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Which Children are Most Vulnerable to the Adverse Effect of Screen Time on ADHD Symptoms? An Empirical Examination of Potential Moderators

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Abstract: *This study examines the relationship between children's screen time and ADHD symptoms, focusing on how this relationship may vary based on child-related factors (age and gender) and parent-related factors (parental aggravation, household income, and social support). Utilizing data from the National Survey of Children's Health (NSCH 2022; n = 25,104 U.S. children, ages 6–17), we found that increased screen time is linked to greater severity of ADHD symptoms. This relationship is particularly pronounced among younger children (ages 6–11), those whose caregivers report lower levels of parental aggravation, and children from higher-income households. In contrast, child gender and parental social support do not significantly affect this relationship. These findings highlight the need for targeted parental mediation to alleviate the negative impacts of screen time on vulnerable groups. Limitations of this study include issues related to causality, reliance on caregiver-reported measures, and limited data on the types and content of screen time. Overall, the findings provide valuable insights for parents, educators, and policymakers.*

Keywords: Attention Deficit Hyperactivity Disorder (ADHD); Screen Time; Child Development; Parental Aggravation; Household Income

1. Introduction

Recent statistics show that about 10% of U.S. children aged 5-17 have been diagnosed with attention deficit hyperactivity disorder (ADHD), with diagnoses steadily increasing in recent years [1], and similar rising trends have been observed globally [2]. As the number of children diagnosed with moderated to severe ADHD grows, related mental disorders, such as anxiety, cognitive impairments, and behavioral problems, are also on the rise [2]. Among the potential factors contributing to or related with children's ADHD symptoms, scholars interested in studies of children and media as well as psychiatric experts have highlighted the danger of excessive use of electronic devices, including televisions, personal computers, smartphones, tablets and gaming consoles, such as PlayStation.

With the widespread use of digital devices and the rising prevalence of ADHD symptoms among children, numerous academic studies have been conducted to address public concerns about the relationship between the two. Although some skepticism persists regarding the adverse effects of children's screen time on ADHD symptoms [3-5], the latest edition of *Diagnostic and Statistical Manual of Mental Disorder* [2] officially acknowledges excessive use of electronic devices as one of the factors associated with children's ADHD symptoms, even if it is not determined as a sole causal factor. Moreover, while prior studies grounded in the theoretical framework of arousal and attentional dysregulation have provided substantial empirical evidence of a significant association between screen time and ADHD symptoms [6-9], there remains a notable lack of research identifying which groups of children are more vulnerable to these adverse effects. To address this gap, this study examines the role of potential moderators, drawing on a critical review of previous research. Specifically, moderators can be classified into two broad categories: (1) child-related characteristics, such as age (6-11 versus 12-17 years) and gender (boys versus girls), and (2) parent-related characteristics, parental aggravation, household income, and social support for parents.

This study is constructed as follows. The next section critically reviews prior research on the relationship between children's use of electronic devices and ADHD symptoms, as well as potential moderators that may influence the strength of this association. Based on this review, six research hypotheses were developed: one addressing the main effect and five focusing on interaction effects. To empirically investigate the relationship and the moderating effects, this study utilizes data from the *National Survey of Children's Health* (NSCH 2022) [10], a nationally representative survey assessing the physical and psychological health of children aged 0-17 in the United States. The findings are then discussed in terms of their theoretical and practical implications.

2. Literature review

2.1 The Relationship Between Children's Screen Time and Their ADHD Symptoms

The use of electronic devices among children has become increasingly prevalent. Prior research indicates that approximately 97% of children in the United States have at least one electronic device in their bedroom [11]. The widespread availability of electronic devices has, in turn, contributed to increased screen time among children. According to the theoretical framework of arousal and attentional dysregulation [6-9], the human brain has a limited capacity to process information, and excessive stimulation may lead to executive dysfunction, which can contribute to the onset and/or exacerbation of ADHD symptoms. When arousal induced by fast-paced media exceeds children's cognitive processing capacity, it may result in a range of negative outcomes, including difficulties with sustained attention, heightened emotional stress, and impaired decision-making [6-9], [12, 13]. Consequently, excessive engagement with electronic devices may expose children to overwhelming levels of information, thereby adversely affecting their cognitive and emotional functioning. Consistent with this perspective, the majority of prior studies have found that media use is associated with increased severity of ADHD symptoms [14-16].

In this study, we examine the relationship between children's screen time and the severity level of ADHD symptoms.

H1: Among children, increased screen time will be associated with greater severity of their ADHD symptoms. Specifically, the longer the screen time, the higher the severity of ADHD symptoms.

2.2 Moderators Regarding Child-Related Characteristics: Age and Gender

This study examines whether the relationship between screen time and the severity of ADHD symptoms is moderated by child-related characteristics, such as children's age and gender.

First, children's age moderates the relationship between screen time and ADHD severity due to differences in stages of brain development. As children grows, their screen time tends to increase and become stable around six years old [17]. Studies on brain development [18] indicate that the human brain undergoes rapid development and wiring for cognitive, linguistic, and social skills during infancy (1-3 years), toddlerhood (3-5 years), and early school age (5-7 years). The brain continues to develop beyond the age of seven (e.g., in areas related to cognition and memory), and the initially wired brain during childhood becomes are less plastic as it approaches adulthood. Given that the ADHD symptoms in children is associated with their brain characteristics such as reduced intracranial volume or cortical thickness [19], we cautiously predict that the relationship between screen time and the severity of ADHD symptoms will be stronger in young children, whose brains are still undergoing developmental processes and may be vulnerable to the adverse effect of screen time.

Based on this reasoning, we hypothesize the interaction effect between screen time and children's age on the severity of ADHD symptoms:

H2: The positive relationship between screen time and the severity of ADHD symptoms would be more pronounced in young children compared to adolescents.

Second, children's gender is another child-related characteristic that moderates the relationship between screen time and ADHD severity. Cumulative research reported that boys exhibit greater severity of ADHD symptoms compared to girls [20]. Although many factors contribute to the ADHD severity, neuroscientific studies suggest that sex-related differences in brain development may explain why boys are more severely affected [21, 22]. Specifically, boys' brains generally develop more slowly than girls' brains in areas relating to impulse control and attention regulation. As a result, boys' use of electronic devices may more readily trigger ADHD symptoms, as their brains are less resistant to excessive stimuli delivered by the electronic devices.

Based on this reasoning, we propose gender difference in the strength of the relationship between screen time and ADHD severity:

H3: The relationship between screen time and the severity of ADHD symptoms will be stronger for boys compared to girls.

