



# Adolescent gaming and social media usage before and during the COVID-19 pandemic

## Interim results of a longitudinal study

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**Abstract:** *Background:* The COVID-19 pandemic has raised concerns about a potential increase of addictive behaviors. Adolescents are considered particularly vulnerable to a problematic usage of digital applications. For the first systematic investigation of screen time and problematic usage patterns over the course of the pandemic, a pre-pandemic survey on adolescent social media (SM) and gaming use was extended to a longitudinal study. Here we present the results of the first two measurement points (pre-pandemic/under lockdown). *Methods:* A representative sample of 1,221 adolescents (10–17 years) participated in an online survey in 09/2019, 824 of them in 04/2020. Prevalence rates were measured at baseline with standardized scales covering ICD-11 criteria for problematic usage patterns. These were statistically compared and related to pre- and under-lockdown screen time. *Results:* Pre-pandemic prevalence rates for pathological SM/gaming were about 3% each, for at-risk usage 8–10% including more boys than girls. Usage frequencies and screen times significantly increased under the lockdown. The predictive value of usage patterns for screen time decreased from before to during the lockdown. Changes in screen time could not be predicted by the usage pattern. *Discussion:* The stability of the observed rates and effects should be further examined over the course of the pandemic. This will lead to relevant implications for prevention measures and the allocation of intervention resources.

**Keywords:** gaming disorder, social media disorder, screen time, adolescents, COVID-19 pandemic

### Die Nutzung von digitalen Spielen und sozialen Medien durch Kinder und Jugendliche vor und während der COVID-19-Pandemie

**Zusammenfassung:** *Zielsetzung:* Ein bedeutsamer Anstieg der Nutzungszeiten digitaler Spiele und sozialer Medien (SM) unter der COVID-19-Pandemie hat Besorgnis über eine mögliche Zunahme assoziierter Verhaltenssuchte ausgelöst. Adoleszente scheinen hierbei besonders gefährdet. Für eine systematische Untersuchung von Nutzungszeiten und problematischen Nutzungsmustern im Verlauf der Pandemie, wurde eine vor dem Ausbruch der Pandemie durchgeführte Erhebung zum Mediennutzungsverhalten unter Jugendlichen zu einer Längsschnittstudie mit drei zusätzlichen Messzeitpunkten erweitert. Das vorliegende Manuskript präsentiert die Ergebnisse der ersten beiden abgeschlossenen Erhebungen zu den Zeitpunkten vor der Pandemie und während des ersten Lockdowns. *Methode:* Eine repräsentative Stichprobe von 1221 10- bis 17-jährigen Kindern und Jugendlichen in Deutschland nahm an der Baseline-Befragung (09/2019) teil. 824 von ihnen konnten für die Follow-up-Messung (04/2020) gewonnen werden. Zur Schätzung der Prävalenzen riskanter und pathologischer Gaming-/SM-Nutzung nach ICD-11-Kriterien wurden standardisierte Instrumente eingesetzt. Die Nutzungszeiten von Games und SM wurden zu beiden Messzeitpunkten abgefragt, mittels t-tests statistisch verglichen und durch lineare Regressionsanalysen auf Zusammenhänge mit Nutzungsmustern untersucht. *Ergebnisse:* Zur Baseline erfüllten 10% der Jugendlichen die Kriterien für riskantes und 2,7% die Kriterien für pathologisches Gaming. 8,2% wurden als riskante und 3,2% als pathologische SM Nutzer klassifiziert. 1,3% erreichten den Cut-off für beide pathologischen Nutzungsmuster und 5,7% für ein kombiniertes mindestens riskantes Nutzungsmuster. Jungen zeigten häufiger als Mädchen eine riskante Nutzung von Games und SM sowie pathologisches Gaming. Unter dem Lockdown nahmen die Häufigkeit und die Dauer der Nutzung von Games und SM deutlich zu. Der Vorhersagewert problematischer Nutzungsmuster in Bezug auf Nutzungszeiten nahm vom ersten zum zweiten Messzeitpunkt ab (gaming:  $R^2_{\text{vor Pandemie}} = 0.23$  zu  $R^2_{\text{unter lockdown}} = 0.08$ ; SM:  $R^2_{\text{vor Pandemie}} = 0.07$  zu  $R^2_{\text{unter lockdown}} = 0.03$ ). Er war in Bezug auf den Anstieg der Nutzungszeiten vernachlässigbar. *Schlussfolgerungen:* Die COVID-19-Pandemie stellt ein großes Risiko für die physische, aber auch eine große Belastung für die psychische Gesundheit der Gesamtbevölkerung dar. Mit zunehmenden Nutzungszeiten von Games und SM bei Kindern und Jugendlichen steigt potenziell das Risiko für problematische Nutzungsmuster unter der Pandemie. Dieser Zusammenhang ist jedoch mit hoher Wahrscheinlichkeit nicht linear. Die Ergebnisse der nächsten Messzeitpunkte müssen abgewartet werden, um die Stabilität der beobachteten Effekte zu überprüfen und die Prävalenzraten unter der Pandemie einschätzen zu können. Diese werden zu relevanten Implikationen für Maßnahmen der Prävention und Intervention führen.

