to -0.220; in girls: $\beta = -0.103$ to -0.240) and high negative affect (in boys: $\beta = 0.141$ to -0.193; in girls: $\beta = 0.175$ to 0.290) were personality correlates of internet addiction.

Conclusions: Internet addiction is a widespread problematic behavior among male and female adolescents, and it is related to psychopathological symptoms. Low conscientiousness and high negative affect were identified as stable correlates for internet addiction independent of age and gender and can therefore be considered as risk factors for internet addiction.

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Phenomenology of Internet Addiction

Despite the promise of the internet, concerns have arisen on adverse effects of its use.[1,2] In 1998, Young[2] provided case studies on internet addiction (IA), and, since then, research on this topic has become popular. Recently, the American Psychiatric Association (APA) included internet gaming disorder—a subtype of IA—in Section III of the *DSM-5* as a condition warranting more research before being included as a formal diagnosis.[3] Consequently, there has been a call for intensified research.[4]

Similar to substance use disorders,[5–7] IA is characterized by increasing time spent online, decreased behavioral control, and continued use despite negative repercussions. Adolescents are especially prone to develop IA,[8] however, representative studies are still underrepresented. Two studies,[9,10] based on European samples, found IA prevalence rates of 1.2% and 4.4%. IA has been associated with major adverse effects such as psychosocial distress, heightened psychopathological symptoms, and high rates of comorbid disorders.[10–13]

Predisposing Factors of Internet Addiction

In Western countries, adolescents are characterized by a high involvement in online activities.[14] However, only a minority develop addictive use, leading to the question of which factors are contributing to the development of IA. Only a few models address developmental aspects of IA.[15–17] Similar to a model proposed for gambling disorder,[18] in IA, personality traits might act as predisposing factors, but research has rendered inconsistent findings here.[16,19–22] One explanation might be that personality is maturing throughout lifetime with normative changes in different age-stages.[23] Thus, controlling for age-related influences is necessary, but few of the existing studies on personality in IA have done so.

Research Questions

We aimed to determine the prevalence of IA among a representative sample of adolescents and to characterize adolescents with IA in regard to demographics, personality, and psychopathology. To gather data of best possible validity, we applied a combined design using data from

Clinical Points

- Internet addiction among adolescents has received considerable attention in the last decade. While there is growing knowledge on epidemiologic aspects, less is known about the factors that contribute to the development of internet addiction.
- In a study of a representative sample of adolescents, internet addiction was found to affect a substantial percentage of youth; negative mood states, lack of impulse control, and difficulties in self-structuring were main correlates of internet addiction.
- Early intervention strategies might prevent adolescents from developing full symptoms of internet addiction.

2 epidemiologic surveys and a clinical sample of adolescent treatment seekers.

IA has been reported to occur more frequently among males.[8,24] Thus, we expected to find a higher prevalence among boys. Following suggestions made by the APA,[4] we were interested not only in the rate of adolescents meeting full criteria for IA, but also in the rate of those close to meeting full criteria for IA.

We also aimed to identify personality traits indicative of IA. Theory-driven hierarchical regression analyses were conducted to take into account findings from prior studies[16,19,21] on personality in IA. We hypothesized that IA would be predicted by low conscientiousness, negative affect, low extraversion, high interpersonal distrust, and low positive affect. As a novel approach, we took into consideration the maturing principle of personality and conducted age- and gender-specific analyses.

METHODS

Sampling Procedure and Data Collection

Two samples of adolescents (12 to 18 years and 12 to 19 years) were representatively drawn from different states of Germany in 2012. The participants were drawn randomly, based on a sampling plan stratified by region, school type, and age, with 62 and 41 sampling units. The sample sizes were estimated using power analyses with an expected IA frequency of 1%.

The response rate was 66.1% (sample 1; N = 4,047) and 54.3% (sample 2; N = 6,081). No systematic differences regarding region or school type were identified between participants and nonparticipants. Two hundred seventy-three adolescents (6.8%; sample 1) and 561 participants (9.2%; sample 2) were excluded because of missing data, leading to a final data set of N = 9,293.