2.3 Moderators Regarding Parent-Related Characteristics: Parental Aggravation, Household Income, and Social Support for Parents

In addition to child-related characteristics, parent-related characteristics, such as parental aggravation, household income, and social support for parents can also moderate the relationship between screen time and ADHD severity.

First, parental aggravation, defined as "stress experienced by parents associated with caring for children" [23], is an important factor influencing children's mental and behavioral health. Prior studies [23, 24] highlight that parents of children with ADHD experience higher parenting stress because they expend greater cognitive and/or behavioral efforts on the children, often leading to feelings of exhaustion or burnout. Although previous research pay attention on the relationship between ADHD severity and parental aggravation as a measure of parental mental health, propose that parental aggravation also serves as a critical moderator of the relationship between screen time and ADHD severity. Parents experiencing higher levels of aggravation may closely monitor their children's screen time and provide more structured guidance on its appropriate use. In contrast, parents with lower levels of aggravation are more likely to adopt laissez-faire parenting strategies, allowing their children to use electronic devices with minimal supervision. In other words, parental aggravation can regulate the undesirable effect of screen time on the severity of ADHD symptoms.

Based on this reasoning, we hypothesize the following:

H4: Parental aggravation will weaken or neutralize the positive relationship between screen time and ADHD severity.

Second, household income, an indicator for parents' socioeconomic status, is a critical factor influencing children's mental and behavioral health as well as their access to media devices. Public health research [25, 26] have found that children from low-income families are more likely to be diagnosed with ADHD. These children are often less likely to consume nutritionally adequate food and more likely to be exposed to environmental risks or toxins (e.g., pollution or lead), which can restrict or even damage normal brain development. Furthermore, children from low-income families are more likely to experience neglect and lack sufficient social interactions with parents or peers. In this context, the relationship between screen time and ADHD severity may be amplified among children from lower-income families, as their underdeveloped brains, limited financial resources, and lack of parental guidance in media use make them more vulnerable to the adverse effects of excessive screen time.

Based on this reasoning, we propose the following hypothesis:

H5: The positive relationship between screen time and ADHD severity will be stronger among children from lower-income families compared to those from higher-income families.

Finally, social support for parents, which can be defined as assistance that is "provided by other people and arises within the context of interpersonal relationships" [27-30], has been emphasized as a critical factor influencing to mental health for both children and parents. Parents who can receive sufficient social support from family, friends, or local communities are better equipped to provide quality childcare, which is essential for development of children's mental and behavioral health. Additionally, children receiving informational or emotional support from extended family members (e.g., grandparents), neighbors, community members, alongside parental care, are more likely to develop healthier cognitive and social skills, which can serve as protective factors against the adverse effects of excessive media use. Therefore, the relationship between screen time and ADHD severity may be weakened among children whose parents benefit from stronger social support.

Based on this reasoning, we propose the following hypothesis:

H6: Social support for parents will weaken or neutralize the positive relationship between screen time and ADHD severity.

The research model, which integrates both the main effect (H1) and the five interaction effects (H2 to H6), is illustrated in Figure 1.

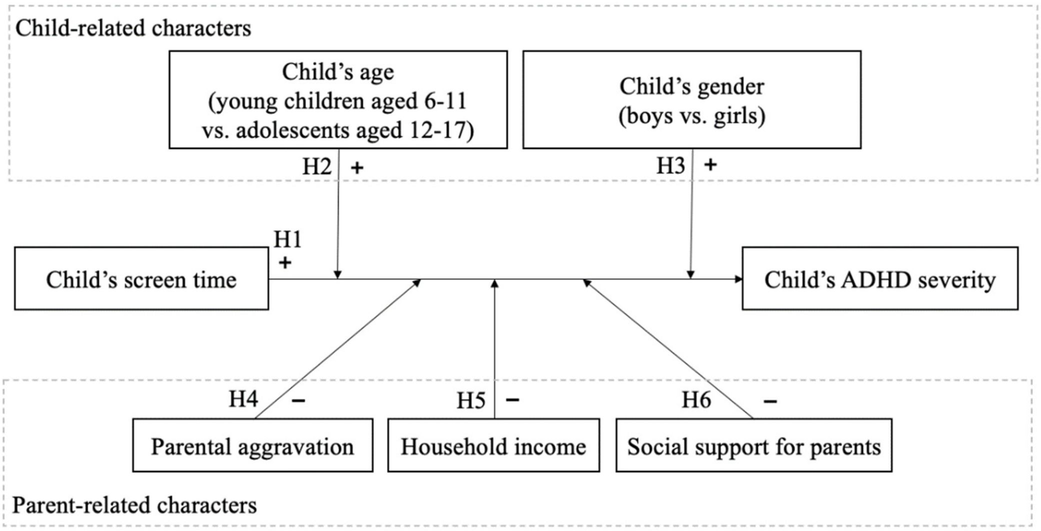

Figure 1. Research Model

3. Methods

3.1 Data Source and Sample

This study utilizes survey data from *National Survey of Children's Health* (NSCH 2022) [10], a nationally and state-representative survey of the health and well-being of children aged 0-17 years in the U.S. The NSCH data is funded and directed by the *Bureau of Maternal and C`hild Health of the Health Resources and Services Administration*, and is conducted annually by the U.S. Census Bureau.

3.2 Procedures

This NSCH 2022 data was collected online or by mail. After completing the initial household screening (pre-survey screener), one child per household was randomly selected to complete the survey. Age-specific surveys (0-5 years, 6-11years, and 12-17 years) were completed by an adult (parent or caregiver) in the household who was most knowledgeable about the child's health (full survey). A complete list of survey topics can be found at the publicized website [10].

This study conducts a secondary analysis of NSCH 2022 survey data, which includes responses from 54,103 children. However, since children of 3 to 5 years did not contain responses of ADHD symptoms, this study focuses exclusively on 25,104 children aged 6 to 17 years.

3.3 Measures of Main Interest

Assessment of Screen Time. In NSCH2022, children's screen time was assessed by asking family caregivers about the amount of time children spent using media devices on weekday. The survey item for screen time was as follows: "ON MOST WEEKDAYS, about how much time does this child usually spend in front of a TV, computer, cellphone or other electronic device watching programs, playing games, accessing the internet or using social media? (Do not include time spent doing schoolwork)" (variable name: screentime). Responses were recorded in five categories: 'Less than 1 hour' (*n* = 1,531, 6%), '1 hour' (*n* = 3,492, 14%), '2 hours' (*n* = 7,592, 30%), '3 hours' (*n* = 5,796, 23%), and '4 our more hours' (*n* = 6,693, 27%). For this study, screen time is treated as a continuous predictor variable (*M* = 3.50, *SD* = 1.19) to examine its relationship with the severity of children's ADHD symptoms.

