

Adolescent Problematic Video Streaming: Exploring Parental and Family Risk Factors in a Population-Based Sample with Prospective Follow-Up

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Abstract

Background

Problematic video streaming (PVS) is an emerging health concern in adolescents. However, the investigation of its etiological factors is limited. Problematic internet use, an umbrella concept, was previously associated with parental and family risk factors; however, the transferability of findings to PVS remains unclear. This exploratory research, thus, aimed to investigate parental and family risk factors in adolescent PVS.

Methods

A population-based online survey was conducted with German adolescents (aged 10 to 17 years) and their parents (n = 1,083 dyads) with a 10-month follow-up (n = 559 dyads). Adolescent PVS was measured using the ICD-11 based Streaming Disorder Scale for Adolescents. Assessed parental and family factors included sociodemographic characteristics, parental digital media use, severity of parental depressive symptoms, general anxiety disorder (GAD) symptoms and stress, parental restrictive mediation, digital parenting self-efficacy (DPSE), family communication, and family functionality. In an exploratory approach, key risk factors of adolescent PVS were identified via best subset regression analysis and tested in cross-sectional and longitudinal regression models.

Results

Parental problematic gaming (PG) as well as problematic social media use (PSMU), GAD symptoms, and DPSE were identified as the best subset of risk factors regarding model fit and parsimony. All four variables were significantly associated with adolescent PVS in the cross-sectional analysis. Baseline parental PSMU and DPSE remained significant predictors of adolescent PVS longitudinally.

Conclusions

The findings underscore the important role of parental factors in the context of adolescent PVS. Strengthening parental involvement in prevention and treatment efforts is highly warranted. Further research should consider the complex interplay of risk factors to inform targeted interventions.

Background

Video-streaming (VS), i.e., watching video-based material on digital platforms, is a prevalent internet activity among adolescents. Between 80 and 90% of German family households possess at least one online video-streaming service [1, 2]. However, social media platforms have gained in relevance regarding video entertainment [3]. Instead of actively engaging with other users on social media platforms (e.g.,

through chatting, posting, liking, following, commenting), VS comprises passive consumption of video-based content on such platforms (e.g., watching short videos), as well as classic video streaming services (e.g., watching television (TV) series). Approximately 11% of German adolescents exhibit problematic video streaming (PVS) [4], which refers to VS habits adversely impacting well-being by undermining developmental needs or promoting excessive use [5].

The etiological understanding of adolescent PVS is markedly under-researched. The limited number of existing studies suggests the following factors to be associated: Frequent binge-watching of TV series, a preference for short videos, difficulties engaging in goal-directed behavior while experiencing strong emotions, a lack of emotional clarity [6], poor mental health, elevated impulsivity, lower academic achievement, reduced quality of life [7], and platform design or content features that deliberately enhance excessive usage behaviors [8]. The prevalence of adolescent PVS is comparable to other forms of problematic internet use (PIU), such as problematic gaming (PG; 12%) and problematic social media use (PSMU, 11%) [9].

The World Health Organization (WHO) formally recognized the clinical relevance of PG by introducing *gaming disorder* (GD) and *hazardous gaming* (HG) as two distinct classifications in the International Classification of Diseases (ICD-11) [10]: GD comprises an impaired control over, as well as an increased priority given to, and the continuation (or escalation) of playing digital games despite negative consequences. It results in significant functional impairment and occurs usually over period of 12 months. If the gaming pattern warrants professional attention but does not meet the diagnostic requirements of GD, the WHO suggests to classify HG. These diagnostic procedures are currently discussed to be applied to other forms of PIU regarding the use of social media, online pornography, and online shopping platforms [11]. Considering PVS accordingly appears justified, given the lack of standardized operationalization and its clinical relevance due to comparable prevalence rates [4]. In addition, leading addiction researchers advocate further investigations of PVS [12].

Previous research – though partly inconsistent – indicates parental and family factors to significantly contribute to adolescent PG and PIU in general, demonstrating effect sizes similar to individual factors like psychopathology, emotion regulation, or self-esteem [13]. The influence of parental or family factors (e.g., socioeconomic status, poverty, household dysfunction, parental digital media use, inconsistent parenting, and low parenting efficacy) is highlighted in the Interactional Theory of Childhood Problematic Media Use (IT-CPU) through distal and proximal interactions [14]. Additional research shows that both higher and lower socioeconomic status [15, 16] as well as living in a single-parent household [17] could predict adolescent PIU. Moreover, parental mental health problems were associated to adolescent PIU in a scoping review [18].