The clinical sample consisted of 308 consecutive treatment seekers (aged 12–19 years) from a specialized outpatient clinic. Every patient presenting between 2009 and 2014 was asked to fill in additional questionnaires and to provide written informed consent. Due to missing data, 71 cases (23.1%) were excluded. Both studies were approved by the local ethical commissions and adhered to the Declaration of Helsinki.

Measures

Self-reports. The Scale for the Assessment of Internet and Computer Game Addiction (AICA-S)[25] addresses the global construct of IA based on the *DSM* criteria for gambling disorder of 14 items. Frequency of 8 internet activities (ie, gaming, chatting, shopping) is included. Preliminary cut-off scores were derived from the general population and in adolescent samples[26] and were validated on a clinical level.[25] By comparing the scores of AICA-S with external ratings of psychotherapists, good diagnostic accuracy was obtained (sensitivity = 80.5%; specificity = 82.4%).[25] A score of 0 to 6.5 points corresponds to nonproblematic IA, 7 to 13 to mild IA, and 13 points and above to suspected IA. AICA-S yielded sound psychometric properties in previous studies.[27]

The Strengths and Difficulties Questionnaire (SDQ)[28] assesses psychopathological strain in adolescents on 5 subscales (Hyperactivity, Emotional Symptoms, Conduct Problems, Peer Problems, and Prosocial Behavior) in 25 items (scored from 0 to 3). A total difficulties score can be calculated by adding the single scores. The German version of the SDQ has sound psychometric properties.[29]

The Positive and Negative Affect Schedule (PANAS)[30] is a self-report with a sound construct validity that assesses affective states by 20 adjectives (eg, excited, nervous) on 5-point Likert scales. In this study, the trait version of the PANAS was used, assessing affect within the past 12 months.

The NEO Five-Factor Inventory (NEO-FFI)[31,32] consists of 60 items on 5-point Likert scales. The NEO-FFI is one of the most widely used questionnaires assessing personality according to the Five-Factor Model[33] and has been demonstrated to have good psychometric properties.[34] In this study, only the subscales for Extraversion and Conscientiousness were used.

The subscale Interpersonal Distrust of the Eating Disorder Inventory[35] was used to assess feelings of distrust and alienation in social interactions (eg, "I can communicate with others easily").

The Symptom Checklist-90 Revised (SCL-90R)[36] was used to assess psychopathological symptoms in the clinical sample only. The SCL-90R is a well-established self-report with sound psychometric properties[37] based on 90 items (0 = no symptoms to 4 = strong symptoms) in 9 subscales. The Global Severity Index (GSI) represents the overall distress and is computed as the mean of the subscales.

Clinical Interviews

In the clinical sample, the IA criteria were assessed by a validated clinical interview (Checklist for the Assessment of Internet and Computer Game Addiction; AICA-C[38]). The internet activity associated with addictive symptoms was also explored. Moreover, Global Assessment of Functioning (GAF)[39] was determined.

Data Analyses

All analyses were based on SPSS (version 22.0; IBM, Armonk, New York). χ^2 tests were performed for comparisons of nominal variables with phi (φ) and Cramer *V* as measures

Table 1. Demographic Characteristics of the Aggregated Sample According to Types of Internet Use

