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RESEARCH

Screen use: Its association with caregiver mental health, parenting, and children's ADHD symptoms

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Abstract

Objective: The aim was to examine the relationship between caregiver's mental health (parental psychological distress, and parenting stress), dysfunctional parenting (lax or overreactive parenting), and the screen media use in understanding attention-deficit/hyperactivity disorder (ADHD) symptoms of children within an integrated model framework.

Background: Familial factors and screen use have shown to be significantly related to ADHD in children. However, theoretical models of the role of family environment, screen use, and ADHD have rarely been tested jointly, and little is known about these associations in southeastern European middle-income countries (MICs).

Method: Data from 835 primary caregivers (92% biological mother, 4% biological father, 3% grandmother or grandfather, 1% other) of children (2 to 9 years) from three MICs were analyzed using path analyses, and models were tested for generalizability across education levels and marital status using multigroup analyses. ADHD-related symptoms were assessed with a structured clinical interview (Mini International Neuropsychiatric Interview for Children and Adolescents–Parent Version [MINI-KID-P]) and the Child Behavioral Checklist (CBCL).

Results: Whereas screen use was directly associated with ADHD symptoms across measures, a significant indirect effect of lax parenting on attentional problems via screen use was found only for the CBCL parent report. The final models were tested using multigroup analyses across education levels and marital status with no significant differences.

Conclusion: Investments in resource and capacity building for children's primary caregivers that target lax parenting and limiting of screen use may impact children's attentional problems across educational levels and married and nonmarried caregivers.

KEYWORDS

ADHD symptoms, attentional problem behavior, dysfunctional parenting, parental psychological distress, parenting stress, screen media use

Attention-deficit/hyperactivity disorder (ADHD) is one of the most common neurodevelopmental disorders among children and often persists into adulthood with large societal and economic impacts. It is characterized by hyperactivity, inattention, and impulsivity, and has been shown to be associated with dysfunction in daily activities (Danckaerts et al., 2010; Sayal et al., 2018). According to meta-analytic reviews, ADHD affects 2% to 7% of school-aged children worldwide (Polanczyk et al., 2007; Willcutt, 2012). Global estimates of the prevalence in public health systems vary (i.e., clinically diagnosed or recorded in health care surveillance systems; Sayal et al., 2018), and ADHD particularly remains an underresearched topic in low- and middle-income countries (LMICs; Bitta et al., 2018). Several studies were published on ADHD in children in North Macedonia, with estimates of the incidence being 2% (Pop-Jordanova, 2009). In a meta-analysis (Bitta et al., 2018) on the burden of neurodevelopmental disorders in LMICs, the prevalence of ADHD in children was estimated to be 3%. However, there is reason to believe that the number of children affected by ADHD in LMICs is underestimated due to a lack of epidemiological studies.

The etiology of ADHD is complex and involves multiple causes. Following a multifactorial genesis framework, genetic factors are assumed to play a crucial role in the development of ADHD, whereas psychosocial factors are assumed to significantly influence the form and course of the disorder (Sciberras et al., 2017). A range of social determinants was found to impact the symptomatology of ADHD in high-income countries (HICs), such as low socioeconomic status (SES), low parental education, family conflict, and parental mental disorders (Biederman, 2005; Biederman & Faraone, 2005). However, even if moderating effects have been partially investigated, the mediating mechanisms of how these variables relate to ADHD among children, especially in low resource settings such as low- and middle-income countries (LMICs), are less well researched. Furthermore, they do not always correspond to findings from HICs as the importance, and distribution, of social variables (e.g., socioeconomic status and gender) differ substantially from what is observed in HICs (Maselko, 2017).

Family environmental factors and ADHD

Past research has pointed to parenting as an important family environmental factor involved in the etiology and, in particular, the persistence of ADHD (Deault, 2010; Modesto-Lowe et al., 2008). Especially, overreactive and lax parenting practices have been consistently linked to behavioral problems in children (Lachman et al., 2019). Evidence has further shown that parents of children with ADHD experience higher parenting stress and more mental health difficulties which, in turn, not only reinforce the disrupting behavior but also promote the use of dysfunctional parenting strategies (Modesto-Lowe et al., 2008; Theule et al., 2013).

Furthermore, past research has shown that parenting interventions are effective in reducing child ADHD symptoms through a reduction of parenting stress and dysfunctional parenting

behaviors (Abikoff et al., 2015; Franke et al., 2020), highlighting the importance of familial variables for children's mental health development. Although these findings refer to parenting and "parents," much of the research findings are based on samples with mothers or other female primary caregivers. This reflects traditional gender roles, as most primary caregivers are women in both high- and low-income countries (Jones et al., 2008; Panter-Brick et al., 2014).

ADHD, family environmental factors, and screen media use in lower income settings and samples

The relationship between children's screen media use and ADHD has long been a subject of debate. Most research points to genetics as the primary cause of ADHD in children. Another part of the research argues that the change in prevalence is too big over a short period for a strong genetic component (Hutchings et al., 2011; Jones et al., 2008), and recent studies have found positive associations between screen time (watching TV/DVDs, using a computer, tablet, mobile phone, or playing video games) and attention deficits in preschool children (Beyens et al., 2018; Tamana et al., 2019). Results further indicated that children with more than 2-hours of screen-time per day displayed a 7.7-fold increased risk of meeting the criteria for ADHD.