As proclaimed in the IT-CPU, parents also influence their children's digital engagement directly and indirectly through modeling behaviors, parenting practices, and emotional or relational dynamics. For instance, adolescents were more likely to develop PG or PSMU when their parents were also affected by PG or PSMU [19, 20]. Moreover, inconsistent parental mediation, characterized by reactivity and lack of responsiveness, was identified as a risk factor, whereas positive parenting strategies and clear rule-setting

served as protective factors [21]. Besides, parents' confidence in promoting healthy media use, i.e., digital parenting self-efficacy (DPSE), predicted lower levels of adolescent PG and PSMU [20]. Lastly, impaired family functioning as well as poor family communication was associated with increased vulnerability to adolescent PG and PIU [16, 22]. Despite shared findings, generalization to other forms of PIU should be conducted cautiously due to inherent conceptual differences [23, 24]. Thus, research on parental and family factors of adolescent PVS specifically is currently non-existent.

As prevalence rates of adolescent PVS are estimated at concerning levels, and PVS was previously associated with poor mental health and reduced quality of life, research on associated risk factors, such as parental and family factors, is essential to inform integrated prevention or intervention measures for this vulnerable age group. Due to the lack of research on this topic, an exploratory approach was chosen in which this study aimed to (1) identify the most relevant parental and family risk factors for adolescent PVS among those highlighted by previous research and (2) investigate their predictive value by employing both cross-sectional and prospective analyses.

Methods

Participants and procedure

This study is part of a large ongoing longitudinal study on family digital-media use and mental health with annual waves since 2019. Participants were recruited by the German *forsa* Institute for Social Research and Statistical Analysis from the online *forsa.omninet* panel, a regularly updated database comprising over 100,000 individuals aged 14 years and older residing in Germany at the time of data collection. From this panel, a sample of adults aged between 28 and 75 years was selected by a random sampling procedure to reflect population distribution regarding sex, age, education, and geographical region, based on the largest annual household survey in Germany *microcensus* (for details on the study procedure, see [25]). Eligible participants were required to have at least one child aged 10 to 17 years. In cases of more than one child within the age range, the one with the most recent birthday was chosen. Participants were invited annually to fill-in an online survey. In case of non-responsiveness, new families were included to maintain cross-sectional representativeness. Both the selected parent and adolescent took part in the survey. They were instructed to answer their targeted questionnaires independently and one after the other. Data for this study were drawn from surveys conducted in September 2023 (baseline) and June 2024 (follow-up). At baseline, 1,083 parent-adolescent dyads completed questionnaires. 559 dyads participated at follow-up 10 months later, resulting in a retention rate of 51.6%. Completion of questionnaires required approximately 25 minutes. Participants gave informed consent prior to participation and could withdrawal from the study at any time. They received vouchers as compensation for their effort.

Measures

Sociodemographic information included adolescents' and parents' age, sex, and relationship status for sample description, as well as parents' partnership status as a proxy for household composition and parental educational level and financial stability as a proxy for socioeconomic status. Educational level was trichotomized (high-middle-low), financial stability and partnership status were dichotomized (yes-no) for easier interpretability.

Adolescent PVS was measured using the Streaming Disorder Scale for Adolescents (STREDIS-A) [4], based on the ICD-11 criteria for HG and GD (sample item: *'I often continue viewing videos even though it causes me distress with others.'*). The scale demonstrated excellent internal consistency in this study ($\alpha_{\text{baseline}} = 0.93$, $\alpha_{\text{follow-up}} = 0.93$). Higher scores indicated greater PVS severity.

Parental PG and PSMU were evaluated at baseline as proxies for parental digital media use, because no validated tool for adult PVS had been published at the time of the study. Hence, the Gaming Disorder Scale (GADIS) [26] and the Social Media Use Disorder Scale (SOMEDIS) [27] were applied, both adapted for adult self-report and previously used in adult samples (sample items: *'I often play digital games more frequently and longer than I planned to.'* or *'I neglect daily duties, e.g., grocery shopping or cleaning, because I prefer using social media.'*). The scales exhibited excellent internal consistency for adult self-reports ($\alpha_{\text{GADIS}} = 0.93$, $\alpha_{\text{SOMEDIS}} = 0.91$). Additionally, parents reported their average gaming and social media usage times on workdays and days off, and their weekly usage days, from which weighted average weekly usage times were calculated.

Psychological factors included measures of parental mental health. Thus, perceived psychological stress (PSS-10; $\alpha_{\text{baseline}} = 0.88$, $\alpha_{\text{follow-up}} = 0.89$, sample item: *'How often in the past month did you feel that you were unable to control the important things in life?'*) [28], depressive symptoms (PHQ-9; $\alpha_{\text{baseline}} = 0.88$, $\alpha_{\text{follow-up}} = 0.88$, sample item: *'In the past two weeks, how often have you been bothered by feeling down, depressed, or hopeless?'*) [29], and general anxiety disorder (GAD) symptoms (GAD-7; $\alpha_{\text{baseline}} = 0.90$, $\alpha_{\text{follow-up}} = 0.89$, sample item: *'Over the past two weeks, how often have you experienced worrying too much about different things?'*) [30] were assessed in parents. Internal consistencies ranged from good to excellent. Higher sum scores indicated greater symptom severity.