Characteristic	Internet Addiction (n = 243)	Mild Internet Addiction (n = 1,088)	Nonproblematic Use (n = 7,962)	Test Statistics			
				χ^2	*df*	*P*	Cramer *V*
Gender, n (%)							
Male	133 (2.9)	574 (12.6)	3,862 (84.5)	10.02	2	.007	.033
Female	110 (2.3)	514 (10.9)	4,100 (86.8)				
Age, y							
Mean (SD)	15.5 (1.69)	15.8 (1.62)	15.5 (1.71)				
12–13, n (%)	25 (2.0)	93 (7.4)	1,147 (90.7)	54.29	6	≤.001	.054
14–15, n (%)	94 (2.8)	344 (10.4)	2,874 (86.8)				
16–17, n (%)	97 (2.8)	475 (13.8)	2,861 (83.3)				
18–19, n (%)	27 (2.1)	176 (13.7)	1,080 (84.2)				
Has migration background, n (%)	25 (3.9)	102 (15.8)	517 (80.3)	16.72	2	≤.001	.043
School type, n (%)							
Lower secondary	27 (2.8)	140 (14.7)	788 (82.5)	155.19	8	≤.001	.091
Middle school	58 (2.8)	238 (11.3)	1,803 (85.9)				
Integrated school	38 (4.5)	112 (13.3)	690 (82.1)				
High school	34 (1.1)	255 (7.9)	2,927 (91.0)				
Vocational school	86 (3.9)	343 (15.7)	1,754 (80.3)				
Living with both parents, n (%)	167 (2.4)	785 (11.2)	6,064 (86.4)	15.50	2	≤.001	.041

of effect size. Metric variables were analyzed using Pearson correlation coefficient (*r*). Multiple analyses of covariance (ANCOVA), with age as covariate, were performed to analyze group differences with eta-squared (η^2) indicating the effect sizes. For identifying differences in personality traits without having gender and age as confounding variables, 8 gender- and age-specific linear regression analyses were conducted. For the prevalence rates, 95% confidence intervals are indicated.

RESULTS

The Epidemiologic View: Prevalence, Content Used, and Sociodemographic Predictors

Of the samples, 68.3% (n = 2,578; sample 1) and 72.6% (n = 4,006; sample 2) used the internet every day in their leisure time. According to the classification of AICA-S, 2.6% (n = 243; 95% CI, 2.3–2.9; sample 1: 2.2%, sample 2: 3.3%) of the adolescents met criteria for IA, and 11.7% (n = 1,088; 95% CI, 11.0–12.3; sample 1: 11.0%, sample 2: 12.7%) were classified with mild IA. IA was related to a mean internet use of 7.2 hours (SD = 5.08 hours) on a weekend day. This was significantly more time spent online than among mild IA (mean = 5.5 hours, SD = 4.14 hours) and nonproblematic users (mean = 2.7 hours, SD = 2.62 hours) (each $P \leq .001$). Table 1 lists major sociodemographic characteristics of the samples drawn from 2 epidemiologic surveys.

Several significant differences occurred with highest effect size for school type, indicating that IA was more frequent in integrated schools and vocational schools. Boys were slightly more often classified with IA than girls.

In order to investigate if frequency of use of specific internet applications was related to heightened risk for IA, regression analyses were performed with 8 online activities as predictors for the AICA-S score. For boys, online gaming (β = 0.312) had the highest influence on the AICA-S score, followed by chats (β = 0.179), online pornography (β = 0.141), and online gambling (β = 0.131); for girls, chats (β = 0.247), use of social networking sites (β = 0.178), and online gaming (β = 0.107) were of heightened influence.

The Clinical View: Characteristics of Adolescent Treatment Seekers

From those clients presenting because of suspected IA, 54.9% (n = 130; IA group) were diagnosed with IA. In 45.1% (n = 107; non-IA group), full criteria of IA were not met. Table 2 depicts their demographics.

Only a small percentage of the treatment seekers were females (1.3%), and a preponderance of adolescents attending high school was noticed. Comparing the 2 groups showed that the diagnosis of IA was related to the school type, with lower secondary and vocational schools having a higher proportion of adolescents with IA compared to high school.

The IA group reported spending 7.8 hours (SD = 3.95 hours) on a weekend day online compared to 5.5 hours (SD = 3.16 hours) in the non-IA group ($t_{218} = 4.84$, $P \leq .001$). Among the IA group, a preponderance of use of online computer games (77.3%) became evident, followed by use of several types of online content (generalized IA; 10.9%), offline computer games (6.7%), and social networking sites (3.4%).