ADHD Severity. The outcome variable in this study, ADHD severity, is a composite measure derived from two variables: (1) whether a child is diagnosed with attention deficit disorder (ADD) or attention-deficit/hyperactivity disorder (ADHD), and (2) the caregiver-reported severity of the symptoms. Specifically, caregivers were asked whether a doctor or other health care provider had ever told them that their child has ADD or ADHD (variable name: 'k2q31a' and 'k2q31b'). For children with a confirmed diagnosis, a follow-up question assessed the severity of the symptoms (variable name: 'k2q31c').

Following the guidelines outlined in 2022 NSCH Codebook, children's ADHD severity were categorized into four stages: 'none' (n = 21,511, 86%), 'mild' (n = 1,527, 6%) and 'moderate or severe' (n = 2,066, 8%).

3.4 Moderators: Child-related and Parent-related Characteristics

Child's Age. The NSCH classified children into three age groups: '3 to 5 years,' '6 to 11 years,' and '12 to 17 years.' Because children of 3 to 5 years did not contain valid responses of ADHD symptoms in the NSCH 2022 data, valid responses for ADHD symptoms were only available for children aged 6 to 17 years Consequently, this study classifies children into two age groups: (1) 6-11 years (n = 11,458, 46%), and (2) 12-17 years (n = 13,646, 54%).

Child's Gender. Child's gender is also considered one of the moderators in this study. In the NSCH 2022 data for children aged 6 to 17 years, 52% were boys (n = 13,082) and 48% were girls (n = 12,022).

Parental Aggravation. Parental aggravation was measured using the *Aggravation in Parenting Scale* [30] included in the NSCH 2022 data. This measure comprises three questions. "How often have you felt that this child is much harder to care for than most children their age?" (variable name: k8q31), "How often have you felt that this child does things that really bother you a lot?" (variable name: k8q32), and "How often have you felt angry with this child?" (variable name: k8q34). Responses were recorded on a conventional five-point Likert scale ranging from "(1) Never" to "(5) Always". Following the guidelines outlined in the 2022 NSCH Codebook, responses of "(4) Usually" and "(5) Always" were combined into a single category, "(4) Usually or always." The three items demonstrated a sufficient level of internal consistency (Cronbach's α = .80), they were averaged to create a composite parental aggravation score (M = 1.77, SD = 0.68).

Household Income. Household income level for the child was measured using the question "What is the income level of the household that this child lives in?" (variable name: povlev4_22). To address missing data for this variable, the NSCH 2022 data employed multiple imputations as recommended by the U.S. Census Bureau and provided family poverty indicator (FPI), which categorized household income four levels: '0~99% FPL' (n = 2,730, 11%), '100%~199% FPL' (n = 3,749, 15%), '200%~399% FPL' (n = 7,391, 29%), '400% FPL or greater' (n = 11,234, 45%).

Social Support for Parents. In the NSCH 2022 data, social support for parents was assessed using the question: "During the last 12 months, was there someone that you could turn to for day-to-day emotional support with parenting or raising children?" Respondents were asked to indicate 'yes' or 'no' for various categories of supporters, including "Domestic partners" (yes, 84%), "Other family or close friends" (yes, 88%), "Healthcare care provider" (yes, 31%), "Peer support group" (yes, 13%), and "Others" (yes, 2%). Social support for parents was quantified by summing the total number of 'yes' responses across the categories (M = 2.18, SD = 0.85).

3.5 Control Variables

Prior research [31, 32] suggests that the relationship between screen time and ADHD symptoms may be influenced by child's race, caregivers' education level, parenting self-efficacy, and children's after-school activities. These variables are included as controls in this study.

Child's Race. Previous research has reported racial or ethnic disparities in ADHD diagnosis and treatment among children. Specifically, compared with white children, minority children, such as African American or Hispanic children, have lower odds of having an ADHD diagnosis [33]. This disparity may be due to differences in access to medical resources across countries, or varying awareness toward ADHD symptoms in children among different ethnic groups [34], minority children may exhibit ADHD symptoms more severely than white children, yet their likelihood of being formally diagnosed with ADHD is significantly lower. In the NSCH data, parent-reported race and ethnicity were used to classify children into five categories: (1) Caucasians with no Hispanic origin (n = 17,481, 70%), (2) Africans (n = 1,466, 6%), (3) Hispanics (n = 3,195, 13%), (4) Asians (n = 151, 1%), and (5) others (n = 2,811, 11%). For analysis, Caucasians were used as the reference racial category.

Caregivers' Education Level. Caregiver's education was measured by asking, "What is the highest grade or year of school you/this caregiver have completed?" Responses were categorized as: (1) "Less than high school" (n = 435, 2%), (2) "High school degree or GED" (n = 2,947, 12%), (3) "Some college or technical school" (n = 5,504, 22%), and (4) "College degree or higher" (n = 16,218, 65%).

Parenting Self-Efficacy (PCE). Parenting self-efficacy reflects a caregiver's confidence in handling the demands of raising children [35]. It was measured by asking, "How do you think you are handling the day-to-day demands of raising children?" (variable name: k8q30), with responses recorded on a 4-point Likert scale: "Very well" (n = 13,661, 54%), "Somewhat well" (n = 11,105, 44%), "Not very well" (n = 321, 1%), and "Not very well at all" (n = 17, <1%). PCE is treated as a continuous variable in this study (M = 1.47, SD = 0.53).

Children's After-School Activities. Child's participation in after-school activities is a significant factor in the prevalence and severity of ADHD. These activities include both physical activities, such as competitive sports, and non-physical activities, such as music, dance, and language lessons. After-school activities were assessed through three questions, asking whether the child participated in a sports team (yes, 62%), clubs or organizations (yes, 52%), or other organized activities/lessons such as music, dance, language, or arts (yes, 45%). After-school activities were measured by summing the total number of 'yes' responses across the items (M = 1.59, SD = 1.05).

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3.6 Statistical Analysis

The variables in the model were preprocessed according to the procedures recommended in the NSCH 2022 data user codebook [10]. Because the outcome variable, ADHD symptoms, is essentially ordinal variable with a non-normal distribution, an ordinal logistic regression model was employed.

To test the proposed moderation hypotheses (H2 to H6), interaction effects were examined between children's screen time and a series of moderators, including children's age, gender, parental aggravation, household income, and social support for parents. All quantitative predictors were rescaled to 0-1 range to facilitate comparison of effect sizes, and child's age and gender were dummy coded.

All data analyses were conducted using R, an open-source statistical language.

