University Bielefeld

Faculty for Sports and Psychology

Department of Psychology

AE 07: Clinic Psychology and Psychotherapy of Children and Adolescents

Master Thesis

Among Night Owls, Smombies and Fidgety Philips: Connections between sleep problems, media use and ADHD symptoms in children

A questionnaire survey

Submitted by:

Name: Luisa Himmelmeier

Bielefeld, 08.07.2021

Index

List of Figures

List of Tables

Abstract

The current state of research shows a research gap with regard to the interrelations between sleep problems, media use and ADHD symptoms. In order to investigate this for children between the ages of five and 10 years, a questionnaire survey will be conducted as part of this study. For this purpose, parent-report versions of the Children's Sleep Habits Questionnaire, the ADHD assessment form from the diagnostic system for mental disorders according to ICD-10 and DSM-V for children and adolescents as well as further questions on media use will be used. In order to include relevant control variables, the short version of the Alabama Parenting Questionnaire is used to record parenting behaviour. Therefore, 122 mothers and five fathers of 127 children between five and 10 years completed the questionnaires. The results were pathwise consistent with the hypotheses. There were significant correlations between sleep problems, media use and ADHD symptoms. Daily media use was found to be a significant moderator between sleep problems and inattention. Due to this moderating effect of daily media use, approaches for interventions could be formed that could possibly alleviate the symptoms by reducing media use during the day. Bedtime media use did not appear as a significant moderator, suggesting that while screen reduction may be appropriate for clinically relevant media use, bedtime media use as a sleep ritual may also be potentially sleep-inducing. To confirm the results discovered, further research should be conducted, especially longitudinally, to test the causal effects of the triad and of derived possible treatments and newly assumed sleep-promoting effects of bedtime media use.

1 Introduction

In the following, the state of research on sleep problems and attention deficit hyperactivity disorder (ADHD) is summarised. Subsequently, the results of previous studies on sleep problems and media use are summarised. Next, the correlations between media use and ADHD are considered, in order to finally be able to examine the three constructs together in the effect concept.

1.1 Sleep problems and ADHD

Sleep problems in children are very common and affect around 20-25% of all children during their childhood (e.g. Gottschalk et al., 2011; Owens, 2008; Schlarb et al., 2015; Wiater & Scheuermann, 2007). The effects of sleep problems can be extensive and lead to memory disorders and behavioural problems (e.g. Blunden et al., 2005; Gottschalk et al., 2011; Lehmkuhl et al., 2008; Schlarb et al., 2015; Wiater & Scheuermann, 2007). Especially ADHD is often associated with disturbed sleep and needs to be considered as a comorbid or differential diagnosis of sleep problems (e.g. Felt et al., 2014; Frölich et al., 2003; Hvolby, 2015; Wolraich et al., 2011). ADHD is known as one of the most common neuropsychiatric diseases with onset in childhood (e.g. Felt et al., 2014; Kieling & Rohde, 2012; Wolraich et al., 2011), a chronic course with high dysfunction and lifelong morbidity (e.g. Bachmann et al., 2017; Biederman et al., 2010; Döpfner et al., 2015; Kieling & Rohde, 2012; Turgay et al., 2012).

Both, ADHD and sleep problems are highly prevalent (e.g. Hvolby, 2015; Reale et al., 2017; Tsai et al., 2016; Virring et al., 2016) and interrelated through reciprocal causality, comorbidity and interacting mechanisms (e.g. Gau et al., 2007; Hvolby, 2015; Stein et al., 2012). The causal directions of effect do not yet seem to be clearly understood (Kirov & Brand, 2014). The current state of research revealed that children with ADHD are more likely to develop sleep problems than children without ADHD, whereas the severity of ADHD represents a risk factor for sleep problems (e.g. Hvolby, 2015; Konofal et al., 2010; Lycett et al., 2014). Kirov and Brand (2014) emphasize, consistent with another study (Reale et al., 2017), that patients with severe sleep disorders develop ADHD-like behaviour as a consequence which can lead to decreased levels of quality of life and social functioning, functional impairments in mood affection, attention, behaviour and school performance. Schwerdtle et al. (2012) report that sleep problems in children may manifest themselves for example in hyperactivity or lacks of concentration. Craig and colleagues (2017) assume insomnia, excessive day-time sleepiness and a variability in sleep schedule closely linked to ADHD, whereas Hvolby (2015) reports apnoea, shortened sleep durations and heightened sleep onset latencies. Virring et al. (2016)