Personality Traits in Internet Addiction

The epidemiologic perspective: personality features of internet addiction. In a sequence of multiple linear regression analyses, the AICA-S score was entered as the criterion and the predictors were entered in a hierarchical order, starting with conscientiousness and extraversion, followed by negative and positive affect and interpersonal distrust. Before we ran the analyses, statistical preconditions were checked (eg, variance inflation factor, heteroscedasticity).

Moderate to small R^2 (between 0.109 to 0.132 for boys and 0.052 to 0.145 for girls) became evident (Table 3). Only

Table 2. Demographic Characteristics of the Clinical Sample According to the Status of Internet Addiction

	Total Sample (n = 237)	IA Group (n = 130)	Non-IA Group (n = 107)	Statistical Significance			
				χ^2	*t*	*df*	*P*
Gender, n (%)							
Male	234 (98.7)	127 (97.7)	107 (100)	2.501		1	.254
Female	3 (1.3)	3 (2.3)	0 (0.0)				
Age, y[a]							
Mean (SD)	16.3 (1.79)	16.4 (1.93)	16.2 (1.61)		0.782	228	.435
12–13, n (%)	15 (8.5)	12 (9.3)	3 (2.9)				
14–15, n (%)	65 (28.1)	33 (25.6)	32 (31.4)	10.68		3	.013
16–17, n (%)	84 (36.4)	39 (30.2)	45 (44.1)				
18–19, n (%)	67 (29.0)	45 (34.9)	22 (21.6)				
Has migration background, n (%)[a,b]	6 (2.7)	2 (1.7)	4 (4.0)	1.12		1	.414
School type, n (%)[a]							
Lower secondary	8 (4.5)	7 (7.4)	1 (1.2)				
Middle school	36 (20.5)	22 (23.4)	14 (17.1)				
Integrated school	16 (9.1)	8 (8.5)	8 (9.8)				
High school	64 (36.4)	25 (26.6)	39 (47.6)	13.67		6	.032
Vocational school	22 (12.5)	16 (17.0)	6 (7.3)				
Unemployed	9 (5.1)	5 (6.1)	4 (4.3)				
Other	21 (11.9)	12 (12.8)	9 (11.0)				

[a]Missing values occurred for the variables "age," "school type," and "migration."
[b]Percentages are calculated within 1 column.
Abbreviations: IA group = adolescents diagnosed with internet addiction, non-IA group = adolescents not diagnosed with internet addiction.

Table 3. Personality Traits as Predictors of AICA-S Score in Male and Female Adolescents of Different Age Groups

	B				SE B				β			
Variable	12–13 y[a]	14–15 y[b]	16–17 y[c]	18–19 y[d]	12–13 y	14–15 y	16–17 y	18–19 y	12–13 y	14–15 y	16–17 y	18–19 y
Step 1												
Constant												
Boys	7.16	7.71	9.15	9.63	0.86	0.55	0.54	0.74	…	…	…	…
Girls	5.52	6.46	7.25	6.89	0.78	0.49	0.55	0.89	…	…	…	…
Conscientiousness												
Boys	−1.41	−1.59	−1.69	−1.36	0.26	0.17	0.15	0.22	−0.245***	−0.258***	−0.280***	−0.249***
Girls	−1.57	−1.45	−1.33	−0.97	0.21	0.14	0.15	0.25	−0.298***	−0.260***	−0.225***	−0.169***
Extraversion												
Boys	−0.39	−0.06	−0.28	−0.72	0.32	0.21	0.19	0.25	−0.055	−0.008	−0.037	−0.114**
Girls	0.37	0.20	−0.05	−0.28	0.28	0.16	0.18	0.30	0.054	0.030	−0.007	−0.040
Step 2												
Constant												
Boys	1.97	2.03	4.86	4.50	1.56	1.09	1.05	1.58	…	…	…	…
Girls	0.52	2.65	2.29	0.54	1.39	0.94	1.04	1.64	…	…	…	…
Conscientiousness												
Boys	−0.93	−1.30	−1.33	−1.04	0.29	0.18	0.16	0.23	−0.161***	−0.212***	−0.220***	−0.191***
Girls	−1.26	−0.89	−0.87	−0.59	0.22	0.15	0.16	0.27	−0.240***	−0.161***	−0.147***	−0.103*
Extraversion												
Boys	0.17	0.28	0.18	−0.13	0.24	0.23	0.22	0.30	0.024	0.037	0.024	−0.020
Girls	0.65	0.79	0.65	0.29	0.31	0.19	0.22	0.35	0.094*	0.119***	0.094**	0.041
Negative affect												
Boys	0.74	1.06	1.10	0.87	0.25	0.16	0.15	0.20	0.141**	0.184***	0.193***	0.170***
Girls	1.38	1.28	0.99	0.85	0.20	0.12	0.14	0.21	0.290***	0.272***	0.192***	0.175***
Positive affect												
Boys	−0.13	0.26	−0.24	−0.18	0.29	0.19	0.18	0.20	−0.023	0.037	−0.037	−0.027
Girls	0.06	−0.73	−0.52	0.06	0.23	0.16	0.18	0.28	0.011	−0.122***	−0.083**	0.010
Interpersonal distrust												
Boys	0.08	0.05	0.33	0.70	0.03	0.02	0.02	0.03	0.149**	0.086**	0.056	0.122*
Girls	0.02	0.02	0.06	0.08	0.02	0.17	0.02	0.03	0.035	0.031	0.100*	0.142**