**Schlüsselwörter:** Computerspielstörung, Abhängigkeit von sozialen Medien, Nutzungszeiten, Adoleszente, COVID-19-Pandemie

## Introduction

Digital media have become an integral part of our society. Under the societal restrictions of the ongoing global pandemic caused by the new type of coronavirus (COVID-19), application downloads and sales rates have significantly increased worldwide since the beginning of 2020 (GWI, Global Web Index, 2020). Correspondingly, the number of active social media (SM) users and download rates of digital games has risen (statista.com, 2020a; wearesocial, 2020). Accordingly, there are growing concerns regarding an increase of behavioral addictions like pathological gaming and social media (SM) use (King, Delfabbro, Billieux, & Potenza, 2020; Rumpf et al., 2020). Adolescents in particular are considered vulnerable to problematic behavioral patterns due to incomplete neural maturation processes (Konrad, Firk & Uhlhaas, 2013).

The Gaming Disorder (GD) was recently included in the International Classification of Diseases (ICD-11) of the World Health Organization (World Health Organization, 2018). GD is characterized by a loss of control over gaming, its prioritization over other activities and continued use despite negative consequences. To meet the diagnosis, the gaming pattern must persist over a period of at least 12 months and lead to significant personal, social or career-related impairments. Hazardous gaming reflects a less severe condition of problematic gaming, which, however, entails an increased risk for negative consequences. Under certain circumstances it might turn into GD.

Prior to the WHO, the APA (American Psychiatric Association, 2013) introduced nine criteria of pathological gaming – a condition warranting more research – into the 5<sup>th</sup> revision of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5). An Internet Gaming Disorder is present when at least five criteria are met during the past 12 months. Four of the DSM-5 criteria correspond to the ICD-11 criteria for GD (Jo, Bhang, Choi, Lee, Lee & Kweon, 2019; Ko, Lin, Lin, & Yen, 2019). Although criteria for problematic SM use have not yet been included in the diagnostic manuals, researchers argue that this form of digital usage behavior should be classified as addictive behavioral pattern (Brand et al., 2020) and described by the same set of diagnostic criteria as pathological gaming (van den Eijnden, Lemmens & Valkenburg, 2016).

The time spent with digital media (screen time) is not a criterion for a problematic usage but a positive association has been repeatedly shown (e.g., Laconi, Pirès & Chabrol, 2017; Paik, Cho, Chun, Jeong & Kim, 2017; Savci, Ercengiz & Aysan, 2017). Wartberg, Kriston and Thomasius (2020) identified screen time as a predictor

for pathological gaming in adolescents one year later. However, there is an ongoing debate about the usefulness of this measure regarding the indication of pathological usage. Besides the problem of reporting biases, it actually does not allow to distinguish between excessive and uncontrollable addictive use. In this context, Han et al. (2014) were able to show significant differences in brain structure (grey matter volume) between professional gamers compared to pathological gamers – both playing for extended periods. Moreover, Jo et al. (2019) could not find a significant difference in screen time between normal and disordered gamers. It remains to be investigated whether a change in screen time during the COVID-19 pandemic can be linked to an increase of problematic usage patterns.

Prevalence rates among adolescents have so far been assessed based on DSM-5 criteria and range from 1.2% to 5.9% for pathological gaming (Sugaya, Shirasaka, Takahashi & Kanda, 2019) and 3,3% to 14,8% for problematic SM use (Boer et al., 2020). Prevalence estimates for adolescents according to the ICD-11 are missing, although the manual will come into effect on January 1, 2022. Moreover, current rates are important for the intensity of intervention efforts, as problematic gaming and SM use are often accompanied by comorbid mental disorders like depression or social anxiety, family conflicts, disturbed sleep patterns, and declining school performance (Royant-Parola, Londe, Tréhout & Hartley, 2018; Sampasa-Kanyinga, Chaput & Hamilton, 2019; Sugaya et al., 2019).