Parenting factors comprised restrictive mediation (RM) and digital parenting self-efficacy (DPSE). RM was defined as the consequent implementation of rules by parents regarding their child's digital media use and was measured at baseline by the Media Rules Questionnaire (MR-6, sample item: *'We have firm household rules about how much time my child may spend using digital media.'*) [20]. Internal consistency was good ($\alpha = 0.84$). DPSE refers to parents' perceived confidence in their ability to guide their child to a healthy use of digital media and was measured at baseline using the Digital Parenting Self-Efficacy Scale (DPSES, sample item: *'I feel capable of effectively guiding my child toward healthy digital media use.'*) [31]. Internal consistency was acceptable ($\alpha = 0.75$). Higher sum scores indicated more RM or DPSE.

Family factors contained parental satisfaction with positive communication among family members, which was investigated at baseline using the Family Communication Scale (FCS; $\alpha = 0.93$, sample item: *'How*

satisfied are you with the ability of your family to share positive experiences with each other?') [32]. Parental perception of family functionality in relation to adaptability, partnership, growth, affection, and resolve (APGAR), was assessed at baseline using the Family APGAR Scale ($\alpha = 0.80$, sample item: 'I am confident that I can ask my family for help when something upsets me.') [33]. The scales showed good to excellent internal consistency. Higher sum scores indicated more favorable outcomes.

Statistical analysis

All statistical analyses were performed in R, version 4.3.2 [34]. Before conducting the main analyses, the data underwent comprehensive preparation and cleaning procedures, including systematic screening for data accuracy, outliers, missing values, and verification of all relevant statistical assumptions. Missing values were imputed using the *mice* package [35] via fully conditional specification regression models, if the missing data was not substantial ($< 1/3$ per scale); otherwise, participants were excluded from further analyses.

Examination of skewness (values > 2.0 indicated substantial skewness) and kurtosis (values > 7.0 indicated substantial kurtosis) was conducted descriptively to evaluate normal distribution [36]. Frequencies and percentages were computed for categorical variables; means, standard deviations, and ranges were calculated for metric variables using the *psych* package [37]. Difference and equivalence between baseline and follow-up samples were tested to evaluate sample comparability despite substantial dropout rate via the *TOSTER* package [38], with equivalence bounds set at $\Delta = \pm 0.3$ for 90% power and $\alpha = 0.05$. Equivalence was assumed when mean differences fell within these bounds (see Table 1). Correlations (Pearson's r , point-biserial or phi coefficients) were calculated among baseline variables (see Supplementary Table 1). Variance inflation factors (VIF) were computed using the *car* package to assess multicollinearity (present if $VIF > 5$).

Table 1
Baseline and follow-up sample characteristics, incl. tests for equivalence and difference.

Variables	Baseline (<i>n</i> = 1083) M (SD)/ n (%)	Follow-up (<i>n</i> = 559) M (SD)/ n (%)	Difference [90% CI] ¹	TOST Statistic ²	TOST <i>p</i> - value ³	NHST Statistic ⁴	NHST <i>p</i> - value ⁵
Child variables							
Biological sex			-0.04 [-0.08, 0.01]	<i>z</i> = 10.09	< 0.001	χ^2 = 1.97	0.160
Male	546 (50.42)	303 (54.20)					
Female	537 (49.58)	256 (45.80)					
Age [in years]	13.52 (2.20)	14.46 (2.20)	-0.94 [-0.98, -0.88]	<i>t</i> = -20.72	1	<i>t</i> = -8.13	< 0.001
Relationship status			-0.001 [-0.03, 0.02]	<i>z</i> = 20.27	< 0.001	χ^2 = 0	1
Biological child	987 (91.14)	510 (91.23)					
Other ^a	96 (8.86)	49 (8.77)					
Education level			-0.001 [-0.05, 0.04]	<i>z</i> = 11.21	< 0.001	χ^2 = 0.03	0.985
High ^b	549 (56.19)	261 (56.37)					
Middle ^c	328 (33.57)	156 (33.69)					
Low ^d	100 (10.24)	46 (9.94)					
Missing	106	96					
Problematic video streaming	6.31 (6.81)	6.93 (7.20)	-0.62 [-1.23, -0.004]	<i>t</i> = -0.85	0.803	<i>t</i> = -1.66	0.098
Missing	40	13					