*$P \leq .05$.
**$P \leq .01$.
***$P \leq .001$.
[a]Boys: n = 583; $R^2 = 0.071$ for step 1, delta $R^2 = 0.113$ for step 2 ($P \leq .001$); girls: n = 682; $R^2 = 0.083$ for step 1, delta $R^2 = 0.057$ for step 2 ($P \leq .001$).
[b]Boys: n = 1,570; $R^2 = 0.068$ for step 1, delta $R^2 = 0.109$ for step 2 ($P \leq .001$); girls: n = 1,742; $R^2 = 0.065$ for step 1, delta $R^2 = 0.145$ for step 2 ($P \leq .001$).
[c]Boys: n = 1,734; $R^2 = 0.085$ for step 1, delta $R^2 = 0.127$ for step 2 ($P \leq .001$); girls: n = 1,699; $R^2 = 0.051$ for step 1, delta $R^2 = 0.104$ for step 2 ($P \leq .001$).
[d]Boys: n = 682; $R^2 = 0.088$ for step 1, delta $R^2 = 0.132$ for step 2 ($P \leq .001$); girls: n = 601; $R^2 = 0.033$ for step 1, delta $R^2 = 0.084$ for step 2 ($P \leq .001$).
Symbol: … = not applicable.
Abbreviations: AICA-S = Scale for the Assessment of Internet and Computer Game Addiction, B = B value of the multiple regression analyses, β = β coefficient of the multiple regression analyses, SE B = standard error of the B value.

Table 4. Mean Scores of the SDQ Subscales in Adolescents With Internet Addiction, Mild Internet Addiction, and Nonproblematic Internet Use According to Gender[a]