To the best of our knowledge, no representative data on the development of screen time and problematic usage patterns over the course of the COVID-19 outbreak in Germany are yet available, but there is a general need for epidemiological studies to derive prevention measures (Rumpf et al., 2020). This paper covers the latest results of two surveys among German adolescents conducted in September 2019 (pre-COVID) and April 2020 (during the first lockdown) in the scope of a longitudinal study and addresses the following issues:

1. How high was the prevalence of at-risk and pathological use of games and SM among adolescents according to the ICD-11 criteria just before the pandemic?
2. To what extent did the adolescents mean screen times change under the first lockdown?
3. To what extent were problematic usage patterns associated with screen times before the pandemic?
4. To what extent did usage patterns identified before the pandemic predict screen times under the first lockdown?

## Methods

### Participants and procedure

To enable a systematic investigation of screen times and usage patterns over the course of the pandemic, a survey on adolescent media use conducted before the COVID-19 outbreak was extended to a longitudinal study including four measurement points: before the pandemic (baseline), 6-month follow-up (during lockdown), 12- and 18-month follow-up. Intermediate results of the first two measurement points are presented in this manuscript. Surveys were conducted from September 13 to 17 and April 20 to 30 via the online platform of the German market research and opinion polling company Forsa Politik- und Sozialforschung GmbH. Participants belonged to the forsa.omninet panel including about 75,000 randomly selected Germans aged 14 years and above (forsa, 2020). Of these, 23,736 adults between 28 and 75 years were contacted via e-mail. Of 12,427 respondents 1,733 confirmed having children aged 10 to 17 years. Of these households 1,221 adolescents gave informed consent and provided necessary details. 824 of them could be reached for the second measurement (67.49% response rate). Representativity was assured regarding proportions of sex, age, and region of residence.

The study was approved by the local ethics committee of the University Hospital in Hamburg, followed the ethical guidelines of the relevant national and institutional committees on human experimentation and was in accordance with the Declaration of Helsinki.

### Measures

Standardized questionnaires and individual items were used to capture sociodemographic variables (baseline), problematic usage patterns (baseline), weekly average frequencies of usage (in days) and mean screen times (for gaming and SM separately, at baseline and follow-up). The latter was calculated by the reported mean screen times on weekdays (i.e. school days) and weekend days (i.e. spare days, in hours). Games were defined as all offline and online games for digital devices. SM included messenger services (e.g. WhatsApp), streaming services with comment/like function (e.g. YouTube), digital photo and video albums (e.g. Instagram, Tik Tok), microblogging services (e.g. Twitter) and professional platforms (e.g. XING).

The Gaming Disorder Scale for Adolescents (GADIS-A, Paschke, Austermann & Thomasius, 2020) was used to assess the ICD-11 criteria for Gaming Disorder (GD). GADIS-A is a two-factorial 10-item screener covering cognitive-behavioral symptoms and negative consequences as well

as the time criterion. Agreement to given statements was rated on a five-point Likert scale (strongly disagree [0] to strongly agree [4]) with higher scores indicating more problems. Screening for GD was positive if adolescents had reached the cut-off values for both factors and the time criterion was fulfilled. If only the time criterion and/or the cut-off value for the negative consequences was not met, at-risk gaming (RG) was assumed.

Since no validated ICD-11-related instrument exists, Social Media Disorder (SMD) and at-risk Social Media Use (RSMU) were assessed using the one-factorial, polythetic DSM-5 based Social Media Disorder Scale (SMDS, van den Eijnden et al., 2016) – a nine item instrument with a dichotomous response format (no [0]/yes [1]). A higher total score indicated a higher risk for problematic SM use. Items 4–6 and 9 of the scale (SMDS-4) reflect ICD-11 associated criteria and were therefore considered separately to estimate pathological and at-risk usage (Jo et al., 2019; Ko et al., 2019). Screening on SMD was considered positive when adolescents agreed to all four items. If two or three items had been answered with *yes*, RSMU was assumed.