Variables	Baseline (<i>n</i> = 1083) M (SD)/ n (%)	Follow-up (<i>n</i> = 559) M (SD)/ n (%)	Difference [90% CI] ¹	TOST Statistic ²	TOST <i>p</i> -value ³	NHST Statistic ⁴	NHST <i>p</i> -value ⁵
Child variables							
Parent variables							
Biological sex			0.03 [-0.01, 0.07]	<i>z</i> = -10.46	< 0.001	$\chi^2 = 1.09$	0.296
Male	560 (51.71)	305 (54.56)					
Female	523 (48.29)	254 (45.44)					
Age [in years]	46.76 (7.29)	47.88 (7.17)	-1.12 [-1.21, -1.03]	<i>t</i> = -14.98	1	<i>t</i> = -2.97	0.003
Partnership			0.01 [-0.02, 0.04]	<i>z</i> = -16.57	< 0.001	$\chi^2 = 0.32$	0.573
Yes	949 (87.87)	485 (86.76)					
No	131 (12.13)	74 (13.24)					
Missing	3	0					
Educational level			0.01 [-0.03, 0.05]	<i>z</i> = -11.79	< 0.001	$\chi^2 = 1.38$	0.501
High ^e	182 (17.09)	107 (19.45)					
Middle ^f	355 (33.33)	178 (32.36)					
Low ^g	528 (49.58)	265 (48.18)					
Missing	18	9					
Financial stability			-0.05 [-0.09, -0.01]	<i>z</i> = 10.84	< 0.001	$\chi^2 = 3.73$	0.053
Enough ^h	743 (69.25)	412 (73.97)					

Variables	Baseline (<i>n</i> = 1083) M (SD)/ n (%)	Follow-up (<i>n</i> = 559) M (SD)/ n (%)	Difference [90% CI] ¹	TOST Statistic ²	TOST <i>p</i> - value ³	NHST Statistic ⁴	NHST <i>p</i> - value ⁵
Child variables							
Not enough ⁱ	330 (30.75)	145 (26.03)					
<i>Missing</i>	10	2					
Digital media use							
Weekly gaming time [in hours]	3.96 (6.66)	-	-	-	-	-	-
<i>Missing</i>	45						
Weekly SM use time [in hours]	10.66 (10.48)	-	-	-	-	-	-
<i>Missing</i>	69						
Problematic gaming	2.2 (4.59)	-	-	-	-	-	-
<i>Missing</i>	8						
Problematic SM use	4.32 (5.36)	-	-	-	-	-	-
<i>Missing</i>	7						
Parental mental health							
Perceived psychological stress	15.22 (6.90)	14.87 (7.41)	0.35 [-0.27, 0.98]	<i>t</i> = 0.15	0.558	<i>t</i> = 0.94	0.350
<i>Missing</i>	9	8					
Depressive symptoms	5.70 (4.95)	5.88 (4.94)	-0.18 [-0.60, 0.25]	<i>t</i> = 0.47	0.319	<i>t</i> = -0.69	0.493
<i>Missing</i>	14	7					
GAD symptoms	4.59 (4.37)	4.68 (4.19)	-0.09 [-0.45, 0.28]	<i>t</i> = 0.96	0.169	<i>t</i> = -0.38	0.702

Variables	Baseline (<i>n</i> = 1083) M (SD)/ n (%)	Follow-up (<i>n</i> = 559) M (SD)/ n (%)	Difference [90% CI] ¹	TOST Statistic ²	TOST <i>p</i> -value ³	NHST Statistic ⁴	NHST <i>p</i> -value ⁵
Child variables							
Missing	14	11					
Parenting factors							
Restrictive mediation	10.63 (4.71)	-	-	-	-	-	-
Missing	8						
Digital parenting self-efficacy	12.27 (3.26)	-	-	-	-	-	-
Missing	10						
Family factors							
Family communication	24.26 (7.31)	-	-	-	-	-	-
Missing	11						
Family functioning	8.32 (1.92)	-	-	-	-	-	-
Missing	11						
Notes. Abbreviations: M = Mean, SD = Standard Deviation, <i>n</i> = absolute frequency, % = relative frequency, CI = Confidence Interval, TOST = Two One-Sided Tests (equivalence), NHST = Traditional null hypothesis significance testing (difference), SM = Social Media, GAD = General Anxiety Disorder. Equivalence bounds for TOST were set at $\Delta = \pm 0.30$ (90% power, $\alpha = 0.05$). ¹Observed mean difference for continuous variables and proportion difference for categorical variables. ²<i>t</i> = test statistic from the TOST for continuous variables; <i>z</i> = test statistic from the TOST for categorical variables. ³<i>p</i> < 0.05 indicates statistical equivalence. ⁴<i>t</i> = test statistic from the NHST for continuous variables; χ^2 = test statistic from the NHST for categorical variables. ⁵<i>p</i> < 0.05 indicates significant difference. ^aAdopted, step child or foster child, or not specified. ^b(Prospective) University entry qualification (Abitur). ^cSecondary (prospective) school leaving certificate (Realschulabschluss). ^dNo or lower (prospective) school leaving certificate (Hauptschulabschluss). ^eHighest level achieved: master's degree/diploma/doctorate (Ph.D.). ^fHighest level achieved: university entry qualification (Abitur)/apprenticeship/bachelor's degree. ^gHighest level achieved: no or lower school certificate (Hauptschulabschluss)/secondary school leaving certificate (Realschulabschluss). ^h'I have enough money for everything I need' or 'I have enough money, so I can save some every month'. ⁱ'I often worry that I cannot pay my bills' or 'Me and my child often have to abstain, because I am financially limited'.							