A meta-analysis of 45 empirical cross-sectional and longitudinal studies investigating the link between media use and ADHD-related behaviors in children and adolescents (Nikkelen et al., 2014) also showed an influence of media use on ADHD-related behaviors, independent of child age. Moreover, past research indicates that higher levels of parenting stress and more dysfunctional parenting behaviors (Detnakarintra et al., 2020), as well as parental psychological distress (Anand et al., 2014), are associated with more screen-time in children (Emond et al., 2018; Halpin et al., 2021). Parental stress and parental psychological distress in mothers have also been linked with ineffective parenting strategies (Mak et al., 2020; Shin et al., 2021). Additionally, single parents (predominantly mothers) with low education levels are at increased risk of engaging in negative or ineffective parenting practices compared to those who are married and/or have higher education levels (Burlaka et al., 2017; Chanda & Pujar, 2019; Solem et al., 2011). Studies investigating family environmental factors in HICs further, suggest that problematic parenting styles (Linebarger, 2015) and parental psychological distress (Ansari & Crosnoe, 2016) enhance the effects of screen media use on ADHD-related behaviors.

Results from the 2010 cross-sectional Health Behaviour in School-aged Children study, conducted among 9,014 adolescents, indicated that 60% of adolescents aged 13 to 15 years in Romania and 50% of adolescents in North Macedonia engaged in playing video games for 2 or more hours per day (Currie et al., 2012). Compared to the other 36 countries surveyed, these were the highest values (36% on average), with HICs tending to have lower prevalence levels (e.g., Switzerland 18%, Ireland 20%, France 28%). Further, low family income in early childhood is associated with an increased likelihood of ADHD in samples in HICs (Larsson et al., 2014). These results are consistent with findings from previous studies and show that not only ADHD, but also excessive screen media use is more common among children in low-income settings and samples (Anderson & Whitaker, 2010; Russell et al., 2016). Nevertheless, the focus has been mainly on children and adolescents of school age, and the early childhood context has been comparatively neglected.

Although recent research has pointed to both an increase in screen usage time and an increase in the prevalence of ADHD in children during recent years (Beyens et al., 2018; Tamana et al., 2019; Thomas et al., 2020), thus far, evidence on the (mediating) role of screen use in understanding familial variables and ADHD in LMICs is limited. Although several studies focused on investigating cross-sectional or longitudinal associations between parent/caregiver- and child-related variables in HICs, a comprehensive framework testing the interplay of

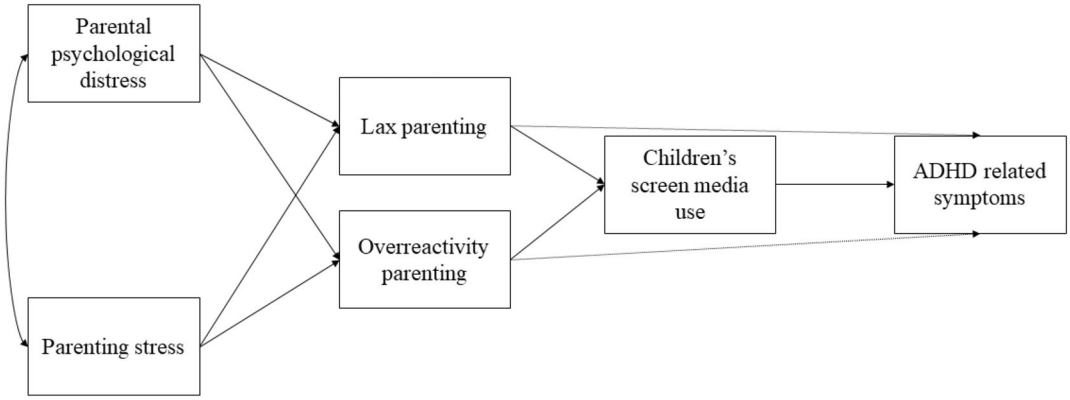

FIGURE 1 Conceptual model of child's ADHD-related symptoms *Note*. ADHD = attention-deficit/hyperactivity disorder.

parental mental health, parenting behaviors, and screen use in context of ADHD and behavioral problems in LMICs is lacking.

CURRENT STUDY

In line with biopsychosocial family models (e.g., spillover theory, Erel & Burman, 1995; risky family model, Repetti et al., 2002), highlighting the negative effect of family dysfunction for children's mental health, the current study aims to examine the relationship between parental mental health, dysfunctional parenting, and screen media use in understanding ADHD within an integrated model framework. Based on the literature review, we hypothesize that parents' mental health and perceived stress will be associated with impairments in their parenting behavior (i.e., an increase in higher levels of dysfunctional parenting practices). Specifically, one result of these parenting difficulties will be increased media consumption of children, which in turn will be associated with children's behavioral problems (see Figure 1).