### Statistical Analysis

Absolute and relative frequencies with 95% confidence intervals (95% *CI*, categorical variables) and mean values with standard deviations (*SD*, metric variables) were computed. Variables including two groups were compared using  $\chi^2$  and (paired) *t*-tests. Those comprising three groups (usage patterns) were compared by one-factorial ANOVAs and post-hoc Scheffé tests. Corresponding effect sizes (*ES*) were calculated using Cramer's *V* (categorical variables) / Cohen's *d* (metric variables) and interpreted according to the following standards:  $0.1 \leq \text{Cramer's } V < 0.05$  weak,  $0.15 \leq V < 0.1$  moderate,  $0.25 \leq V < 0.15$  strong and  $V > 0.25$  very strong effect;  $0.20 \leq \text{Cohen's } d < 0.50$  clinically relevant (small *ES*);  $0.50 \leq d < 0.80$  medium *ES*,  $d \geq 0.80$  large *ES* (Cohen, 1988).

Since not all participants provided information on their weekly gaming ( $N = 15$ ) and SM ( $N = 14$ ) usage, prevalence rates were calculated based on a total number of 1,206 and 1,207 adolescents, respectively. Regarding screen times, participants who reported to use games/SM at least once a week (defined as regular users) and whose comparative values were available at both measurement points were considered separately (games:  $N = 687$ , SM:  $N = 748$ ).

After reviewing the test assumptions, the relation of usage patterns with screen times (both baseline) and lockdown-associated screen time (changes) were examined by linear regressions. Screen time changes were compared for the baseline-defined usage patterns (uncritical, at-risk,

pathological) applying independent t-tests. Absolute values of skewness > 2.0 and kurtosis > 7.0 were used to check for substantial deviation of normality distribution (Kim, 2013). All computations were realized using the software package R (<https://www.R-project.org>).

## Results

### Sample characteristics

Table 1 shows the sample characteristics and a comparison of the baseline and the follow-up sample to account for potential attrition effects. Both samples did not differ significantly.

### Media usage patterns before the pandemic

The prevalence rates for at-risk and pathological gamers and SM users including absolute frequencies and 95% CIs are presented in table 2.

Besides 15.75% (95% confidence intervals [CI] [13.70; 17.81]) non- or irregular *gamers* ( $N = 190$ ), the majority of the adolescents ( $N = 862$ ) showed uncritical *gaming behavior* (71.48%; 95% CI [68.93; 74.02]). Of 10.03% adolescents with RG and 2.74% with GD boys were affected significantly more often than girls.

A proportion of 9.44% (95% CI [7.80; 11.09]) adolescents did not use *SM* or used them only irregularly ( $N = 114$ ). An uncritical *SM usage pattern* before the pandemic was shown by 79.2% (95% CI [76.92; 81.49];  $N = 956$ ). The

**Table 1.** Sociodemographic sample characteristics (baseline and follow-up)

Categories	Baseline sample	Follow-up sample	Comparison
	$N(\%)/\text{mean} (\pm SD; \text{range})$	$N(\%)/\text{mean} (\pm SD; \text{range})$	$\chi^2/t$ ( $p$ value*)
Absolute frequency	1221	824	
Gender			0.004 (0.95)
Male	658 (53.89)	442 (53.64)	
Female	563 (46.11)	382 (46.36)	
Age in years	13.04 (2.39; 10–17)	13.06 (2.4; 10–17)	-0.19 (0.85)
(Prospective) school-leaving certificate <sup>a</sup>			0.001 (0.98)
No/low educational degree	99 (8.48)	66 (8.33)	
Middle or higher educational degree	1069 (91.52)	726 (91.67)	
High school student <sup>b</sup>			0.00 (1.00)
Yes	1132 (92.79)	763 (92.71)	
No	88 (7.21)	60 (7.29)	
Number of underaged children in household	1.68 (0.82; 1–13)	1.66 (0.83; 1–13)	0.47 (0.64)
place of residence			0.04 (0.83)
Urban living	659 (53.97)	440 (53.40)	
Rural living	562 (46.03)	384 (46.60)	
Family's first generation migration background <sup>c</sup>			1.65 (0.20)
Yes	38 (3.18)	36 (4.37)	
No	1158 (96.82)	787 (95.63)	