highlighted nocturnal sleep interruptions in children with ADHD. Restless sleep, night awakenings, fear of the dark and nightmares were observed more frequently in children with ADHD than in the controls (Hvolby et al., 2009). Compared to 1.4% of children without ADHD, studies found that 13.3% to 23.0% of children with ADHD appear to be affected by nightmares (Chin et al., 2018; Hvolby et al., 2009). Furthermore, 37.8% of the children with ADHD reported scary dreams, compared to 7.5% in the control group (Hvolby et al., 2009). The dream contents tended to be negatively toned with misfortunes, threats, negative outcomes and physical aggression to the dreaming child (Kirov & Brand, 2014; Spruyt & Gozal, 2011).

In order to shed more light on the connections between ADHD symptoms and sleep problems, the research group around Gau and colleagues (2007) investigated these associations in more detail. For this, they surveyed 2284 students aged 18 to 20 years. Their findings indicate that sleep problems most strongly associated with inattention were insomnia, nightmares, snoring, and increased need for sleep to maintain daytime function. Besides, insomnia, snoring, sleep talking, nightmares and decreased nocturnal sleep hours predicted hyperactive-impulsive symptoms in their study. Grünwald and Schlarb (2017) examined the ADHD symptoms and their associations with sleep problems individually, including a study sample consisting of 72 children with ADHD symptomatology between six and 13 years. The authors found significant correlations between sleep-disordered breathing (SDB) and the scores for hyperactivity, impulsivity and the ADHD total score. Furthermore, parasomnias were significantly correlated with hyperactivity as well. Moreover, Wajszilber et al. (2018) reviewed studies suggesting that impulsivity is associated with bedtime resistance and delayed sleep onset. It seems that the current state of research is unclear about which ADHD symptoms are associated with which sleep problems, as there is limited agreement between study results.

1.2 Sleep problems and media use

Children and adolescents spend increasingly more time using media than any other activity (e.g. Auhuber et al., 2019; Dewald et al., 2010; Rideout et al., 2010; Rideout, 2016). In 2012, 95.0% of eight- to 12-year-old girls in the US and Canada already had computer access at home and 42.3% had their own mobile phone (Pea et al., 2012). Feierabend et al. (2017) surveyed the media access of six- to 13-year-old children and adolescents in Germany to a diverse range of media sources. Their survey of the 1229 children showed that 97.0% had internet access and a computer in their household. Furthermore, around 50% had their own mobile phone, gaming consoles or a television. Almost half of the youth are classified as internet dependent (Grund & Schulz, 2017; Schmid, 2018). On average, the time spent using different media sources is between 6 and 7.5 hours per day for children aged eight to 18 years (Rideout et al., 2010; Rideout,

2016). For two- to five-year-old children, media use is estimated to be around 4.5 hours per day (Emond et al., 2018). In relation to the recommendations of the BZgA - Bundes Zentrale für gesundheitliche Aufklärung (2019) in which a daily media use of not more than two hours daily is recommended, the actual use seems to be far higher.

The daily media use, especially social media, appears to have negative influences on sleep behaviour and quality (e.g. Abi-Jaoude et al., 2020; Cain & Gradisar, 2010; Genuneit et al., 2018; Limtrakul et al., 2018; Wong et al., 2020) and, when excessive, can lead to chronic sleep deprivation, impaired cognitive control, academic performance and socioemotional functioning (Abi-Jaoude et al., 2020). Longitudinally, media use was shown to be associated with worsening factors of bedtime resistance, sleep anxiety and daytime sleepiness (Genuneit et al., 2018). According to Cain and Gradisar (2010), delayed sleep time and shorter total sleep time may be related to media use. Furthermore, they state that media use may even replace sleep or activities that are part of good sleep hygiene.

In addition to the daily time spent on media, the effects of media use before bedtime should be investigated in more detail. Electronic screen use around bedtime showed influences on various sleep problems such as longer sleep latencies, reduced melatonin release, shift in circadian rhythm (e.g. Abi-Jaoude et al., 2020; Billari et al., 2018; Guram & Heinz, 2018; Wong et al., 2020), lower sleep duration and quality, and excessive daytime sleepiness (e.g. Carter et al., 2016; LeBourgeois et al., 2017; Reid et al., 2016; Wong et al., 2020). Media use in the evening had a greater impact on sleep than total media use time. Each hour of additional media use before bedtime was associated with more severe sleep problems (Garrison et al., 2011). Studies assume that media use before bedtime may physiologically arouse children and therefore make it more difficult for them to relax in the evening before bedtime (Cain & Gradisar, 2010; Wong et al., 2020).