4. Results

To test the hypotheses in the study, three ordinal logistic regression models were constructed. The first model, referred to as the 'Main Effect Model,' includes only the main effects of screen time, the five moderators, and control variables. The second model, termed the 'Full Interaction Model,' adds five interaction effect terms between screen time and the moderators, with adjustments for the control variables. The third model, named the 'Trimmed Interaction Model,' was derived by removing statistically insignificant interaction terms (screen time × child's gender, and or screen time × social support for parents) in the Full Interaction Model. The results of three model estimations are presented in in Table 1.

Table 1. Testing the Research Hypotheses

	Main Effect Model	**Full Interaction Model**	**Trimmed Interaction Model**
Screentime	0.43***	1.08***	0.80***
	(0.07)	(0.23)	(0.11)
Moderators			
Age (Adolescents = 1)	0.21***	0.22***	0.22***
	(0.04)	(0.04)	(0.04)
Sex (Boys = 1)	0.54***	0.54***	0.53***
	(0.04)	(0.04)	(0.04)
Parental aggravation	3.81***	3.90***	3.90***
	(0.09)	(0.09)	(0.09)
Household (HH) income	-0.25***	-0.29***	-0.29***
	(0.02)	(0.07)	(0.07)
Social support for parents	0.25***	0.25***	0.25***
	(0.02)	(0.02)	(0.02)
Interactions			
Screentime * Age		-0.36*	-0.36*
		(0.14)	(0.14)

Screentime * Sex		-0.19	
		(0.14)	
Screentime * Parental aggravation		-1.20***	-1.20***
		(0.27)	(0.27)
Screentime * HH Income		0.63**	0.63**
		(0.19)	(0.19)
Screentime * Social support		-0.07	
		(0.08)	
Statistical controls			
Race (Africans = 1)	-0.31***	-0.31***	-0.31***
	(0.09)	(0.09)	(0.09)
Race (Hispanics = 1)	-0.30***	-0.30***	-0.30***
	(0.06)	(0.06)	(0.06)
Race (Asians = 1)	0.17	0.16	0.17
	(0.22)	(0.22)	(0.22)
Race (Others = 1)	-0.43***	-0.43***	-0.43***
	(0.07)	(0.07)	(0.07)
Education (high sch. Graduate = 1)	0.34*	0.34*	0.34*
	(0.15)	(0.15)	(0.15)
Education (some college = 1)	0.23	0.22	0.22
	(0.15)	(0.15)	(0.15)
Education (BA above = 1)	-0.01	-0.02	-0.02
	(0.15)	(0.15)	(0.15)
Parental self-efficacy	-0.20**	-0.20**	-0.20**
	(0.08)	(0.08)	(0.08)
After-school activities	-0.57***	-0.57***	-0.57***
	(0.06)	(0.06)	(0.06)
Thresholds			
No | Mild	2.78***	2.75***	2.73***
	(0.17)	(0.17)	(0.17)
Mild | Severe	3.50***	3.46***	3.45***
	(0.17)	(0.17)	(0.17)
Goodness of fit indices			
AIC	22336.0	22310.3	22309.0
BIC	22474.2	22489.1	22471.6
Log-likelihood ratio χ^2 test			
Against Main effect model		35.74***	33.03***
Against Full interaction model			2.71

Note. Coefficients of ordinal logistic regression model entered with standard errors in parentheses. All quantitative predictors, in order to compare their effect size, were re-scaled to 0-1, and mean-centered. The variance inflation factors (VIFs) range from 1.01 to 2.33, indicating that multicollinearity is not a concern. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. N = 25,104 (the NSCH 2022 data).

As shown in the bottom rows in Table 1, two information criterion indices (i.e., AIC, BIC) indicate that the Trimmed Interaction Model outperforms the other two models. Additionally, the log-likelihood ratio (LR) χ^2 test show that both Full Interaction Model and Trimmed Interaction Models better explain ADHD severity compared to the Main Effect Model (respectively, LR $\chi^2(5) = 35.74$, $p < .001$; LR $\chi^2(3) = 33.03$, $p < .001$). However, the Trimmed Interaction Model is more parsimonious than the Full Interaction Model while maintaining equal explanatory power for ADHD severity (LR $\chi^2(3) = 2.71$, $p = .26$).

In short, the results of model-fit indices demonstrate that the Trimmed Interaction Model is the best among the three competing models.

Testing the six hypotheses produced the following results. First, as shown in the Main Effect Model, children with higher screen time are more likely to exhibit more severe ADHD symptoms ($b = 0.43$, $p < 0.001$). This effect remains significant when interaction effects between screen time and moderators are included ($b = .80$, $p < .001$, reference category is young children of 6-11 years old). These findings align with prior research [29], providing empirical support for H1.

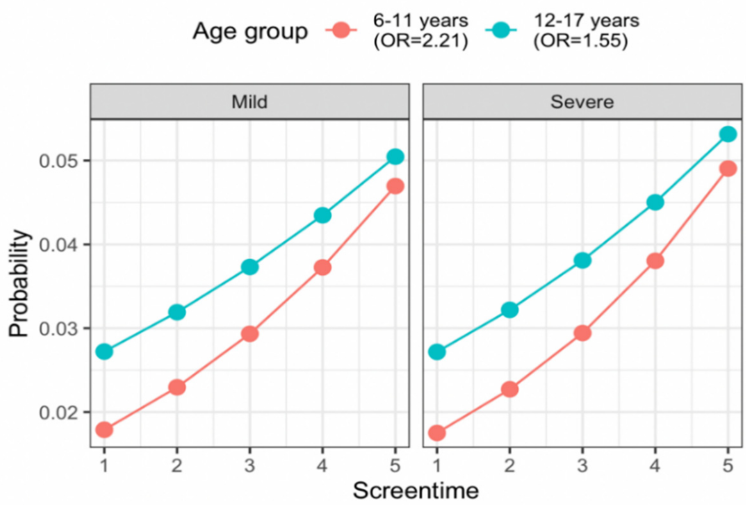

Figure 2. The Interaction Effect Between Screen Time and Age on ADHD severity

Note. Coefficients of ordinal logistic regression model entered with standard errors in parentheses. All quantitative predictors, in order to compare their effect size, were re-scaled to 0-1, and mean-centered.

Second, the relationship between screen time and the severity of ADHD symptoms differs significantly between young children aged 6-11 years and adolescents aged 12-17 years ($b = -0.36$, $p = .006$). Specifically, as illustrated in Figure 2, increased screen time is associated with a greater likelihood of mild or severe ADHD symptoms among young children (6–11 years) at a faster pace (OR = 2.21). In contrast, the increase is less pronounced among adolescents (12–17 years), with a slower rate of change (OR = 1.55). These findings provide empirical support for H2.