In line with research on associations between screen time and ADHD symptoms in children (Abidin, 1990; Nikkelen et al., 2014; Tamana et al., 2019), we first hypothesized that more screen media use would be directly related to higher levels of ADHD-related symptoms in children (H1). Second, in line with biopsychosocial family models, as well as past research acknowledging the importance of parental mental health for parenting behaviors (e.g., Jackson & Choi, 2018; Lovejoy et al., 2000), we hypothesized that higher levels of parental psychological distress and parenting stress would be associated with higher use of dysfunctional parenting behaviors (i.e., lax and overreactive parenting; H2). Furthermore, we expected higher levels of dysfunctional parenting behaviors to be associated with greater screen media use in children (e.g., Domoff et al., 2017; Halpin et al., 2021), which in turn is hypothesized to be associated with more ADHD-related symptoms in children (H3; see model in Figure 1). Subsequently, we tested if this model generalizes across parental education levels and marital status (H4). Thus, we examine whether patterns under investigation in the current study unfold differently across different family systems, given that past studies pointed to the importance of the relationship status and SES for parental and child mental health (e.g., Hannighofer et al., 2017; Reiss, 2013). The examination of these theoretical relationships in this model for the first time with cross-sectional data of primary caregivers in middle-income countries (MICs) can inform intervention development for future studies with randomized designs and with families followed over time.

METHOD

Participants

Participants were recruited from youth-friendly health centers in the Republic of Moldova and kindergartens or primary schools in North Macedonia and Romania (see Lachman et al., 2019 for study protocol and more details on the recruitment) to participate in an evidence-based parenting program, Parenting for Lifelong Health program for parents of young children (PLH-YC), as part of the RISE project, a larger European project on parenting. This project aims to adapt, optimize, evaluate, and extend the most effective and cost-effective version of the PLH-YC to prevent child mental health problems in three southeastern European countries. The project consists of three phases (preparation, optimization, and evaluation). For the present study, the baseline assessment of the second phase was used.

Parents, 18 years or older, were eligible to participate if they were the primary caregiver (biological parents, stepparents, grandparents, foster parents, or other relatives; see Table 1) of a child aged 2 to 9 years and met the following eligibility criteria: they were living in the same household as the target child for at least four nights a week in the previous month; they were willing to provide informed consent to participate in the full study including, if invited, attendance at a parenting group; and their child scored 10 or above on the Child and Adolescent Behavior Inventory (CABI) oppositional defiant disorder subscale screening measure (Burns et al., 2015). Exclusion criteria for adult caregivers included any adult who exhibited acute mental health problems, had a severe learning disability, or had been referred to child protection services due to child abuse.

Of the 1,005 primary caregivers recruited for the study, 956 meet the inclusion criteria, and 835 (83.1%) completed the baseline assessment (North Macedonia $n = 289$, Moldova $n = 284$, and Romania $n = 262$). The majority of caregivers reported being the biological mother of the child (92% biological mother, 4% biological father, 3% grandmother or grandfather, 1% other). The mean age of the primary caregiver was 36 years ($SD = 6.5$). The targeted child was, on average, 6 years old ($SD = 2.0$), with 60% of them being boys. In total 83% of caregivers reported on being married and living together and 75% completed university or college (Table 1).

Procedure

All study procedures were approved by the Human Research Ethics Committee of the University of Klagenfurt and the Human Research Ethics Commission of the local institution of the respective country (Republic of Moldova: 43–56/12.04.2018, North Macedonia: 03–1475/2 from 28.03.2019, and Romania: 3322/1.03.2019; Lachman et al., 2019). The research coordinators invited primary caregivers to participate in the study by phone, letter, or in person and screened each participant for initial eligibility. After initial screening, a full assessment was scheduled with the caregiver and a trained assessor in the local language; each assessment took approximately 1 hour. The assessors guided the caregivers through assessments by reading questions and instructions from tablets programmed with an open-source software platform Open Data Kit. The Mini International Neuropsychiatric Interview for Children and Adolescents–Parent Version was administered with a paper version of the interview in the local language according to the guidelines for administration. All participants received a food or gift voucher for completing each evaluation point (approximately €2 to €5).

TABLE 1 Demographic characteristics of the sample ($N = 835$)

	North Macedonia $n = 289$	Moldova $n = 284$	Romania $n = 262$	Total	p
Adult age in years *M* (*SD*)	37.55 (4.82)	34.77 (8.27)	36.44 (5.54)	36.25 (6.49)	<.001
Child age in years *M* (*SD*)	6.04 (1.97)	5.40 (1.98)	5.60 (1.91)	5.69 (1.97)	<.001
Adult gender—female *n* (%)	275 (95.2)	281 (98.9)	246 (93.9)	802 (96.0)	.006
Child gender—female *n* (%)	116 (40.1)	130 (45.8)	85 (32.4)	331 (39.6)	.006
Education level—university/college *n* (%)	239 (82.7)	164 (57.7)	221 (84.4)	624 (74.7)	<.001
Marital status—married and living together *n* (%)	240 (83.0)	230 (81.0)	223 (85.1)	693 (83.0)	.439
Relationship with child *n* (%)					<.001
Mother	273 (94.5)	256 (90.1)	240 (91.6)	769 (92.0)	
Father	13 (4.5)	3 (1.1)	16 (6.1)	32 (4.0)	
Grandparent	1 (0.3)	18 (6.3)	3 (1.1)	22 (3.0)	
Other	2 (0.7)	7 (2.5)	3 (1.1)	12 (1.0)	

Note. Country differences were tested with analysis of variance (ANOVA) for continuous variables and chi-square test for categorical variables.