1.3 Media use and ADHD

Starting from the age of seven years, there seems to be a correlation between the duration of media use and ADHD symptoms in children (e.g. Levine et al., 2012; Nikkelen et al., 2014; Schmid, 2018). One must pay attention to the assumption that the problematic use rather than the intensity of media use harmfully affects the ADHD symptoms (Boer et al., 2020). A study from Batra and Fallgatter (2015) investigated factors which increase the media use in children with ADHD. The findings of their study indicate that media use offers an attractive, varying, sensorically stimulating range of for instance computer games and internet applications and appeals especially to children with ADHD. Furthermore, media obesity seems to be a comorbid disorder to ADHD (Barth & Renner, 2015), based on studies in which adolescents with internet

addiction had higher ADHD symptoms than adolescents without internet addiction (Yen et al., 2007). It is to assess in which direction the three core ADHD symptoms are correlated to media use in particular.

1.4 Sleep problems, media use and ADHD

Lissak (2018) conducted a study which emphasized that longer screen time and inadequate sleep-wake behaviour increase the risk for ADHD symptoms, whereby the reduction of screen time led to decreased ADHD symptoms. One study assumed that children with ADHD are at an increased risk for media-related sleep problems due to higher media use durations, possible influences of the screen lights on the circadian-rhythm and thus melatonin production (Engelhardt et al., 2013). Rydell and Brocki (2021) conducted a longitudinal study, in which they investigated the associations and effects of ADHD on the media use of 88 adolescents starting at the age of 15 years. The authors found significant correlations from hyperactivity, impulsivity and inattention with disinhibition. Furthermore they state that inattention is significantly associated with violent media use. Thoma et al. (2018) carried out a study in which they analysed the relations between sleep, screen-based media and ADHD symptoms. Therefore, 357 children of a general population and 61 children with ADHD between eight and 18 years completed questionnaires covering sleep habits, media use and ADHD symptoms. In that study children with ADHD reported delayed sleep onsets and more screen time on school days than controls. Moreover, longer media time, inadequate sleep-wake behaviour and sleep deprivation were predictors of ADHD symptomatology.

Tong et al. (2018) investigated moderating effects of different bedtime activities on the association between ADHD symptoms and sleep problems in children. Therefore they surveyed 934 children between nine and 12 years from primary schools in China. The authors found descending sleep durations for children with low screen-time at bedtime. But for both, children with lower screen-time and higher screen-time at bedtime, disordered breathing increased with rising ADHD symptoms. Children with lower media use before sleeping and enhancing ADHD symptoms had worsening problems with delayed sleep onsets. Furthermore, Tong and colleagues (2018) state that it is hard to assess in a cross-sectional study using parent-report only, if the children have difficulties falling asleep and therefore use media to cope these problems or if the difficulties arise from the media use.

There is little research on the associations between sleep problems, ADHD and media use in the age range between five- and 10-year-old children. This shows that there is an urgent need to take a closer look at these constructs for children in this age group. Although children older than 10 years should not be included, as individual developmental emotional instabilities

may increase from the age of 10 years onwards and only decrease in young adulthood (Zimmermann et al., 2018), which could bias the results.

2 Current study

The purpose of this study is explained in terms of its scientific and practical relevance. Then the research question and the hypotheses derived from it are named. Finally, the operationalisation of the hypotheses is presented.

2.1 Practical and scientific relevance

From the state of research described above, it can be deduced that it is necessary to explore the connections of the ADHD symptom triad with sleep problems and media use again and in more detail in order to enable clearer statements about the associations and attempt to close the research gaps. Thereby it will be investigated whether daily and bedtime media use as separate moderators have significant effects on the association of sleep problems and ADHD symptoms.

In addition to the content-related aspects of the age limit, a positive methodological fact can also be shown in the assumption of the age range of five to 10 years. Current research findings on sleep problems, ADHD and media use are mostly available for two- to five-year-old children or for eight-year-olds and older. There is little research in the five to eight years age range, so this study can serve to expand the state of research for this barely researched age range.