	Internet Addiction	Mild Internet Addiction	Nonproblematic Use	ANCOVA Test Statistics			
SDQ Subscale	Mean (SD)	Mean (SD)	Mean (SD)	*F*	*df*	*P*	η^2
Emotional Problems							
Boys	3.8 (2.67)[b]	2.8 (2.27)[c]	1.7 (1.77)[d]	156.28	2,4346	≤.001	.067
Girls	5.9 (2.47)[b]	4.6 (2.43)[c]	3.1 (2.31)[d]	152.63	2,4589	≤.001	.062
Conduct Problems							
Boys	4.3 (2.34)[b]	3.2 (2.05)[c]	2.2 (1.67)[d]	162.21	2,4346	≤.001	.069
Girls	3.6 (1.96)[b]	2.9 (1.70)[c]	1.9 (1.41)[d]	161.41	2,4589	≤.001	.066
Hyperactivity							
Boys	5.4 (2.27)[b]	4.5 (2.13)[c]	3.3 (2.12)[d]	121.38	2,4346	≤.001	.053
Girls	5.7 (2.27)[b]	4.7 (2.17)[c]	3.5 (2.09)[d]	128.16	2,4589	≤.001	.053
Peer Problems							
Boys	3.8 (2.22)[b]	2.8 (1.91)[c]	2.2 (1.68)[d]	69.65	2,4346	≤.001	.031
Girls	3.1 (1.85)[b]	2.6 (1.70)[c]	2.1 (1.56)[d]	33.35	2,4589	≤.001	.014
Prosocial Behavior							
Boys	5.7 (2.66)[b]	6.9 (2.26)[c]	7.1 (2.51)[c]	128.96	2,4346	≤.001	.013
Girls	7.1 (2.41)[b]	7.5 (2.00)[b]	8.1 (1.81)[c]	32.12	2,4589	≤.001	.014

[a]n = 8,943; age was controlled for by including it as a covariate within the ANCOVAs.
[b,c,d]Different superscripts indicate significant group differences (post hoc test: Games-Howell test) between the groups ($P \leq .05$), and values with the same superscript do not differ significantly (b = internet addiction group, c = mild internet addiction group, and d = nonproblematic users).
Abbreviations: ANCOVA = analysis of covariance, η^2 = eta-squared (effect size), SDQ = Strengths and Difficulties Questionnaire.

Table 5. Mean Scores of the Symptom Checklist-90 Revised (SCL-90R) Subscales and the Global Severity Index (GSI) in Adolescent Patients With Diagnosed Internet Addiction and Controls

	IA Group (n = 115)	Non-IA Group (n = 91)	Test Statistics			
Variable	Mean (SD)	Mean (SD)	*t*	*df*	*P*	*d*
SCL-90R Subscale						
Somatization	0.34 (0.34)	0.28 (0.34)	1.43	204	.154	0.180
Obsessive-Compulsive	0.68 (0.60)	0.43 (0.49)	3.29	201	.001	0.427
Social Insecurity	0.54 (0.60)	0.35 (0.50)	2.41	202	.015	0.323
Depression	0.49 (0.51)	0.32 (0.45)	2.58	199	.011	0.337
Anxiety	0.35 (0.42)	0.20 (0.30)	3.09	201	.002	0.390
Aggressiveness	0.50 (0.51)	0.35 (0.48)	2.20	201	.029	0.282
Phobic Anxiety	0.22 (0.37)	0.12 (0.31)	2.12	201	.035	0.290
Paranoid Ideation	0.59 (0.65)	0.39 (0.57)	2.28	201	.023	0.321
Psychoticism	0.26 (0.46)	0.15 (0.30)	2.17	195	.031	0.275
GSI	0.44 (0.39)	0.29 (0.35)	2.99	204	.003	0.391

Abbreviations: *d* = Cohen *d* (effect size), IA group = adolescents diagnosed with internet addiction, non-IA group = adolescents not diagnosed with internet addiction.

low conscientiousness and high negative affect were significant predictors for the AICA-S score regardless of age and gender. Gender differences were identified for extraversion and positive affect that were nonsignificant among males but were shown to have some associations among girls. For boys, low conscientiousness was the strongest predictor for IA, followed by high negative affect; for girls, this association was reversed.

The clinical perspective: personality traits associated with internet addiction. Extraversion, conscientiousness, and interpersonal distrust were also administered in the clinical sample. Additionally, the factor neuroticism was used. Due to the smaller sample size, it was not possible to conduct age-specific regressions; instead, age was included as a predictor yielding a significant model ($R^2 = 0.357$, $P \leq .001$) with low conscientiousness ($\beta = -0.295$, $P \leq .001$), high neuroticism ($\beta = 0.213$, $P \leq .05$), and age ($\beta = 0.169$, $P \leq .05$) predicting the AICA-S-score.