Measures

All questionnaires were translated into the local language (Macedonian, Moldovan, and Romanian) and translated back into English for verification of accuracy. The CBCL translations went through a translation process with the developers of the CBCL and bilingual child mental health experts in the local languages for official approval in the local languages.

Screen media use

Based on a feasibility study to test and evaluate measures in the three countries as a part of the larger RISE project (Frantz et al., 2019; Lachman et al., 2019), children's screen media was identified as an important concern among caregivers. Six items assessed the daily usage time in minutes for the different devices (TV, DVD, computer, games console, tablet, smartphone). These items were summed to reflect a total score in minutes per day. Screen media use across devices ranged from 0 to 781 minutes per day ($M = 156.92$, $SD = 116.84$). The high number can be attributed to the summing across devices with children using multiple devices at the same time (watching the TV while using a smartphone).

ADHD-related symptoms

ADHD symptoms were assessed using the Mini International Neuropsychiatric Interview for Children and Adolescents–Parent Version (MINI-KID-P; Sheehan et al., 2010). This structured interview is used to screen for the presence of current psychiatric disorders (based on the *Diagnostic and Statistical Manual of Mental Disorders* [*DSM-5*] using a binary "yes/no" format) in children between 6 and 17 years. The instrument screens for several psychiatric disorders. For the present study, only children aged 6 or older were assessed with the MINI-KID-P and the ADHD symptom score based on 19 items was used (Cronbach's $\alpha = .89$). Due to the age range

in RISE (2–9 years), ADHD symptoms—utilizing the MINI-KID-P—were not assessed in the whole sample.

Attentional problem behavior was measured in the whole sample with the parent-report versions of the Child Behavioral Checklist (CBCL; Achenbach & Rescorla, 2001) for children aged 1.5–5 years and 6–18 years. The attention problem subscale raw score ranges from 0 to 10 (CBCL young = 1½–5 version) and 0 to 20 (CBCL old = 6–18 version) with higher scores indicating more problem behavior. Cronbach's alpha values for this sample were $\alpha = .62$ for CBCL young and $\alpha = .83$ for CBCL old. The CBCL versions were combined after standardization (aggregated across older and younger children based on *T* scores). ADHD symptoms and attentional problem behavior were analyzed separately as two outcome variables.

Dysfunctional parenting

The Parenting Scale (PS; Arnold, 1993) was used to assess dysfunctional parenting behavior. It was originally designed to measure dysfunctional discipline practices in parents on three subscales (Laxness, Overreactivity, and Verbosity). The subscale Verbosity was excluded in Phase 2 of the RISE project due to poor psychometric performance in the previous pilot study, which is consistent with past research on the validity of the PS (Rhoades & O'Leary, 2007; Salari et al., 2012). Each item (out of a total of 21 items) was rated on a 7-point Likert scale in which parents were presented with a difficult parent–child situation and then asked to rate their parenting behavior on a continuum scored from 1 = *most effective* to 7 = *most ineffective* (e.g., "When my child does something I don't like…" 1 = *"I do something about it every time it happens"*, 7 = "*I often let it go*"). Responses on the items were averaged. Higher scores indicated more dysfunctional parenting. Cronbach's alpha was $\alpha = .63$ for the Laxness subscale and $\alpha = .67$ for the Overreactivity subscale.

Parenting stress

The Parental Stress Scale (PSS; Berry & Jones, 1995) was used to measure parental stress across different domains (rewards, stressors, satisfaction, and loss of control) utilizing 18 items. Caregivers were presented different statements and answered on a scale from 1 = *strongly disagree* to 5 = *strongly agree*. The overall score ranges from 18 to 90, with higher scores indicating more parenting stress (Cronbach's $\alpha = .80$).

Parental psychological distress

The Depression Anxiety Stress Scale (DASS; Lovibond & Lovibond, 1995) was utilized to assess parents' perceived psychological distress. Caregivers were presented with 21 items and asked to report the frequency of symptoms in the previous week using a Likert scale (0 = *never* to 3 = *always*). The 21-item version is scored as a sum score multiplied by two for comparability with the 42-item version. The DASS total score ranges from 0 to 126, with higher scores indicating more psychological distress (Cronbach's $\alpha = .92$).

Demographics

Caregivers' characteristics including age, gender, marital status (coded as *married and living together* vs. *not married*), and education level (categorized as *university/college degree* vs. *no university/college degree*) as well as children's age and gender were self-reported by caregivers.