The results of this study are of practical relevance, as they could be used, for example, to derive interventions to regulate media use, which could potentially reduce or alleviate sleep problems and ADHD symptoms. By means of this study, media use will be examined in more detail as a potential facilitating factor of sleep problems and ADHD symptoms in children, in order to derive assistance for affected children and to comprehend the underlying effects better.

2.2 Research question

In summary, the aim of this study is to examine the associations between sleep problems, media use, hyperactivity, impulsivity and inattention, and to investigate the moderating function of media use in the complex of effects of sleep problems and ADHD symptoms.

2.3 Hypotheses

Hypothesis 1: Sleep problems, (daily and bedtime) media use and ADHD symptoms are significantly correlated with each other.

Hypothesis 2.1: The daily media use moderates the association between sleep problems and ADHD symptoms.

Hypothesis 2.2: The bedtime media use moderates the association between sleep problems and ADHD symptoms.

2.4 Operationalisation of the hypotheses

In the present study, sleep problems are defined, congruently with other studies conducted (Owens et al., 2000; Schwerdtle et al., 2016), as a deviation in sleep behaviour that exceeds a certain threshold. Prehn-Kristensen et al. (2018) defined sleep problems in the S1 Guidelines according to the criteria of the International Classification of Sleep Disorders (ICSD), third edition. According to this definition, sleep problems represent a psychological condition with a disturbance in the duration, quality or timing of sleep, abnormal episodes of behavioural patterns or physiological events that occur during the sleep-wake transition.

ADHD symptoms are considered in this study, in line with the descriptions of the International Statistical Classification of Diseases and Related Health Problems in the tenth revision (ICD-10) and the Diagnostic and Statistical Manual of Mental Disorders in the fifth edition (DSM-V). Accordingly, ADHD can be regarded as a developmental disorder beginning in childhood, lasting at least six months and occurring across situations, with the core symptom triad of inattention, impulsivity and or motor restlessness (American Psychiatric Association, 2013; World Health Organization, 1992).

In this study, media use is conceived as a more general term encompassing the use of media offerings, especially mass media. Media use is recorded via additional questions, which will be explained in more detail in chapter 3.3, together with the other measuring instruments mentioned.

With help of the operationalised constructs, an examination of the triad of sleep problems, media use and ADHD symptoms (Figure 1) is to be conducted.

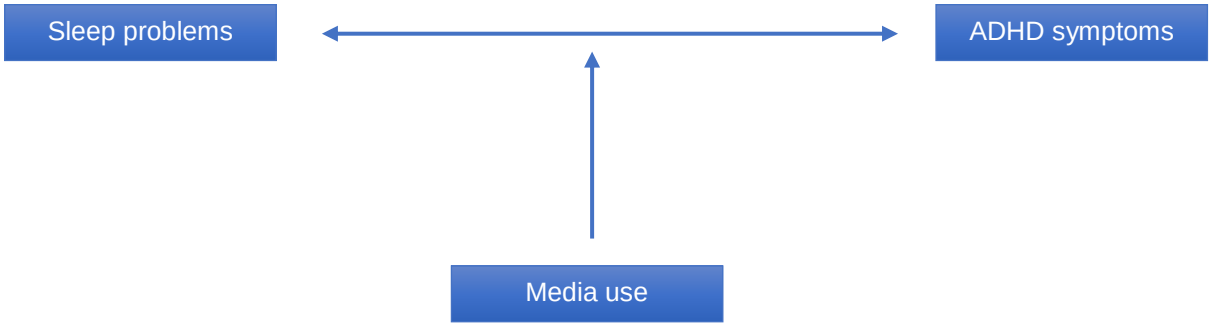

Figure 1. Triad of sleep problems, media use and ADHD symptoms.

3 Method

In the following, it is presented how the investigation of the hypotheses proceeded. First, the procedure of the study is explained. Afterwards, the sample is described. Then the survey instruments are shown in detail. Finally, the statistical data evaluation and analysis are mentioned.

3.1 Procedure

The study was conducted as a cross-sectional online questionnaire survey with a non-experimental design, as there was no manipulation of variables. Due to the cross-sectional design, assignments of independent and dependent variables cannot be established with regard to causality statements. At the beginning of the survey, the parents were informed about the participation in the study and had to confirm that they accepted this information as a declaration of consent to participate in the study. The average completion time of 26 minutes was also mentioned. The exact structure of the study as well as the utilised questionnaires and their sequence are shown in Table 1.