Third, a child's gender does not significantly moderate the relationship between screen time and the severity of ADHD symptoms ($b = -0.19$, $p = .08$). In other words, the adverse effects of screen time on ADHD severity are similar for both boys and girls. Consequently, H3 does not receive empirical support.

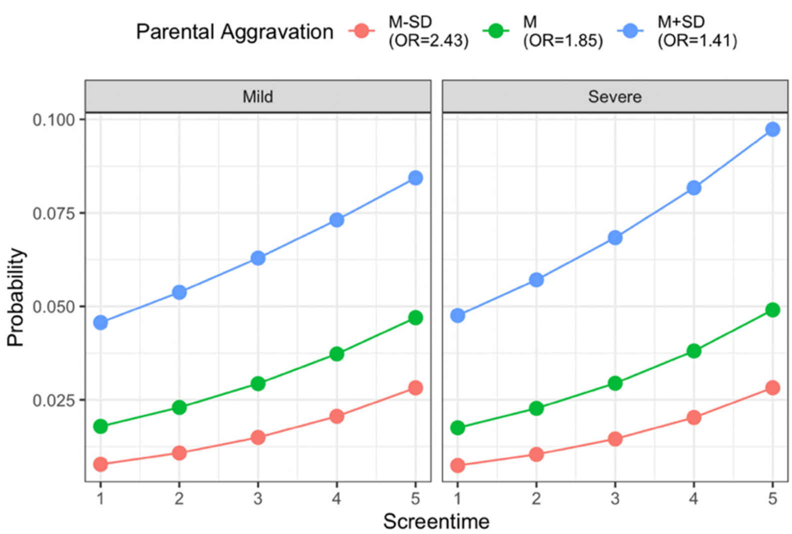

Figure 3. The Interaction Effect Between Screen Time and Parental Aggravation on ADHD severity

Fourth, caregivers' parental aggravation significantly moderates the relationship between children's screen time and the severity of ADHD symptoms (b = -1.20, p < .001). As illustrated in Figure 3, increased screen time generally exacerbates ADHD severity. However, this trend is more pronounced among children cared for by parents with below-average levels of parental aggravation (M - SD, OR = 2.43), compared to children of caregivers with above-average levels of parental aggravation (M + SD OR = 1.41). These findings provide empirical support for H4.

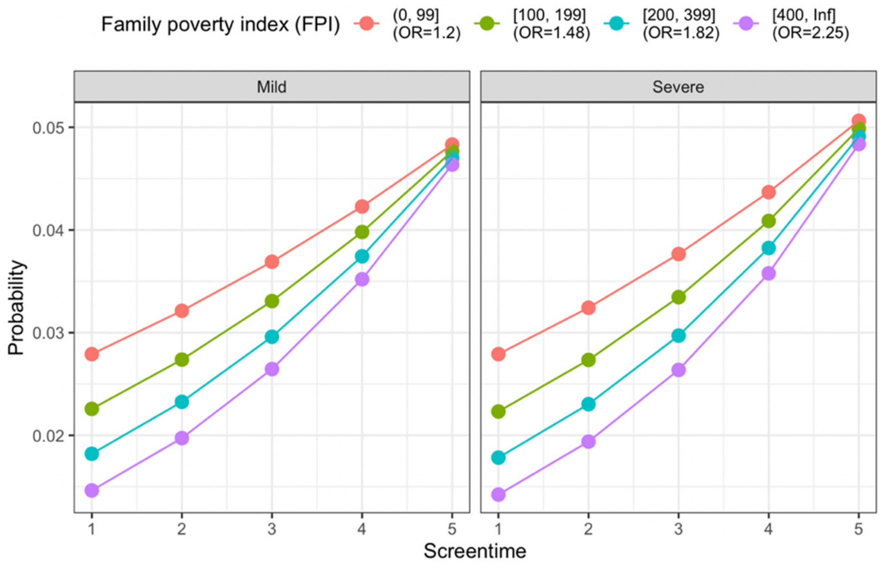

Figure 4. The Interaction Effect Between Screen Time and Household Income on ADHD severity

Fifth, the adverse effects of screen time on ADHD severity fluctuate, depending on the level of household income (b = 0.63, p < 0.001). As displayed in Figure 4, the relationship between a child's screen time and ADHD severity becomes stronger with higher household income (FPI [400, Inf), OR = 2.25], but weaker in households with lower income (FPI (0, 99), OR = 1.20). Although the moderation effect is statistically significant, the observed pattern contradicts the expectation in H5, leading to a clear rejection of the hypothesis.

Finally, social support for parents does not significantly influence the relationship between children's screen time and ADHD severity (b = -0.07, p = .18). In other words, the adverse effects of screen time are consistently observed whether caregivers receive social support. Consequently, H6 does not receive empirical support.

Table 2. Key Variables Summary Table

Hypothesis assessment	Statistical results	Interpretation
H1 is supported	b = 0.43, p < 0.001	The positive relationship between screen time use and ADHD severity.
H2 is supported	b = -0.36, p = .006	The positive relationship becomes more pronounced among young children than among adolescents.
H3 is not supported	b = -0.19, p = .08	The positive relationship does not differ significantly between boys and girls.
H4 is supported	b = -1.20, p < .001	The positive relationship becomes more pronounced among parents with lower level of parental aggravation.
H5 is rejected	b = 0.63, p < 0.001	Contrary to H5, the positive relationship becomes more pronounced among parents with higher income.
H6 is not supported	b = -0.07, p = .18	The positive relationship does not vary according to the level of social support received by parents.

The hypothesis assessments, corresponding statistical results, and interpretations are presented in Table 2. Specifically, children's screen time is associated with greater ADHD symptom severity, and this relationship is more pronounced among younger children aged 6–11 years, children whose caregivers exhibit lower levels of parental aggravation, and children from more financially affluent families. In contrast, the adverse effects of screen time do not differ significantly between boys and girls, nor do they vary across levels of parental social support.

4. Discussion

Utilizing a large-scale nationwide survey data from the United States, this study examines whether children's level of ADHD symptoms is associated with their screen time and how this relationship varies based on child-related characteristics (i.e., age and gender) and parent-related characteristics (i.e., parental aggravation, household income, and social support for parents). Ordinal logistic regression analyses reveal that children with longer screen time are more likely to exhibit mild or moderator/severe ADHD symptoms. The adverse effects of screen time are more pronounced among younger children and those whose caregivers report lower levels of parental aggravation or have higher household incomes. However, the relationship between children's screen time and ADHD symptoms does not vary by children's gender or caregivers' perception of social support. This study offers both theoretical and practical implications.