Given the lack of evidence, an exploratory approach was chosen to identify key parental and family risk factors associated with adolescent PVS using cross-sectional data (see also [20]). Hence, best subset regression analysis was applied [39] by using a branch-and-bound algorithm implemented in the *leaps* package [40] and evaluating 16 models with an increasing number of parental and family factors, ranging from a single variable to the full set of available variables. The best combination of parental and family risk factors within a linear regression framework regarding model fit and parsimony was identified using established goodness-of-fit indices, including R^2 , the Bayesian Information Criterion (BIC), and Mallows' C_p (see Supplementary Table 2). Metric variables were standardized using z-scores for enhanced interpretability.

Model performance was assessed via ten-fold cross-validation analysis using the *caret* package [41], partitioning data into ten subsets, each serving as a test data set, while 90% served as training data. The model with the best fit within a 5% range of the lowest cross-validation error was selected.

Following model selection, the selected predictors were entered into regression analyses. Specifically, the best subset of parental and family risk factors was used in two separate linear regression models to explain adolescent PVS cross-sectionally at baseline and prospectively at follow-up, while controlling for adolescent age and baseline adolescent PVS. Assumptions of linear regression analysis were tested on the baseline model. VIF values indicated no multicollinearity. No observations showed extreme influence as the maximum Cook's distance was below 0.1 ($D_{\max} = 0.086$; Supplementary Fig. 1). However, 91 cases exceeded the screening threshold of $4/n$ and were therefore considered potentially influential, but sensitivity analysis showed that no substantial alteration of the pattern of results after exclusion. Hence, cases were retained. The Breusch-Pagan test indicated significant heteroscedasticity ($BP(5) = 110.58$, $p < 0.001$), which was also suggested by the residual-versus-fitted-values-plot (Supplementary Fig. 1). A Shapiro-Wilk test indicated non-normal residuals ($W = 0.924$, $p < 0.001$). The Q-Q plot showed deviations from normality, particularly at distribution tails (Supplementary Fig. 1). Consequently, bootstrapping with 1,000 iterations was applied to obtain robust confidence intervals for regression coefficients.

Use of Large Language Models

During the preparation of this work the authors used *perplexity.ai* in order to improve grammar and wording. After using this service, the authors reviewed and edited the content as needed and take full responsibility for the content of the published article.

Results

Sample characteristics are presented in Table 1. Equivalence between baseline and follow-up samples was confirmed regarding sociodemographic variables, except age, reflecting expected changes over time. No meaningful difference was shown for longitudinally assessed psychometric variables. VIF values ranged from 1.10 to 3.66, indicating no to moderate correlations between variables. Supplementary Table 1 shows the correlation matrix of all variables at baseline.

[Please insert Table 1 from pp. 29–31 about here]

Table 2 shows the predictor identification process. Model selection prioritized both predictive accuracy and parsimony. All models fell within 5% of the minimum cross-validation error (Supplementary Table 2). Ultimately, the four-predictor model was selected as the most parsimonious compromise between a comparatively high adjusted R^2 of 0.171 (highest adjusted $R^2 = 0.177$), the lowest BIC (-147), and a Mallows' C_p value of 5.50, which was close to the five estimated regression coefficients, including the intercept. The cross-validation error for this model (0.904) was also close to the minimum observed value (0.897). The final model included the following parental variables: PG, PSMU, GAD symptoms, and DPSE.