Psychopathological Symptoms of Internet Addiction

The epidemiologic perspective on psychosocial distress. Gender-specific ANCOVAs with IA, mild IA, and nonproblematic internet use as group variable and age as covariate on the Total Difficulties Score of the SDQ were run. For boys, a significant main effect was found ($F_{2,4368} = 260.75$, $P \leq .001$; $\eta^2 = 0.107$), with age yielding an independent effect ($P \leq .001$). The post hoc tests revealed that those with IA had significantly higher SDQ scores than those with mild IA and nonproblematic use (each $P \leq .001$). In girls, a significant main effect was present ($F_{2,4604} = 257.88$, $P \leq .001$; $\eta^2 = 0.101$), with age showing an additional effect ($P \leq .025$; $\eta^2 = 0.001$) and those with IA displaying elevated SDQ scores compared to those with mild IA and nonproblematic use (each $P \leq .001$).

The procedure was repeated for the SDQ subscales (Table 4). Significant main effects occurred for every subscale regardless of gender. In all subscales, male and female adolescents with IA displayed higher symptoms than adolescents with nonproblematic internet use.

The clinical perspective on psychopathological symptoms in internet addiction. The IA group revealed significantly higher scores than the non-IA group in every SCL subscale (Table 5) and yielded lower scores than the non-IA group in Psychological Functioning (IA group: mean = 66.0, SD = 11.8; non-IA group: mean = 79.9, SD = 10.9; $P \leq .001$), Social Functioning (IA group: mean = 64.1, SD = 13.5; non-IA group: mean = 78.2, SD = 11.8; $P \leq .001$), and Achievement-Related Functioning (IA group: mean = 64.0, SD = 13.2; non-IA group: mean = 76.7, SD = 12.0; $P \leq .001$).

DISCUSSION

We were interested in providing a detailed description of IA in adolescents using 2 community-based samples and 1 clinical sample. A considerable percentage of adolescents met criteria for IA (2.6%) and a higher proportion (11.7%) for mild IA. Interestingly, boys and girls, almost equally, met IA criteria, which contradicts prior findings but matches results from recent publications.[9,10,24] A clear contrast occurred regarding reports on treatment seekers in specialized institutions, where most of the patients are male.[40,41] Subsequently, our data from the clinical sample confirmed this mismatch with only 1.3% female treatment seekers. This leads to the question whether girls affected by IA might not feel helped by counseling programs. Alternatively, it might be the case that girls with IA maintain a high level of functioning (eg, by maintaining social contacts) for a longer time and, therefore, might not be perceived as being in need of help (eg, by parents and friends).[42]

The linkage between using online computer games and IA was stressed again. Online computer games were the strongest predictor for IA in boys, and three-quarters of the patients diagnosed with IA were exclusively using online games. This confirms that it is not the use of the internet per se that is contributing to IA symptoms but rather the preoccupation with specific content.[43,44]

Compared to healthy regular internet users, adolescents with IA reported clinically relevant symptoms such as emotional distress, anxiety, and inattentiveness. In the clinical sample, the biggest effect sizes were associated with obsessive-compulsive and anxiety symptoms, matching previous results.[45,46] The seriousness of IA was stressed by decreased levels of functioning among young IA patients. Likewise, adolescents classified with a mild form of IA also showed heightened psychosocial distress compared to regular internet users. Although these symptoms were still lower than those of the IA group, it becomes evident that implementation of early intervention strategies is reasonable in order to reduce distress and to prevent adolescents from developing the full symptoms of IA.