First, this study demonstrates that the likelihood of children exhibiting mild or severe ADHD symptoms generally increases with longer screen time across all children (H1 supported), while the strength of this relationship varies based on both children's and caregivers' characteristics. In other words, children's use of electronic devices negatively impacts their mental health, strongly suggesting the necessity of appropriate parental mediation to protect children from excessive screen exposure. Consistent with advice from psychiatric experts and media scholars, this study provides an additional valuable insight that the adverse effects of screen time on children's mental health do not occur uniformly across all groups.

Second, this study identifies groups who are more vulnerable to the adverse effects of children's screen time on ADHD symptoms. Consistent with the expectations in H2 and H4, young children aged 6-12 years and children raised by parents experiencing lower levels of parental aggravation are more susceptible to the negative impact of screen time on ADHD symptoms. The finding that younger children are more adversely affected by electronic device use underscores the importance of providing them with more attentive and deliberate parental mediation [36, 37] during their ongoing cognitive and psychological development to promote better mental health.

However, the relationship between parental aggravation and the adverse effects of screen time on ADHD symptoms warrants careful interpretation. On one hand, the strong effect of parental aggravation on ADHD severity ($b = 3.90$, $p < .001$ in Table 1, and also see Figure 3) suggests that higher levels of parental aggravation may result from their children's mild or severe ADHD symptoms [23], rather than causing them. This dynamic might explain the weakened effect of screen time on ADHD symptoms in cases where the symptoms are already present, leaving less room for additional adverse effects of screen exposure.

On the other hand, parental aggravation may also reflect differences in how parents regulate their children's electronic device usage. Parents experiencing lower levels of aggravation may adopt laissez-faire approaches to mediation, allowing children greater freedom with electronic devices. This lack of parental regulation of children's electronic device usage could amplify the adverse effects of screen time, providing more opportunities for these effects to manifest.

Third, contrary to the expectation stated in H5, a stronger association between children's screen time and ADHD symptoms was observed among children from higher-income households. This finding warrants careful interpretation and further investigation using more robust research designs and additional measures. Two possible explanations merit consideration. One explanation concerns *differences in device ownership*: children in wealthier households may have greater access to electronic devices, such as TVs, desktop PCs, smartphones, and tablets. Consequently, children from higher-income households are more likely to be exposed to a variety of electronic devices, although the extent of parental regulation of their device use remains unclear. A second explanation involves potential *reporting bias*. Because the questionnaire was completed by parents or caregivers, socioeconomic differences may shape how caregivers perceive and report their children's ADHD symptoms. In particular, caregivers in higher-income households may be more likely to recognize ADHD-related behaviors, report symptoms accurately, and seek professional medical evaluation. In contrast, caregivers in lower-income households may have more limited awareness of, or access to, information and diagnostic resources related to ADHD, which could result in underreporting or overlooking symptoms.

Unfortunately, this study was unable to statistically control for the household-level media environment, there is no empirical evidence to confirm whether this interpretation of the finding contrary to H5 is valid. Future research could yield theoretical insights by incorporating measures of the household-level media environment and parental mediation to test which factor more plausibly explains this unexpected result.

Fourth, neither child's gender (H3) nor social support for parents (H6) significantly influences the strength of the relationship between children's screen time and ADHD symptoms. The finding that gender fails to moderate this relationship suggests that, after the age of six, children's brain development may not differ substantially between boys and girls. Alternatively, it is also possible that the mere amount of screen time is insufficient to capture potential gender differences. In this context, it may be theoretically valuable to consider that gender serves as a crude proxy for qualitative differences in media use, such as exposure to violence or fast-paced editing. Future studies should prioritize direct measures, such as the specific programs children watch or the activities they engage in using electronic devices, rather than relying on indirect proxies like gender. Similarly, while social support for parents is associated with children's ADHD symptoms, it does not influence the strength of the relationship between screen time and ADHD symptoms. This finding suggests that although parents' perception of social support may benefit their children's mental health, it is unlikely to mitigate the adverse effects of excessive screen time.

Despite its valuable findings, this study is not without limitations. First, the primary concern lies in the potential issues surrounding causality. Children diagnosed with ADHD symptoms are often more likely to seek stimuli, and electronic devices may fulfill this need by providing visual engagement (e.g., TV, tablets) and interactive experiences (e.g., gaming consoles or video games). In other words, the causality assumed in this study might be reversed, suggesting that children with mild or severe ADHD symptoms may spend more time on screens. Although the use of electronic devices is recognized as a potential covariate associated with ADHD symptoms by psychiatric experts [9], the assumed causality and the proposed set of moderators in this study should be further investigated in a longitudinal context to provide a clearer understanding of these relationships.

Second, this study relies on a secondary analysis of publicly available archival data, and the primary predictor—screen time—is measured in a relatively broad manner. Specifically, the measure of screen time does not differentiate among types of electronic devices, which limits the study's ability to offer practical recommendations regarding which devices may warrant closer parental mediation. In addition, the study does not distinguish among media content types (e.g., educational content such as Sesame Street versus entertainment content such as fast-paced animation) or platform types (e.g., social media platforms such as YouTube versus digital video books). Future research should employ more nuanced measures of children's media use by accounting for factors such as the interactive nature of device use (e.g., passive versus active engagement), characteristics of the content (e.g., violent content, editing pace), and the amount of time spent on each type of device.

Third, caregivers' self-reported measures may lack sufficient measurement validity. For instance, the NSCH 2022 data used in this study assesses ADHD symptoms by asking caregivers whether a doctor or healthcare provider had diagnosed their child with mild or severe ADHD symptoms. This approach inherently overlooks children who have not had the opportunity to receive a professional diagnosis, such as those from low-income families or non-Caucasian backgrounds. To address this limitation, future studies should consider incorporating key behavioral indicators commonly associated with severe ADHD symptoms. Such measures could help identify undiagnosed children who might otherwise be missed, providing a more comprehensive understanding of ADHD prevalence and its effects.

Fourth, the findings of this study may be influenced by the recent COVID-19 pandemic. Due to lockdowns and health-related concerns about physical contact, screen time among children—and adults—surged substantially [32]. This increase suggests that the observed strength of the relationship between screen time and ADHD symptoms might be more pronounced during the measurement period of the NSCH 2022 data. Therefore, the unique contextual factors related to this study's findings should be carefully considered.

Finally, the outcome variable (i.e., children's level of ADHD symptoms) may be subject to measurement error. Specifically, the outcome relied on caregivers' self-reports of whether a health professional had ever diagnosed the child with ADHD/ADD, combined with caregiver-rated severity among those diagnosed. As a result, some children with ADHD symptoms may have been misclassified into the "none" category if they did not receive a formal diagnosis from a health professional. Given that such diagnoses are more likely among children from higher-income households and those whose caregivers reported lower levels of aggravation (i.e., the moderators examined in this study), our findings should be interpreted with greater caution.