Note. SD = standard deviation. No/low educational degree = no, special-school (Förderschulabschluss), or lower school certificate (Hauptschulabschluss); Middle or higher educational degree = secondary school certificate (Realschulabschluss) to university entry qualification (Abitur); No high school student = in voluntary service, apprenticeship, national service, or jobseeking; Low education = no or lower school-leaving certificate (Hauptschulabschluss); Middle or high education = secondary school-leaving certificate (Realschulabschluss) – doctor's degree (PhD). <sup>a</sup> no answer  $n = 53$  (baseline)/  $n = 32$  (follow-up); <sup>b</sup> no answer  $n = 1$  (baseline)/  $n = 1$  (follow-up); <sup>c</sup> no answer  $n = 25$  (baseline)/  $n = 1$  (follow-up). \*uncorrected for multiple comparisons.

criteria of RSMU was fulfilled by 8.2% ( $N = 99$ ) and of SMD by 3.15% ( $N = 38$ ) of the adolescents. A significant gender difference in favor of the boys was found for RSMU but not for SMD.

A *combined pattern* of a problematic use of games and SM was shown for 5.67% of the adolescents ( $N = 68$ ). The criteria of GD and SMD was fulfilled by 1.33% of the adolescents ( $N = 16$ ) including a higher proportion of boys.

## Media screen times before and under the pandemic

Comparative data on user frequencies and average screen times for the measurement points before COVID-19 (baseline) and during lockdown (follow-up) are displayed in table 3. The frequencies of regular and daily gamers and SM users significantly increased from September 2019 to April 2020. Weak to moderate increases in mean screen times on days during the week (i.e. school days) and at weekends (i.e. spare days) were found for both usage of games and SM.

## Media usage patterns and times before and under the pandemic

Please refer to table 4 for descriptive statistics and comparative data on screen times before the COVID-19 pandemic and during the lockdown across the three usage patterns (uncritical, at-risk, pathological). A one-factorial ANOVA on the time spent on gaming/SM depending on the three gaming patterns revealed significant effects at both measurement points (gaming: baseline:  $F(2, 977) = 31.12, p < 0.001$ ; follow-up:  $F(2, 607) = 9.91, p < 0.001$ ; SM: baseline:  $F(2, 1056) = 13.33, p < 0.001$ ; follow-up:  $F(2, 672) = 5.09, p = 0.006$ ).

Before the COVID-19 pandemic, screen times of uncritical gamers and SM users were significantly shorter than those of at-risk and pathological users according to post-hoc Scheffé tests with medium to large and small to medium effect sizes. During the lockdown, screen times of uncritical gamers were significantly shorter than those of at-risk and pathological gamers with small to large effect sizes. Uncritical SM users' screen was significantly shorter than those of pathological but not of at-risk users with small to medium effect sizes. At-risk users did not signifi-

**Table 2.** Prevalence rates<sup>a</sup> of adolescents with problematic gaming and social media usage

	Absolute and relative frequencies			Comparison	
	total	boys	girls	boys – girls	
	N(%) [95% CI]	N(%) [95% CI]	N(%) [95% CI]	$\chi^2$ (p value)	V
<b>Gaming</b>					
Gaming disorder	33 (2.74) [1.84; 3.66]	24 (3.65) [2.22; 5.08]	9 (1.60) [0.56; 2.63]	4.02 (0.045)	0.06
At-risk gaming	121 (10.03) [8.34; 11.73]	93 (14.13) [11.47; 16.80]	29 (5.15) [3.33; 6.98]	28.46 (<0.001)	0.16
<b>Social media usage</b>					
Pathological social media usage	38 (3.15) [2.16; 4.13]	26 (4.00) [2.49; 5.514]	12 (2.15) [0.95; 3.36]	2.77 (0.096)	0.05
At-risk social media usage	99 (8.20) [6.65; 9.75]	64 (9.85) [7.56; 12.14]	35 (6.28) [4.27; 8.30]	5.03 (0.025)	0.07
<b>Combined</b>					
Pathological gaming and social media usage	16 (1.33) [0.68; 1.98]	13 (2.01) [0.93; 3.09]	3 (0.54) [0.0; 1.16]	3.79 (0.051)	0.06
Pathological or at-risk gaming and social media usage	68 (5.67) [4.36; 6.98]	41 (6.33) [4.45; 8.20]	27 (4.9) [3.1; 6.7]	8.67 (0.003)	0.09

Note. V = Cramer's V, <sup>a</sup>assessed at baseline. Usage patterns were assessed by the Gaming Disorder Scale for Adolescents (GADIS-A) and the four ICD-11 associated items of the Social Media Disorder Scale (SMDS-4).