TABLE 2 Descriptive statistics and intercorrelations between predictors, covariates, and outcome variables

	N	*M*	*SD*	Min.	Max.	2	3	4	5	6	7
1. Screen media use (min/day)	802	156.92	116.84	0.00	781.00	.108*	.167***	.100**	.189***	.133***	.078*
2. MINI-KID-P—ADHD symptoms	422	4.17	6.15	0.00	19.00	–	.638***	.180***	.101*	.277***	.228***
3. CBCL—attentional problem behavior	835	59.49	14.73	37.22	119.69		–	.191***	.105**	.273***	.255***
4. Overreactive parenting	835	2.98	0.95	1.00	5.80			–	.126***	.337***	.345***
5. Lax parenting	835	3.16	0.98	1.00	6.18				–	.231***	.181***
6. Parenting stress	835	37.05	8.30	18.00	63.00					–	.425***
7. Parental psychological distress	835	23.39	16.61	0.00	102.00						–

Note. ADHD = attention-deficit/hyperactivity disorder; CBCL = Child Behavioral Checklist; MINI-KID-P = Mini International Neuropsychiatric Interview for Children and Adolescents–Parent Version.
*$p < .05$.**$p < .01$.***$p < .001$.

Analytical strategy

Data were analyzed using JASP (Version 0.13; JASP Team, 2020) and Mplus (Version 8.4; Muthén & Muthén, 1998–2019). Prior to all analyses, data were cleaned and checked for data entry errors, outliers, and assumptions of normality. To address the nonnormal distribution of data, all scales were transformed prior to analyses (i.e., square root transformation). The descriptive statistics of the total sample ($N = 835$) are presented together with the original scores in Table 1. Descriptive summaries include means and standard deviations (*SD*) for continuous variables and frequency (*n*) and percentage (%) for categorical variables. Correlation coefficients were examined to answer Hypotheses 1 and 2 (two-tailed, with a significance level of $p < .05$; presented in Table 2). Maximum likelihood with robust standard errors (MLR) was used to estimate the proposed path model (see Figure 1). Structural equation modeling (SEM) models were examined to answer Hypothesis 3 and were run separately with the MINI-KID-P and the CBCL as measures of ADHD-related symptoms. In addition to the theoretical model proposed in this study (see Figure 1) an alternative model was tested that could plausibly fit the data (i.e., screen media use mediates the link from parenting stress to ADHD-related symptoms). Overall model fit was evaluated using the following indices and cut-off criteria for acceptable model fit: root mean-square error of approximation (RMSEA < .08), comparative fit index (CFI > .90), and Tucker-Lewis index (TLI > .90; Hu & Bentler, 1999). Bias-corrected bootstrapped 95% confidence intervals were examined to determine statistical significance of indirect associations (MacKinnon et al., 2004). To examine Hypothesis 4, multigroup differences were tested with the χ^2 difference test across education level and marital status in which regression path estimates and covariances were constrained to be equal across groups and compared to a released model in which regression paths and covariances are free to vary across groups.

RESULTS

Demographic characteristics are reported in Table 1. Pearson's correlations between screen time, ADHD-related symptoms (ADHD symptoms and attentional problem behavior),

parental psychological distress, parenting stress, and dysfunctional parenting (i.e., lax parenting and overreactive parenting) are shown in Table 2. All study variables were significantly positively intercorrelated.

Screen media use and family environmental factors

Screen media use was significantly correlated with children's age ($r = .249$, $p < .001$) and, as hypothesized, with ADHD symptoms across measures (see Table 2). Significant differences were found for countries, $F(2, 799) = 35.09$, $p < .001$, with Moldovan participants reporting significant higher screen times in their children ($M = 189.01$, $SD = 135.78$) than North Macedonian ($M = 160.44$, $SD = 96.80$, $p < .010$) and Romanian participants ($M = 117.10$, $SD = 101.73$, $p < .001$). Significant differences were found for education level, $t(800) = 2.44$, $p = .015$, with participants with a university or college degree reporting significantly lower screen times in their children ($M = 151.07$, $SD = 117.74$) than participants without a university or college degree ($M = 174.09$, $SD = 112.70$). No differences in children's screen media usage were seen by child gender, primary caregivers' gender, or marital status.

As hypothesized, more parenting stress and higher levels of parental psychological distress were significantly correlated with more use of lax and overreactive parenting behaviors (see Table 2).

Indirect associations

The hypothesized models (see Figure 1) demonstrated poor model fit (based on Hu & Bentler [1999] benchmarks) for ADHD symptoms, $\chi^2(5) = 28.48$, $p < .001$, CFI = .904, TLI = .708, RMSEA = .105, 95% confidence interval [CI] [.070, .145], as well as for CBCL attentional problem behavior, $\chi^2(5) = 51.19$, $p < .001$, CFI = .901, TLI = .702, RMSEA = .107, CI [.082, .135]. Therefore, two direct paths were added to the model (parental psychological distress and parenting stress to ADHD symptoms or CBCL attentional problem behavior, respectively, see Figures 2 and 3), because previous studies have shown that problematic family functioning is associated with ADHD-related symptoms in children (Deault, 2010). This resulted in a good model fit: $\chi^2(3) = 3.34$, $p = .342$, CFI = .998, TLI = .992, RMSEA = .016, CI [.001, .085] for ADHD symptoms and for CBCL attentional problem behavior, $\chi^2(3) = 5.92$, $p = .116$, CFI = .994, TLI = .970, RMSEA = .035, CI [.001, .076]. These final models were used for further analyses.