Table 2

Finding the optimal adolescent PVS model: Step-wise predictor inclusion based on best subset regression analyses

Parental sociodemographic factors	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Age								X	X	X	X	X	X	X	X	X
Biological sex																X
Educational level										X	X	X	X	X	X	X
Financial situation						X	X	X	X	X	X	X	X	X	X	X
Partnership status							X	X	X	X	X	X	X	X	X	X
Parental problematic digital media use																
Gaming time									X	X	X	X	X	X	X	X
Problematic gaming			X	X	X	X	X	X	X	X	X	X	X	X	X	X
SM usage time												X	X	X	X	X
Problematic social media use		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Parental psychological factors																
Perceived stress														X	X	X
Depressive symptoms															X	X
GAD symptoms				X	X	X	X	X	X	X	X	X	X	X	X	X
Parenting factors																
Restrictive mediation													X	X	X	X
Digital parenting self-efficacy	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Family factors																
Notes. Abbreviations: PVS = Problematic Video Streaming, SM = Social Media; GAD = General Anxiety Disorder. Models 1 to 16 are shown with an increasing number of predictors (1 to 16). # indicates at which stage of the best subset regression procedure the predictor was added to the more complex model.																

Parental sociodemographic factors	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Family communication					X	X	X	X	X	X	X	X	X	X	X	X
Family functionality											X	X	X	X	X	X
Notes. Abbreviations: PVS = Problematic Video Streaming, SM = Social Media; GAD = General Anxiety Disorder. Models 1 to 16 are shown with an increasing number of predictors (1 to 16). # indicates at which stage of the best subset regression procedure the predictor was added to the more complex model.																

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[Please insert Table 2 from page 32 about here]

Cross-sectional model

In the cross-sectional model, all four selected variables, increased parental PG, increased parental PSMU, increased parental GAD symptoms, and decreased DPSE, emerged as significant contributors to adolescent PVS with effect sizes (β) ranging from small (parental PG, PSMU, and GAD symptoms) to moderate (DPSE), after controlling for adolescent age (Table 3). The model explained 19% of the variance, indicating a moderate effect.

Longitudinal model

In the longitudinal model, increased parental PSMU and decreased DPSE remained significant predictors after controlling for adolescent age and baseline PVS (Table 3). Although the effects (β) were small, they remained consistent in direction and meaning, given the longitudinal control for baseline PVS. This model accounted for almost 26% of the variance, indicating a moderate effect.

Table 3. Cross-sectional and longitudinal associations of parental factors with adolescent PVS

Parental factors	Cross-sectional model (PVS 2023)		Longitudinal model (PVS 2024)	
	Estimates	95%-CI	Estimates	95%-CI
(Intercept)	-0.33	-0.69 to 0.04	0.71	0.14 to 1.27
Problematic gaming	0.15	0.05 to 0.25	-0.008	-0.04 to 0.02
Problematic social media use	0.12	0.02 to 0.22	0.04	0.01 to 0.07
GAD symptoms	0.11	0.03 to 0.19	0.006	-0.02 to 0.03
Digital parenting self-efficacy	-0.24	-0.30 to -0.18	-0.04	-0.07 to -0.01
<i>Covariates:</i>				
Adolescent age	0.03	-0.002 to 0.05	-0.03	-0.07 to 0.002
Adolescent PVS at baseline	-	-	0.34	0.23 to 0.44
<i>Observations</i>	1043		533	
<i>Adjusted R²</i>	0.190		0.257	

Note. All predictors were standardized (z-scaled), except for adolescent age. Due to violation of model assumptions, bootstrapping with 1,000 iterations was conducted to ensure robustness; Abbreviations: CI = Confidence Interval, PVS = Problematic Video Streaming, GAD = General Anxiety Disorder.

Discussion

This study provides essential insight into parental and family factors associated with adolescent PVS in a population-based parent-adolescent sample. To our knowledge, this was the first investigation of parental and family risk factors of adolescent PVS, based on standardized ICD-11 criteria for disorders due to addictive behaviors. All factors included in this study were selected due to their indicated relevance for other forms of adolescent PIU in previous research. The exploratory analysis identified increased parental PG, PSMU, and GAD symptoms, as well as decreased DPSE, as significant risk factors of adolescent PVS. Subsequently, the discussion focusses on these four key factors, enhancing parsimony and clinical applicability without diminishing the importance of other individual factors.

Parental problematic digital media use

Key findings include small associations between increased parental PG as well as PSMU and increased adolescent PVS. Both variables were included as proxies for parental digital media use, precluding direct analysis of media-specific usage patterns between parents and adolescents. Yet, the fact that both

parental PG and PSMU were included as important risk factors for adolescent PVS may hint towards a broader construct of parental problematic digital media use that warrants more dedicated research.

While the effect of parental PG was only significant in the cross-sectional analysis, parental PSMU persisted as a significant variable in the longitudinal analysis. The relationship between PSMU and PVS seems plausible, because the most popular video formats among adolescents (such as short videos, vlogs or reviews) are usually consumed via social media platforms (e. g., Tiktok, YouTube, and Instagram). Overall, the significant link between parental and adolescent PIU has been confirmed in international research, with small to large effect sizes [13]. According to the IT-CPU, the modelling role of parents is an important factor in the development of PIU, already during childhood [14]. Children develop attitudes towards digital media by observing their parents. Thus, parents serve as role models in the formation of usage habits, such as watching videos for escapism or stress relief, which may contribute to the development of adolescent PVS. At the same time, parental co-regulation of children's negative emotions may be diminished due to negative consequences of parental PIU, such as delayed or missed responses to emotional needs [42].