**Table 3.** Frequency and duration of media usage before and under the pandemic

	Absolute and relative frequencies/means		Comparison	
	Baseline	Follow-up	follow-up vs. baseline	
	N(%) [95 % CI]/ mean ( $\pm$ SD)	N(%) [95 % CI]/ mean ( $\pm$ SD)	$\chi^2/t$ (p value)	V/d
<b>Gaming</b>				
Frequency of usage				
regular <sup>a</sup>	1014 (84.08) [82.01; 86.14]	735 (96.58) [95.29; 97.87]	72.76 (<0.001)	0.19
daily	480 (39.8) [37.04; 42.56]	413 (54.27) [50.73; 57.81]	38.83 (<0.001)	0.14
Screen time <sup>b</sup>				
on weekdays	80.05 (83.99)	144.37 (144.37)	12.32 (<0.001)	0.71
on weekend days	151.24 (156.13)	192.81 (182)	7.26 (<0.001)	0.3
<b>Social media usage</b>				
Frequency of usage				
regular <sup>a</sup>	1093 (90.56) [88.97; 92.20]	761 (93.03) [93.14; 96.26]	4.19 (0.041)	0.05
daily	796 (65.95) [63.28; 68.62]	614 (75.06) [72.10; 78.03]	18.72 (<0.001)	0.10
Screen time <sup>b</sup>				
weekdays (school days)	115.08 (108.37)	191.50 (158.20)	14.55 (<0.001)	0.71
weekend days (spare days)	183.27 (173.79)	239.09 (184.10)	9.33 (<0.001)	0.36

Note. SD = standard deviation, V = Cramer's V, d = Cohen's d, <sup>a</sup>participants using digital games/social media at least once a week, <sup>b</sup>in minutes, for all regular (including daily) users.

cantly differ from pathological users at baseline and first follow-up but showed small to medium effect sizes.

At baseline, the symptom severity of problematic usage behavior indicated by higher GADIS-A and SMDS-4 scores was significantly associated with mean screen times: gaming time explained 23.05 % of the variance of symptom severity (standardized  $\beta = 0.48$ , 95 % CI [0.43; 0.53],  $p < 0.001$ , Nagelkerkes  $R^2 = 0.23$ ) and SM time a smaller but significant proportion of 7.44 % (standardized  $\beta = 0.27$ , 95 % CI [0.22; 0.33],  $p < .001$ , Nagelkerkes  $R^2 = 0.07$ ). The predictive value decreased for the mean screen times assessed under the lockdown to 8.46 % for games (standardized  $\beta = 0.29$ , 95 % CI [0.22; 0.36],  $p < 0.001$ , Nagelkerkes  $R^2 = 0.08$ ) and to 2.92 % for SM (standardized  $\beta = 0.17$ , 95 % CI [0.10; 0.25],  $p < 0.001$ , Nagelkerkes  $R^2 = 0.03$ ). The symptom severity of problematic usage behavior did not predict the change in screen times of games (standardized  $\beta = -0.04$ , 95 % CI [-0.22; 0.03],  $p = .248$ , Nagelkerkes  $R^2 < .001$ ) and SM from baseline to follow-up (standardized  $\beta = -0.05$ , 95 % CI [-0.12; 0.02],  $p = .153$ , Nagelkerkes  $R^2 = 0.001$ ).

## Discussion

To the best of our knowledge, the results presented are the first describing ICD-11-related adolescent prevalence rates of problematic gaming and SM usage before the COVID-19 pandemic. Moreover, using a longitudinal design we could directly compare the frequency and duration of gaming and SM use before the pandemic and during Germany's first lockdown and relate these to pre-pandemic usage patterns.

The prevalence rates reported for pathological gaming, SM use, and for the combined disorder among adolescents are comparable to respective prevalence estimates from other studies when considering given confidence intervals (e.g., Wartberg et al., 2020). Boys were engaged in at-risk or pathological gaming significantly more often than girls, which is also in line with previous research (Sugaya et al., 2019). Moreover, at-risk SM users included more boys than girls. Van den Eijnden et al. (2016) found this significant gender difference in one of three adolescent samples. Wartberg et al (2020) and Fung (2019) did not find a significant gender difference and Boer et al. (2020) revealed