Tests for indirect associations are shown in Table 3. The direct effect of overreactive parenting ($b = 0.115$, 95% CI [0.019, 0.211]) on child ADHD symptoms was significant. The direct effect of lax parenting on screen media use was also significant in this model ($b = 0.217$, CI [0.130, 0.3105]; see Figure 2 for standardized estimates). The first mediation model showed that none of the indirect associations of dysfunctional parenting on child ADHD symptoms via screen media usage were significant. The direct effects of screen media use ($b = 0.127$, CI [0.056, 0.197]) and overreactive parenting ($b = 0.082$, CI [0.012, 0.152]) on child attentional problem behavior were significant. The direct effects of lax parenting ($b = 0.180$, CI [0.113, 0.246]) and overreactive parenting ($b = 0.075$, CI [0.005, 0.114]) on screen media use were also found to be significant (see Figure 3 for standardized estimates). The second model showed a significant indirect association of lax parenting on CBCL attentional problem behavior, including screen media use as a mediator (Table 3).

Additional analyses of the alternative model showed that screen media use was a significant mediator of the association between parenting stress and child attentional problem behavior ($b = 0.018$, $p = .007$, CI [0.005, 0.031]). However, screen media was not a significant mediator

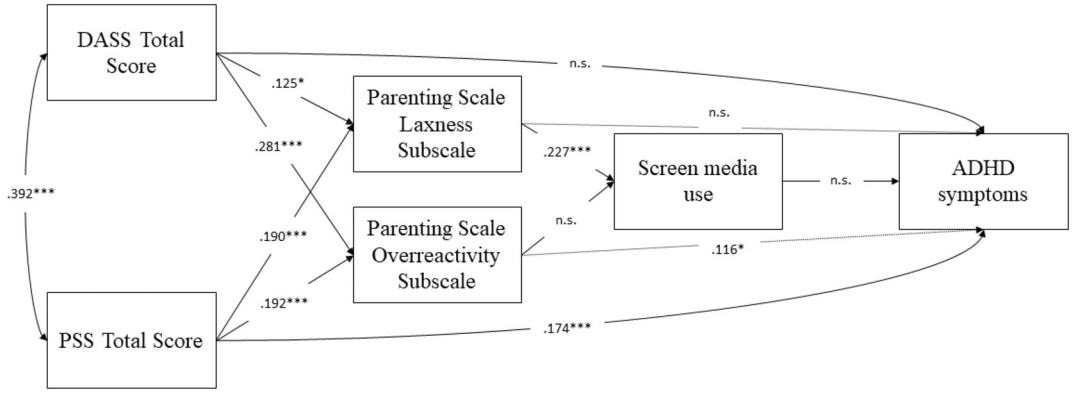

FIGURE 2 Path analytical model predicting ADHD symptoms for children aged 6 years and older ($N = 446$)
Note. ADHD = attention-deficit/hyperactivity disorder; DASS = Depression Anxiety Stress Scale; PSS = Parental Stress Scale. Standardized coefficients are presented. Parenting Scale Laxness Subscale → Screen media use → ADHD symptoms: c' = .005, $p = .653$; Parenting Scale Overreactivity Subscale → Screen media use → ADHD symptoms: c' = .001, $p = .907$. *$p < .05$. ***$p < .001$.

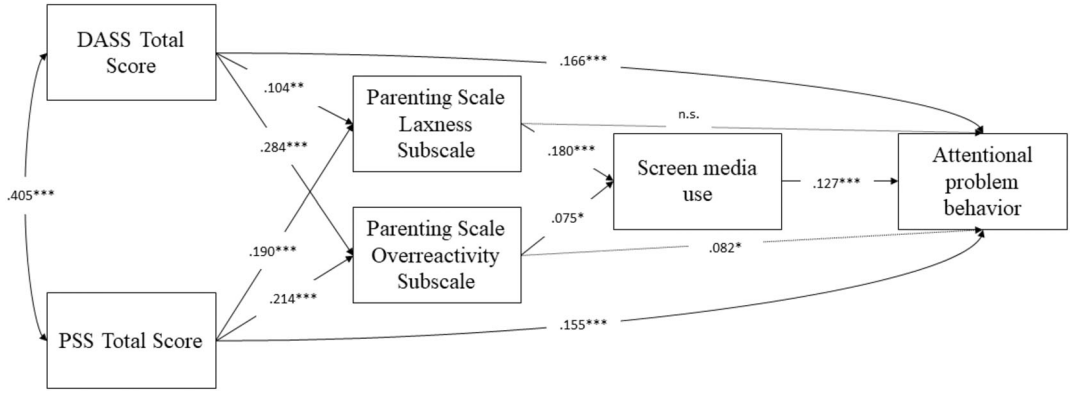

FIGURE 3 Path analytical model predicting attentional problem behavior ($N = 835$) *Note*. ADHD = attention-deficit/hyperactivity disorder; DASS = Depression Anxiety Stress Scale; PSS = Parental Stress Scale. Standardized coefficients are presented. Parenting Scale Laxness Subscale → Screen media use → ADHD symptoms: c' = .023, $p = .003$; Parenting Scale Overreactivity Subscale → Screen media use → ADHD symptoms: c' = .009, $p = .091$. *$p < .05$. **$p < .01$. ***$p < .001$.