A second aim of our study was to identify personality traits acting as vulnerability factors. Regardless of gender and age, low conscientiousness and high negative affect were related to IA in the community-based sample and neuroticism in the clinical sample, matching findings from adult[16,19] and adolescent samples.[47,48] Low conscientiousness has repeatedly been reported in the context of mental illness and, in particular, substance use disorders.[49,50] High conscientiousness has been associated with planning ability, responsibility, and impulse control.[31] Low conscientiousness might be predictive for exhibiting a loss of control regarding one's online behavior, a tendency to neglect other duties, and difficulties in resisting the impulse to go online. This interpretation is strengthened by previous studies demonstrating that impulsivity is correlated with IA and internet gaming disorder.[11,51,52] Since decreased conscientiousness has been identified as a stable correlate of IA in different studies,[49,50] implementing strategies to enhance conscientiousness in intervention programs would appear to be useful. This could be realized by defining clear day structures and training on goal-setting strategies (eg, empowering patients to divide distant goals into proximal ones).

An equally strong predictor for IA in both samples was high negative affect/neuroticism pointing to a preponderance of negative mood states, difficulties regarding emotion regulation, negative self-concept, and heightened proneness to stress.[31] Neuroticism has been demonstrated to be a general risk factor for mental diseases.[50] Although evidence is largely missing here, one could speculate that individuals high in neuroticism try to avoid negative mood states by increasingly turning to virtual environments that might act as distractors from stressful real life events and thereby enhance feelings of control and refuge. Cognitive restructuring and enhancement of stress management skills could therefore be beneficial therapy components. Neuroticism has also been shown to be one subclinical precondition of depressive symptoms and depressive disorders,[53] and might contribute to the high rates of comorbid depression in IA patients,[12] supporting views that additional pharmacologic interventions using mood stabilizers could be beneficial.

In contrast to our hypothesis, no associations between IA and extraversion were found for boys, whereas for girls, extraversion was generally positively related to IA. Thus, whether extraversion is a correlate of IA remains unanswered. A prior study[54] found that increased extraversion was solely associated with addictive use of social networking sites but not IA in general. Extraversion has also been described as a rather heterogeneous trait composed of sociability and social dominance but also optimism and a need for stimulation.[31] Thus, it could be that only some facets of extraversion are related to IA. In accordance with this, we found heightened interpersonal distrust related to IA in boys and girls—at least in some of the age groups and exclusively in the community sample. Focusing on girls with IA, one might suppose that for them—searching for a context to express their extraversion—engagement in virtual relationships might offer an opportunity to avoid face-to-face contact. Since internet-based communication is characterized by a high level of controllability and anonymity, the internet could be perceived as a more comfortable environment in which to communicate. This feature might also impair subjects with IA from daring to directly turn to a professional from the health care system. Consequently, strengthening social skills in students could help prevent further increases of the incidence of IA. Taken together, our results demonstrate that gender and age have to be considered as influencing the associations between some personality traits and IA, a relationship that makes it necessary to adapt existing etiopathological models and to develop age- and gender-specific public health campaigns.

This study has some limitations, such as its cross-sectional design that prohibits conclusions of causality (eg, regarding the direction of the associations between personality and

IA). Moreover, classification of IA in the epidemiologic survey relied on self-reports that cannot replace a clinical diagnosis. Also, in the epidemiologic module, IA was assessed as a global construct and not differentiated according to its specific subtypes (eg, internet gaming disorder). It is possible that predisposing factors vary regarding the specific IA subtypes,[54] which might have caused confounding effects. Although we included a large variety of variables within the surveys, collecting further data (eg, socioeconomics) would have been useful for further insights.

A strong point of this study was its combination of epidemiologic and clinical data. IA was shown to be a frequent health problem in adolescence. While only small gender differences in IA were found, it became evident that girls are not entering the health care system for IA. More research focusing on girls with IA is needed. Low conscientiousness and high negative affect/neuroticism were identified as major predictors of IA. Lastly, our study underscores that IA is accompanied by heightened psychosocial strain, emphasizing its nature as a health-related problem that affects adolescents' lives and stressing the need for professional intervention.

We suggest that future research should continue integrating findings on causes and consequences of IA in holistic theories. Some promising approaches already exist,[17,27,44] including the first empirical underpinnings of the assumptions on the interplay of vulnerability, symptoms of IA, use of critical online content, and resulting psychopathology and distress. Elaborating on these theories should be the next logical step in understanding IA.

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