**Table 4.** Media screen time before and under the pandemic (according to usage patterns)

	Usage patterns <sup>a</sup>			Post-hoc comparisons <sup>b</sup>					
	pathological	at-risk	uncritical	pathological – at-risk		pathological – uncritical		at-risk – uncritical	
screen time <sup>c</sup>	mean (±SD)	mean (±SD)	mean (±SD)	<i>difference</i> [95 % CI] (p value)	<i>d</i>	<i>difference</i> [95 % CI] (p value)	<i>d</i>	<i>difference</i> [95 % CI] (p value)	<i>d</i>
<b>Gaming</b>									
baseline	229.13 (150.20)	179.41 (131.49)	116.03 (104.77)	49.72 [-4.10; 103.54] (0.078)	0.37	113.10 [64.55; 161.53] ( $<0.001$ )	1.06	63.38 [36.67; 90.09] ( $<0.001$ )	0.58
follow-up	293.75 (166.48)	219.16 (147.81)	155.52 (150.98)	74.59 [-41.25; 190.42] (0.288)	0.50	136.04 [26.43; 245.66] (0.010)	0.91	61.46 [17.28; 105.63] (0.003)	0.42
<b>Social media</b>									
baseline	229.79 (133.62)	197.23 (161.79)	148.33 (121.28)	32.41 [-27.66; 92.48] (0.417)	0.21	81.67 [29.24; 134.10] (0.001)	0.67	49.26 [16.63; 81.90] (0.001)	0.39
follow-up	303.80 (193.22)	264.34 (185.96)	208.28 (160.15)	54.59 [-44.63; 153.80] (0.403)	0.21	95.33 [9.35; 181.31] (0.025)	0.59	40.74 [-14.07; 95.55] (0.190)	0.34

Note. SD = standard deviation, *d* = Cohen's *d*, <sup>a</sup>assessed by the Gaming Disorder Scale for Adolescents (GADIS-A) and the four ICD-11 associated items of the Social Media Disorder Scale (SMDS-4) at baseline, <sup>b</sup>according to post-hoc Scheffé tests following significant one-factorial ANOVAs; <sup>c</sup>mean screen time including weekdays (school days) and weekend days (i.e. spare days), in minutes.

a weakly significant but negligible correlation between female sex and problematic SM use. One reason for the small but still present effect found in the current study might be that YouTube was included as an explicit example for SM. YouTube is often used to watch Let's Play Videos which largely attracts boys (Statista, 2020b).

Up to now, prevalence estimates were mainly based on the DSM-5 criteria of IGD. The items of most screening instruments covering the nine IGD criteria are best described by one factor (e.g. by the Internet Gaming Disorder Scale – Short Form by Lemmens, Valkenburg & Gentile, 2015). In the ICD-11 the aspect of negative consequences by dysfunctional media usage received a new weighting congruent with the biaxial model of addiction (Reed et al., 2019; Wakefield, 2015). Thus, specific symptoms associated with the usage itself do not necessarily lead to a GD diagnosis but can also be indicative for at-risk behavior (World Health Organization, 2018). This was considered in the GADIS-A used to assess GD and RG. At this stage, no comparable questionnaire for pathological and at-risk SM use is available but a first step towards an ICD-11-related approach is the selection of corresponding items of available DSM-5 screeners.

Since digital applications become easier available to even children, screening instruments for problematic usage should consider younger age groups and be aware of potential overestimation by recall biases (Coughlin, 1990)

or exaggeration (Jeong et al., 2018). This is of special importance under the ongoing COVID-19 pandemic – a worldwide threat to public health. In spring 2020 Germany issued many regulations to slow down the spread of the virus. These included the nationwide closure of schools and daycare centers, playgrounds and sports facilities, and the implementation of far-reaching contact restrictions (Röhr, Müller, Jung, Apfelbacher, Seidler & Riedel-Heller, 2020). Digital media has played and continues to play an important role in maintaining contacts, fighting boredom, and gathering information which becomes apparent by significantly increased usage frequencies and durations when comparing individuals before the pandemic and during the first German lockdown. As a result of increased screen time, feelings of loneliness and loss of control might be reduced, and digital media could take over relieving functions. For a part of the users, digital media might be also used as a strategy to reduce stress and negative feelings. Previous research suggests that these users are particularly at risk of developing at-risk or pathological usage behavior (King et al., 2020). Due to their increased susceptibility to distress and mental disorders in a developmental phase marked by significant physiological and neurobiological transition processes (Grant et al., 2006), adolescents should play a more superior role in ongoing debates.