TABLE 3 Test of indirect associations between dysfunctional parenting and ADHD symptoms or CBCL attentional problem behavior via screen media use

Test of indirect associations	Estimate (*SE*)	95% CI
Parenting Scale Overreactivity Subscale → Screen media use → ADHD symptoms	0.001 (0.001)	[−0.002, 0.002]
Parenting Scale Laxness Subscale → Screen media use → ADHD symptoms	0.005 (0.012)	[−0.062, 0.028]
Parenting Scale Overreactivity Subscale → Screen media use → CBCL attentional problem behavior	0.009 (0.006)	[−0.002, 0.020]
Parenting Scale Laxness Subscale → Screen media use → CBCL attentional problem behavior	0.023 (0.008)**	[0.008, 0.038]

Note. ADHD = attention-deficit/hyperactivity disorder; CBCL = Child Behavioral Checklist; CI = confidence interval.
**$p < .01$.

TABLE 4 Results of multigroup analyses and χ^2 difference tests

	Baseline model				Comparison model				
	χ^2	CFI	TLI	RMSEA	χ^2	CFI	TLI	RMSEA	$\Delta\chi^2$
ADHD symptoms									
Education	7.15 (6)	.995	.975	.003	24.34 (18)	.972	.954	.041	17.19 (12)
Marital status	8.29 (6)	.990	.949	.043	17.15 (18)	1.00	1.00	.000	8.86 (12)
CBCL attentional problem behavior									
Education	8.55 (6)	.995	.973	.033	20.27 (18)	.995	.992	.018	11.72 (12)
Marital status	10.32 (6)	.991	.955	.042	14.49 (18)	1.00	1.01	.000	4.17 (12)

Note. ADHD = attention-deficit/hyperactivity disorder; CBCL = Child Behavioral Checklist; CFI = comparative fit index; RMSEA = root-mean-square error of approximation; TLI = Tucker–Lewis index. Education = no university/college versus university/college; marital status = married and living together versus not married.
*$p < .05$.

of association between parenting stress and child ADHD symptoms ($b = 0.004$, $p = .491$, CI [−0.008, 0.017]).

Multigroup analysis

The final models were tested across education levels (university or college degree, no university or college degree) and marital status (married and living together, not married) using multigroup analyses. Contrasts of the baseline model and a comparison model, in which path estimates and the covariance between parental stress and psychological distress were constrained to be equal across groups, were tested. No differences were found for education levels and marital status, either for the CBCL attentional problem behavior model or for ADHD symptoms (see Table 4).

DISCUSSION

This is the first study to investigate the association between screen media use and ADHD in three MICs taking indirect effects into account. Although the cross-sectional nature of the data precludes any causal statements, testing these associations with a hard-to-reach sample of primary caregivers in MICs is a useful first step in understanding these relationships.

The first aim of the present study was to examine whether screen media use was directly related to higher levels of ADHD-related symptoms in children. Screen media use was positively correlated with ADHD symptoms as well as attentional problem behavior in children, which corresponds to findings from HICs (Nikkelen et al., 2014). Second, this study showed that in a sample of predominantly female primary caregivers' parental psychological distress, parenting stress, and dysfunctional parenting were significantly correlated with screen media use and child ADHD-related symptoms. Additionally, path analysis showed that parental psychological distress and parenting stress were linked with more dysfunctional parenting practices, which has been previously reported in other studies (Anand et al., 2014; Deault, 2010; Detnakarintra et al., 2020; Emond et al., 2018; Halpin et al., 2021).

Third, we examined whether screen media use mediated the relationships between dysfunctional parenting and child ADHD symptoms in a sample of at-risk children in three MICs. None of the indirect associations of dysfunctional parenting on child ADHD symptoms via

screen media usage were significant. Although ADHD prevalence (i.e., 18%) was high in the present sample, the skewness of the distribution of symptoms ($M = 4.19$, range = 0–19) raises the possibility of floor effects. However, a significant indirect relationship was found between lax parental education and CBCL attention problem behavior, with screen media use as a mediator, whereas the relationship between lax parenting and attention problems in children was found to be fully mediated by screen media use. Additionally, an alternative model in which screen use mediates the link between parenting stress and ADHD-related symptoms was tested. A significant indirect relationship was found for CBCL attention problem behavior, with screen media use as a mediator, but not for ADHD symptoms. That is, a caregiver-reported symptom measure such as the CBCL may have had a stronger association due to measurement properties (e.g., score distributions) than a structured interview measure to assess ADHD symptoms (MINI-KID-P).