5. Conclusion

Despite the limitations inherent in this study, our findings warrant both scholarly and practical attention. In today's media-saturated environment, more deliberate and attentive parental mediation is crucial to mitigate the adverse effects of children's electronic device use on ADHD symptoms. Additionally, this study highlights that (1) children aged 6–12 years, (2) children with caregivers with lower level of parental aggravation, and (3) children from high-income households are particularly vulnerable to the adverse effects of screen time on ADHD symptoms. These groups may therefore benefit from more targeted parental attention and intervention. For example, governments may implement public interventions to promote active parental mediation, particularly among parents of younger children and those from higher-income households, as well as develop public policies aimed at reducing parental aggravation (e.g., through parenting support or child-rearing consultation services) and subsidizing ADHD diagnosis and assessment for families from lower-income households. In addition, scholars and childcare professionals may build on these findings to develop more precise and effective, evidence-based guidelines for parental mediation and child-rearing practices.

Conflicts of Interest: The authors declare no conflict of interest.

References

[1] E. Mundell and C. T.Miller, "One in 10 U.S. school-age kids have ADHD report finds," Medical Xpress, Mar. 20, 2024. Accessed: May. 10, 2024. [Online] Available: https://medicalxpress.com/news/2024-03-school-age-kids-adhd.html

[2] American Psychiatric Association (APA), Diagnostic and Statistical Manual of Mental Disorders, 5th ed., American Psychiatric Association, p. 70, 2022.

[3] B. Levelink, M. van der Vlegel, M. Mommers, J. Gubbels, E. Dompeling, F. J. M. Feron, D. M. C. B. van Zeben-van der Aa, P. Hurks, and C. Thijs, "The Longitudinal Relationship Between Screen Time, Sleep and a Diagnosis of Attention-Deficit/Hyperactivity Disorder in Childhood," Journal of Attention Disorders, vol. 25, no. 14, pp. 2003–2013, 2020, doi: https://doi.org/10.1177/1087054720953897.

[4] S. Nivins, M. A. Mooney, J. Nigg, and T. Klingberg, "Digital Media, Genetics and Risk for ADHD Symptoms in Children – A Longitudinal Study," Pediatrics Open Science, vol. 2, no. 1, pp. 1-10, 2025, doi: https://doi.org/10.1542/pedsos.2025-000922.

[5] T. Stevens and M. Mulsow, "There is no meaningful relationship between television exposure and symptoms of attention-deficit/hyperactivity disorder," Pediatrics, vol. 117, no. 3, pp. 665–672, 2006, doi: https://doi.org/10.1542/peds.2005-0863.

[6] V. Isaac, V. Lopez, and M. J. Escobar, "Arousal dysregulation and executive dysfunction in attention deficit hyperactivity disorder (ADHD)," Frontiers in Psychiatry, vol. 14, 2024, doi: https://doi.org/10.3389/fpsyt.2023.1336040.

[7] J. B. Wu, X. N. Yin, S. Y. Qiu, G. M. Wen, W. K. Yang, J. Y. Zhang, et al., "Association between screen time and hyperactive behaviors in children under 3 years in China," Frontiers in Psychiatry, vol. 13, Article 977879, 2022, doi: https://doi.org/10.3389/fpsyt.2022.977879.

[8] Y. Zhou, X. Jiang, R. Wang, B. Guo, J. Cai, Y. Gu, et al., "The relationship between screen time and attention deficit/hyperactivity disorder in Chinese preschool children under the multichild policy: A cross-sectional survey," BMC Pediatrics, vol. 23, no. 1, Article 361, 2023, doi: https://doi.org/10.1186/s12887-023-04130-x.

[9] J. B. Wu, S. Y. Qiu, X. N. Yin, et al., "The relationship between screen time, screen content, and ADHD symptoms in children," PLOS ONE, vol. 21, no. 1, e0341722, 2025, doi: https://doi.org/10.1371/journal.pone.0312654.

[10] Child and Adolescent Health Measurement Initiative (CAHMI), 2022 National Survey of Children's Health. STATA codebook for data users: Child and Family Health Measures, National Performance and Outcome Measures, and Subgroups, Version 1.0., Data Resource Center for Child and Adolescent Health supported by Cooperative Agreement U59MC27866 from the U.S. Department of Health and Human Services, Health, Resources and Services Administration (HRSA), Maternal and Child Health Bureau (MCHB), 2024. Retrieved Jun. 7, 2024. [Online] Available: childhealthdata.org

[11] M. Gradisar, A. R. Wolfson, A. G. Harvey, L. Hale, R. Rosenberg, and C. A. Czeisler, "The sleep and technology use of Americans: Findings from the National Sleep Foundation's 2011 Sleep in America poll," Journal of Clinical Sleep Medicine, vol. 9, no. 12, pp. 1291-1299, 2013, doi: https://doi.org/10.5664/jcsm.3272.

[12] D. Bawden and L. Robinson, "The dark side of information: overload, anxiety and other paradoxes and pathologies," Journal of Information Science, vol. 35, no. 2, pp. 180-191, 2009, doi: https://doi.org/10.1177/0165551508095781.

[13] Z. J. Lipowski, "Sensory and information inputs overload: Behavioral effects," Comprehensive Psychiatry, vol. 16, no. 3, pp. 199-221, 1975, doi: https://doi.org/10.1016/0010-440x(75)90047-4.

[14] S. W. Nikkelen, P. M. Valkenburg, M. Huizinga, and B. J. Bushman, "Media use and ADHD-related behaviors in children and adolescents: A meta-analysis," Developmental Psychology, vol. 50, no. 9, pp. 2228-2241, 2014, doi: https://doi.org/10.1037/a0037318.

[15] R. M. S. Santos, C. G. Mendes, D. Marques Miranda, and M. A. Romano-Silva, “The association between screen time and attention in children: A systematic review,” Developmental Neuropsychology, vol. 47, no. 4, pp. 175-192, 2022, doi: https://doi.org/10.1080/87565641.2022.2064863.

[16] S. K. Tamana, V. Ezeugwu, J. Chikuma, D. L. Lefebvre, M. B. Azad, T. J. Moraes, et al., “Screen-time is associated with inattention problems in preschoolers: Results from the CHILD birth cohort study,” PLoS One, vol. 14, no. 4, e0213995, 2019, doi: https://doi.org/10.1371/journal.pone.0213995.

[17] S. Anand and J. A. Krosnick, “Demographic predictors of media use among infants, toddlers, and preschoolers,” American Behavioral Scientist, vol. 48, no. 5, pp. 539-561, 2005, doi: https://doi.org/10.1177/0002764204271512.