Whether the pandemic will lead to rising prevalence of pathological behavior cannot be reliably verified earlier

than a year from the beginning of local restriction due to the pandemic when the ICD-11-time criterion can be considered. Therefore, we will not expect valid numbers for pandemic-associated GD and SMD before spring 2021. In our study pre-pandemic problematic behaviors were indicative for the screen time under the first lockdown 2020 to a smaller extent than they were at the end of 2019. Even though problematic gamers and SM users differed from uncritical users in terms of screen times before and during the pandemic, additional aspects such as a general usage increase irrespective of the usage pattern should be accounted for. Interestingly, the extent of change in screen times was not associated with the pre-pandemic usage pattern. Thus, problematic users in fall 2019 did not show a larger increase than uncritical users. Although ceiling effects could be taken under considerations, motives such as fighting boredom or staying in contact applying to almost all adolescents seem to be a more likely explanation. The measured screen times for pathological users correspond to pre-pandemic findings of three to six gaming hours per day on average (Fuster, Carbonell, Pontes & Griffiths, 2016; Milani et al., 2018; Pontes, Király, Demetrovics & Griffiths, 2014; Torres-Rodriguez, Griffiths, Carbonell & Oberst, 2018). But still, it cannot be ruled out that pre-pandemic uncritical users start to show a problematic usage pattern as suggested by a cross-sectional study based on retrospective ratings of Dong, Yang, Lu and Hao (2020) during the Chinese COVID-19 lockdown. Accordingly, the prevalence of problematic internet users (33.4%) among the 6- to 18-years old children and adolescents almost doubled compared to those reported earlier in China (17.1%). Moreover, adolescents with problematic media behavior in their past, might show a relapse in old behavioral patterns in a period of isolation and uncertainties.

The continuation of this study and new studies are necessary to evaluate the stability of current findings. Furthermore, progress in the development of suitable and clinically validated instruments measuring problematic patterns of digital media usage is urgently needed. An early diagnosis and the identification of risk factors is the prerequisite for initializing appropriate prevention and intervention measures. This would contribute to an early detection and treatment of symptoms and, thus, a prevention of various negative consequences including comorbid disorders and chronification in the especially vulnerable group of adolescents. Relevant lifestyle and internet-specific advice on the prevention of problematic user behavior under the COVID-19 pandemic is given in the consensus guidance by Király et al (2020). This includes the development of activity schedules, regular engagement in physical activity, good sleep hygiene, strict monitoring of screen time, and the use of analogue technical tools to reduce overuse.

## Limitations

The reported results are from an ongoing study. Current conclusions must therefore be treated with caution. A common problem of prospective surveys is the drop-out of participants. This reduces representativity but is a balanced cost regarding the advantage of longitudinal information. In addition, a real-time recording of usage frequencies and durations would have had considerable added value in promoting the objectivity of the respective data but is difficult to realize on a large representative scale. Moreover, the GADIS-A is the first tool to assess GD in adolescents and was validated in the baseline sample. The use of the four SMDS items to assess SMD was analogue to the GD approach of Ko et al. (2019) and Jo et al. (2019) but the items do not cover all details of the ICD-11 criteria. Furthermore, this approach has not been validated for SMD yet. At this point no standardized instruments are available to assess ICD-11 at-risk and pathological gaming and social media use in adolescents that have been clinically validated. This would be the gold standard for drawing conclusions that go beyond screening information at a populational level. Finally, the present study did not investigate the use of other screen activities common among adolescents like watching non-SM videos (e.g. on Netflix or Amazon Prime) which could be of potential clinical interest.

## Conclusion

We presented the first ICD-11-related prevalence estimates for RG (10,1%), RSMU (8,2%), GD (2.7%) and SMD (3.6%) in adolescents. They were obtained just before the COVID-19 pandemic and comparable to those of previous DSM-5-related studies. Not surprisingly, during the first German COVID-19 lockdown the frequency and duration of digital media usage statistically increased compared to pre-pandemic conditions in a prospective design. Although problematic users showed significantly longer screen times at both measurement points than uncritical users, their predictive value for the usage pattern (operationalized by scale sum scores) decreased during the lockdown compared to half a year earlier. This suggests that almost all adolescents, irrespective of a-priori risks concerning problematic media usage, used digital media more often, most likely due to similar motives like fighting boredom and staying in contact. Whether these time increases will lead to a larger proportion of young people with problematic media use over the course of the pandemic, is the aim of the continuing longitudinal study.



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