To date, only a handful of studies have examined family environmental factors, focusing on parenting styles, media-specific education, demographic characteristics, and parental well-being (e.g., Ansari & Crosnoe, 2016; Linebarger, 2015; Nikkelen et al., 2014; Nikkelen et al., 2016). Past research has examined the role of socioeconomic status and parental well-being as moderators of the bidirectional screen use–ADHD relationship (Ansari & Crosnoe, 2016), showing that higher levels of hyperactivity were associated with later increases in television viewing only among children whose caregivers had lower incomes, lower levels of education, and higher levels of parental depression. Another study examined the moderating role of parenting styles in an at-risk sample. Results showed that responsive parenting moderated the effects of video game exposure on children's hyperactivity levels and attention problems (Linebarger, 2015). Despite these findings, past research has not yet examined the interplay of these variables with screen use as moderating or mediating variable in samples from LMICs. A recent meta-analysis (Pinquart, 2021) investigated associations of dysfunctional parenting with internalizing and externalizing symptoms across regions worldwide. Eastern Europe was the only region where no data were available due to a lack of studies. North Macedonia, Moldova, and Romania are among those European countries with relatively low per-capita incomes (The World Bank, 2019) and high prevalence of physical abuse, domestic violence toward the mother, and emotional neglect (Bellis et al., 2014). Further, Romania and North Macedonia were among the European countries with the highest prevalence of TV viewing for 2 or more hours per day (between 50%–70% of 11–15-year-old children; Currie et al., 2012) and among the three European countries where this prevalence even increased with higher family affluence.

Overall, there is very little evidence in the literature of family environmental factors and the effects of media use on ADHD-related behaviors, which indicates further research on this topic is needed. Results from our study indicate that the hypothesized relationship could be confirmed for lax parenting and child attentional problems with screen media use as a mediator but not for overreactive parenting or ADHD symptoms. Specifically, higher parental psychological distress, as well as higher parenting stress, are associated with higher lax parenting behaviors, which in turn relate to higher screen media use and higher attentional problem behavior in at-risk children. However, this association could not be confirmed for ADHD symptoms measured by the MINI-KID-P, which was conducted with a smaller sample of children aged 6 years and older. Nevertheless, these results were not explained by the age of the child or sample size alone.

Our results are partly consistent with previous studies and extend earlier findings to the effect that higher parental psychological distress not just enhances the effects of screen media use on ADHD-related behaviors but increases lax parenting behaviors, which results in higher screen media use and higher attentional problem behavior in children. This fits with the conceptual models based on well-researched biopsychosocial family models such as the risky family model (Repetti et al., 2002). The fourth aim of this study was to test whether the hypothesized models are generalizable. The path models generalized across education level and marital status.

Much of the literature in this area is based on studies with high-income, White participants in Western countries. It is important to carefully consider how theoretical models such as the one tested in the current study differ and extend across complex systems and countries (e.g., Maselko, 2017). Nevertheless, the results of the present study may inform early interventions to the extent that reducing parental psychological distress, parenting stress, and lax parenting behavior, as well as directly limiting children's media consumption, may be beneficial.

Strengths and limitations

The current study has several strengths, including testing a conceptual model that integrates literature on what is known about parenting, psychological distress, parental distress, screen use, and ADHD symptoms in a family psychological framework. Past studies have frequently tested only parts of this model. Another strength is the assessment of attentional symptoms and ADHD symptoms based on both parental reports and a structured clinical interview. On the other hand, although based on theoretical models, the cross-sectional design precludes conclusions about the direction of effects or causality. Future longitudinal research is therefore needed to better understand how relationships between family environmental variables, screen media use, and ADHD-related symptoms codevelop over time.

Even though the term *parents* was used in this study and recruitment was of primary caregivers, and it must be noted that the final sample was predominantly female (96%). Therefore, the study results may not apply to parents in general. Fathers continue to be underrepresented in parenting research studies and in many cases in their children's lives as active parents and deserve more attention regarding recruitment in future studies (Fabiano, 2007; Panter-Brick et al., 2014). Furthermore, all measures were based on parent self-reports, and it is possible that, especially for the child problem measures, caregivers who were less tolerant of their children's misbehavior rated their children as having more behavioral problems than their actual behavior justified. Future studies could incorporate other methods of assessing children's attentional problem behavior and ADHD symptoms at home (e.g., observational studies) and more reliable ways of measuring screen use to confirm that the results presented here are robust to such shared rater variance. Measures of parenting style and attentional problem behavior demonstrated lower reliability than other measures and therefore may have impacted the results. Hence, future studies with more robust measures are also needed.

Implications

The present study tested a model of the relationships between family-related variables, screen media use, and ADHD-related symptoms in an at-risk sample, in which family-related variables were hypothesized to be associated with ADHD-related outcomes through the extended use of screen media use. This study presents several novel aspects including the diverse sample and tests for generalizability across marital status and education. Future longitudinal research is needed to determine the direction of effects, establish temporal relationships, and examine individual differences. Findings are suggestive of valuable targets for interventions aiming at resource and capacity-building investments for families in MICs that target and reduce parental psychosocial distress and parenting stress and improve parenting behavior. This may impact child ADHD symptoms, child attentional problem behavior, and child mental health regardless of caregivers' education level

and marital status. Future work will be necessary to identify mechanisms that may amplify or mitigate these effects, such as the type of screen media use or individual factors that may influence the susceptibility of caregivers and their children.

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