Digital parenting self-efficacy (DPSE)

Parents' confidence in fostering healthy digital media use was significantly and negatively associated with adolescent PVS in both cross-sectional and longitudinal analyses. Higher DPSE corresponded with lower PVS in their children; the protective association was stronger cross-sectionally but remained significant in the longitudinal analysis. DPSE has been previously linked to a positive attitude towards digital media and greater parental digital media competencies, both of which play an important role in the application of effective parenting practices [43]. Although studies on parenting practices and adolescent PIU were partially inconsistent, a certain pattern emerged: Refraining from any parental mediation of their children's digital media use tends to exacerbate adolescent PIU, while restrictive mediation (e.g., setting rules and limits) can be both beneficial and ineffective, especially when rules are formulated reactively. In contrast, active and prospective mediation, i.e., showing interest in the adolescent's media use, is associated with lower adolescent PIU [44]. Thus, parenting practices focused solely on control and restriction are rather insufficient and should be accompanied by active involvement and broader parental supervision [16, 45, 46]. This interpretation is supported by our study, as RM was not included in the final estimation model for adolescent PVS. The mere presence of media-related rules appeared to be of less predictive value for adolescent PVS compared to parents' overall confidence in their media-related parenting, which encompasses more than just rule setting. However, parents' confidence in fostering healthy digital media use may be facilitated by considerate rule-setting or vis versa, as increased DPSE was moderately correlated with increased RM in a previous study [31]. Thus, rules should be implemented specifically to a certain usage behavior, instead of exercising restrictions inconsistently or reactively [14, 21].

Parental GAD symptoms

This study demonstrated a small but significant and positive association between parental GAD symptoms and adolescent PVS in the cross-sectional analysis. However, this association was not significant in the prospective analysis, which might be explained by the long observation period between

measurements. Our finding aligns with systematic reviews highlighting the relationship between adolescent PIU and parental mental health problems, though conceptual differences between depression and anxiety disorders should be considered [13, 47]. For instance, a study on adolescent internet addiction found only a significant association for parental depression, but not for parental anxiety [48]. However, other studies reported significant associations between parental anxiety and adolescent PIU [49], highlighting additional indirect associations: While adolescents may develop PIU as a direct coping mechanism in response to their parents' anxiety, anxious parents may also transfer their elevated levels of anxiety directly to their child [50] or negatively influence the quality of the parent-child relationship [51] or the family environment [52], which in turn results in increased adolescent PIU. Future research is needed to investigate the transferability of these findings to adolescent PVS.

Family factors

Regarding family factors, neither family communication nor family functionality was selected in the final model of this study, although correlations with adolescent PVS were in a similar range as parental PG, PSMU, or GAD symptoms (Supplementary Table 1). In contrast, previous research has identified low family cohesion, poor family functionality, intrafamilial conflict, and poor quality of parent-child relationship as risk factors for adolescent PIU [13, 16, 44–46]. While family communication and family functionality represent global constructs that capture overarching family processes, they were not unrelated to the identified key risk factors in this study. Instead, they showed small (parental PG and PSMU) to moderate (parental GAD symptoms and DPSE) correlations (Supplementary Table 1) suggesting shared variance. Thus, their relative explanatory power to adolescent PVS was statistically weaker than that of the selected risk factors, which were therefore prioritized in the final model. Family communication and functionality might not be unimportant to adolescent PVS but their influence might already be explained by their relationship with the identified risk factors.

Clinical implications

Based on the results of this study, it appears relevant to routinely involve parents in the treatment of adolescents with PVS, as called for by experts in the field of PIU [53]. Clinicians may encourage parents to reflect on their own media use patterns, to address potentially problematic habits, and to improve chances of positive role-modeling for their children's media use. Parents with increased GAD symptoms may be informed of the potential impact on their children's PVS and, if needed, referred to adult clinicians for additional support. Conversely, adult clinicians may be sensitized to PIU patterns in their patients and address the potentially harmful parent-child-dynamics, when indicated. Child and adolescent clinicians may focus on boosting parents' DPSE through education on known risk factors for adolescent PVS, active involvement (e.g., by co-viewing) and positive parenting practices (e.g., developing VS rules together with adolescent), addressing family communication and functionality thereafter to optimize care in busy clinical settings. Currently developed interventions for parents of adolescents with PG [54, 55] are being adapted for PVS and could be scaled up to provide access to a broad parent population. Overall, findings support the importance of involving parents in prevention and treatment efforts for adolescents with PVS and the collaboration of pediatric clinicians as well as adult psychiatrists and psychotherapists.