[18] B. Kolb and R. Gibb, “Brain plasticity and behavior in the developing brain,” Journal of the Canadian Academy of Child and Adolescent Psychiatry, vol. 20, no. 4, pp. 265-276, 2001. [Online] Available: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3222570/

[19] M. A. Mooney, P. Bhatt, R. J. Hermosillo, P. Ryabinin, M. Nikolas, S. V. Faraone, et al., “Smaller total brain volume but not subcortical structure volume related to common genetic risk for ADHD,” Psychological Medicine, vol. 51, no. 8, pp. 1279-1288, 2021, doi: https://doi.org/10.1017/S0033291719004148.

[20] S. Bölte, J. Neufeld, P. B. Marschik, Z. J. Williams, L. Gallagher, and M. C. Lai, “Sex and gender in neurodevelopmental conditions,” Nature Reviews Neurology, vol. 19, no. 3, pp. 136-159, 2023, doi: https://doi.org/10.1038/s41582-023-00774-6.

[21] K. Rubia, R. Halari, A. Cubillo, A. M. Mohammad, M. Brammer, and E. Taylor, “Methylphenidate normalizes fronto-striatal underactivation during interference inhibition in medication-naive boys with ADHD,” Neuropsychopharmacology, vol. 34, no. 3, pp. 547-558, 2009, doi: https://doi.org/10.1038/npp.2011.30.

[22] P. Shaw, M. Gilliam, M. Liverpool, C. Weddle, M. Malek, W. Sharp, et al., “Cortical development in typically developing children with symptoms of hyperactivity and impulsivity: Support for a dimensional view of attention deficit hyperactivity disorder,” American Journal of Psychiatry, vol. 168, no. 2, pp. 143-151, 2011, doi: https://doi.org/10.1176/appi.ajp.2010.10030385.

[23] J. Han, K. Koser, M. R. Mamey, D. L. Vanderbilt, D. J. Schonfeld, L. Yin, et al., “Mediation of parental aggravation in the association between ADHD severity and electronic media use: A national survey of children’s health study,” Journal of Attention Disorders, vol. 28, no. 2, pp. 127-138, 2024, doi: https://doi.org/10.1177/10870547231205028.

[24] M. J. Pimentel, S. Vieira-Santos, V. Santos, and M. C. Vale, “Mothers of children with attention deficit/hyperactivity disorder: Relationship among parenting stress, parental practices, and child behaviour,” ADHD Attention Deficit and Hyperactivity Disorders, vol. 3, no. 1, pp. 61-68, 2011, doi: https://doi.org/10.1007/s12402-011-0053-3.

[25] M. Berger and M. Fendrich, “Socioeconomic disparities in ADHD diagnosis and treatment: Analysis of a national sample of U.S. children,” Journal of Attention Disorders, vol. 24, no. 10, pp. 1417-1426, 2020, doi: https://doi.org/10.1016/j.psychres.2023.115393.

[26] A. E. Russell, T. Ford, R. Williams, and G. Russell, “The association between socioeconomic disadvantage and attention deficit/hyperactivity disorder (ADHD): A systematic review,” Child Psychiatry & Human Development, vol. 47, no. 3, pp. 440-458, 2016, doi: https://doi.org/10.1007/s10578-015-0578-3.

[27] J. Belsky, “The determinants of parenting: A process model,” Child Development, vol. 55, no. 1, pp. 83-96, 1984.

[28] A. Jameel, Z. Ma, M. Li, A. Hussain, M. Asif, and Y. Wang, “The effects of social support and parental autonomy support on the mental well-being of university students: The mediating role of a parent-child relationship,” Humanities and Social Sciences Communications, vol. 11, no. 1, pp. 1-8, 2024, doi: https://doi.org/10.1057/s41599-024-03088-0.

[29] K. A. Crnic and M. T. Greenberg, “Minor parenting stresses with young children,” Child Development, vol. 61, no. 5, pp. 1628-1637, 1990, doi: https://doi.org/10.2307/1130770.

[30] H. H. Kim, S. I. Viner-Brown, and J. Garcia, “Children’s mental health and family functioning in Rhode Island,” Pediatrics, vol. 119, Suppl. 1, pp. S22-S28, 2007, doi: https://doi.org/10.1542/peds.2006-2089E.

[31] R. Prat, A. Puig-Ribera, M. Pagerols, G. Español-Martín, C. Rivas, A. Autet, et al., “Patterns of physical activity of adolescents with ADHD in the school context: A cross-sectional study for clinical practice,” Journal of Attention Disorders, vol. 28, no. 8, pp. 1210-1224, 2024, doi: https://doi.org/10.1177/10870547241246688.

[32] N. J. Spencer, J. Ludvigsson, G. Bai, L. Gauvin, S. A. Clifford, Y. Abu Awad, et al., “Social gradients in ADHD by household income and maternal education exposure during early childhood: Findings from birth cohort studies across six countries,” PLoS One, vol. 17, no. 3, e0264709, 2022, doi: https://doi.org/10.1371/journal.pone.0264709.

[33] P. L. Morgan, J. Staff, M. M. Hillemeier, G. Farkas, and S. Maczuga, “Racial and ethnic disparities in ADHD diagnosis from kindergarten to eighth grade,” Pediatrics, vol. 132, no. 1, pp. 85-93, 2013, doi: https://doi.org/10.1542/peds.2012-2390.

[34] T. R. Coker, M. N. Elliott, S. L. Toomey, D. C. Schwebel, P. Cuccaro, S. Tortolero Emery, et al., "Racial and ethnic disparities in ADHD diagnosis and treatment," Pediatrics, vol. 138, no. 3, 2016, doi: https://doi.org/10.1542/peds.2016-0407.

[35] T. L. Jones and R. J. Prinz, "Potential roles of parental self-efficacy in parent and child adjustment: A review," Clinical Psychology Review, Vol.25, No.3, pp. 341-363, 2005, doi: https://doi.org/10.1016/j.cpr.2004.12.004 .

[36] L. S. Clark, "Parental mediation theory for the digital age," Communication Theory, vol. 21, no. 4, pp. 323-343, 2011, doi: https://doi.org/10.1111/j.1468-2885.2011.01391.x.

[37] K. W. Fu, F. K. W. Ho, N. Rao, F. Jiang, S. L. Li, T. M. C. Lee, et al., "Parental restriction reduces the harmful effects of in-bedroom electronic devices," Archives of Disease in Childhood, vol. 102, no. 12, pp. 1125-1131, 2017, doi: https://doi.org/10.1136/archdischild-2017-312639.