Strengths and limitations

The strengths of this study included the large, population-based sample size of parent-adolescent dyads, the use of validated instruments, and the application of standardized ICD-11 criteria for conceptualizing adolescent PVS. Yet, the following limitations should be acknowledged: Although the MR-6 scale is a widely used instrument with good internal consistency, it had not been formally validated at the time of assessment. Factors such as household composition, socioeconomic status and parental digital media use patterns could only be described by proxy variables, which precludes direct analysis of their relationship with adolescent PVS. Due to non-responses, the dropout rate at the 10-month follow-up was high (48.4%), which limits the representativeness of longitudinal findings. However, statistical comparisons with the baseline sample indicated equivalence in sociodemographic variables, except for expected changes in participants' ages, while no meaningful differences were detected in psychometric variables. Lastly, other potentially relevant parental risk factors, such as personality and attachment style, were not assessed due to resource constraints.

Future Research

Based on the exploratory findings of this study, future research should investigate the relationship of the identified risk factors in more detail. For example, parents' parenting self-efficacy, which was negatively associated with parental mental health in previous research [56], may be a mediator within the relationship of parental GAD symptoms and adolescent PVS. High parenting self-efficacy is associated with greater persistence during parenting conflicts due to better parental responsiveness, and may be affected when parents suffer from anxiety. Consequently, the effect of parental GAD symptoms on adolescent PVS may be explained by neglectful parenting as a consequence of parents' GAD symptoms [57].

Conclusions

This study used an exploratory approach to identify relevant parental and family risk factors in the context of adolescent PVS for the very first time. It identified increased parental PG, PSMU, GAD symptoms, and decreased DPSE as most relevant, showing significant associations in the cross-sectional PVS model. Moreover, PSMU and DPSE significantly predicted adolescent PVS after 10 months. Findings highlight the pivotal role of parents as both role models and guardians, emphasizing their continued influence during adolescence. Consequently, prevention and treatment strategies for adolescent PVS should actively involve parents. They should focus on enhancing DPSE, sensitizing for problematic media use in parents, their role model behavior, and potential mental distress.

Abbreviations

α
Cronbach's alpha
AM
Arithmetic mean

APGAR
Adaptability, Partnership, Growth, Affection, Resolve
BIC
Bayesian Information criterion
BP
Breusch-Pagan test statistic
CI
Confidence interval
DPSE
Digital parenting self-efficacy
DPSES
Digital Parenting Self-Efficacy Scale
FCS
Family Communication Scale
GAD
General Anxiety Disorder
GAD-7
General Anxiety Disorder Scale, 7-item version
GADIS
Gaming Disorder Scale
GD
Gaming disorder
HG
Hazardous gaming
ICD-11
International Classification of Diseases, 11th edition
IT-CPU
Interactional Theory of Childhood Problematic Media Use
MR-6
Media Rules questionnaire
n
Absolute frequency
PG
Problematic gaming
PHQ-9
Patient Health Questionnaire, 9-item version
PIU
Problematic internet use
PSMU
Problematic social media use
PSS-10

Perceived Stress Scale, 10-item version

PVS

Problematic video streaming

Q-Q

Quantile-Quantile

RM

Restrictive mediation

SD

Standard deviation

SOMEDIS

Social Media Use Disorder Scale

STREDIS-A

Streaming Disorder Scale

TOST

Two on-sided tests

TV

Television

VIF

Variance inflation factor

VS

Video streaming

W

Shapiro-Wilk test statistic

WHO

World Health Organization

Declarations

Ethics approval and consent to participate

The study complied with national and institutional guidelines on human research and the Declaration of Helsinki. It was approved by the local psychological ethics commission of the University Medical Center Hamburg-Eppendorf (LPEK-0616/-0815).

Consent for publication

Not applicable.

Availability of data and materials

The data presented in this study are available on reasonable request after all results of the survey have been published.

Competing interests

The authors declare no conflict of interest.

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Authors' contributions

Conceptualization: J.-O.C., K.P.; Data curation: J.-O.C., K.P.; Formal analysis: J.-O.C.; Funding acquisition: K.P.; Investigation: J.-O.C.; Methodology: J.-O.C., K.P.; Project administration: K.P.; Resources: K.P.; Software: J.-O.C., K.P.; Supervision: L.K., K.P.; Validation: K.P.; Visualization: J.-O.C.; Writing – original draft: J.-O.C.; Writing – review and editing: J.-O.C., L.K., K.P.. All authors have read and agreed to the published version of the manuscript.

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