Table 1. Illustration of the online survey's structure.

Content	Items
Introduction, study information, details of the study procedure, contact details of contact persons	1
Introduction and recording socio-demographic data, control variables	14
Assessment of parenting behaviour	9
Introduction to the sleep questionnaire and recording of sleep behaviour	50
Questions about the children's media use	16
Questions about the parents' media use	10
Assessment of the ADHD symptoms	3-6 years: 25 6-18 years: 33
Question about the evaluator (mother, father, other person)	1
thanks, farewell, reference to possible follow-up measures at Bielefeld University	1

In order to achieve the a priori calculated sample size, social networks, schools, kindergartens, sports groups and childminders were activated to distribute the study flyer (Appendix A). The study participants had the opportunity to contact the study leaders by e-mail at any time in case of questions or difficulties in understanding. The ethical aspects of the study were reviewed by the Ethics Committee of Bielefeld University and the realisation of the study was approved (Appendix B).

3.2 Sample

The survey period covered two and a half weeks from 21.05.2021 to 08.06.2021. The participation in the study was voluntary and anonymous. At the end of the survey, participants could request a PDF document with hints, information and links to the areas of child sleep, media use and ADHD symptoms.

The G-Power 3.1 programme (Faul, Erdfelder, Lang & Buchner, 2007) was used to calculate the ideal sample size. With an effect size of $F = 0.10$, an α-level of 0.05 and a power of 0.95, a sample size of 110 participants was calculated. However, the calculation of the minimum sample size using G-Power must be viewed critically, as the effect size was only chosen as an example to approximate the size.

All parents of children between five and 10 years of age could participate in the survey. The sample of this study is composed of 126 parent-reports, 122 from mothers, five from fathers. Data about 82 boys and 45 girls were collected. The boys were on average 7.5 years old ($SD = 1.7$) and the girls 7.1 years old ($SD = 1.6$). The more detailed age distribution is shown hereafter (Figure 2).

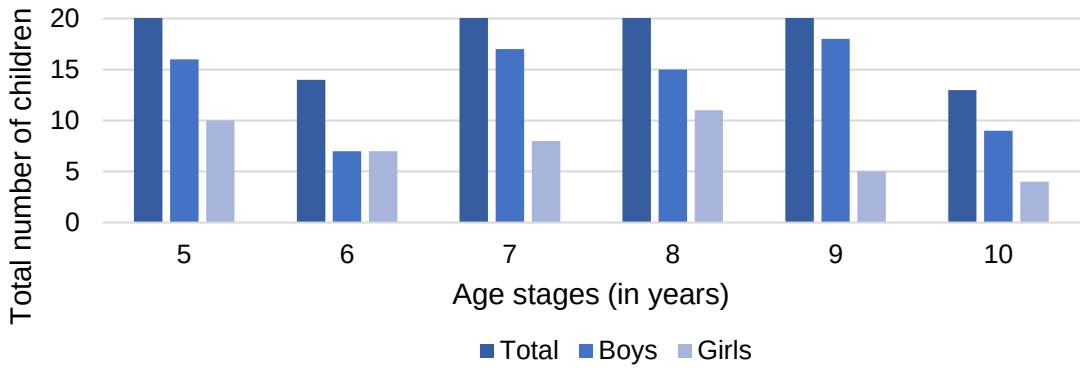

Figure 2. Total number of children in the 5-10 years age groups.

30.7% of the children went to kindergarten and 69.3% to school. Some of the children had chronic medical (18.9%) or mental health (7.9%) diagnoses. According to the data collected, the diagnoses were: ADHD (7.9%), Attention Deficit Disorder (7.9%), atypical and Asperger's autism (4.0%), developmental delay (1.8%), emotional disorders (2.4%), chronic and obstructive bronchitis (1.8%), neurodermatitis (1.8%), asthma (0.8%), dust mite allergy (0.8%), epilepsy (0.8%), strabismus (0.8%), depression (0.8%), impulse control disorder (0.8%) and idiopathic thrombocytopenia (0.8%).

Besides, 91.7% of the households were equipped with a PC, 83.3% with a tablet, 97.5% with a mobile phone, 90.8% with a TV and 60.8% with a gaming console. On average, the

children had a daily media use of 2.0 hours and 0.3 hours at bedtime. Additionally, the specified reasons for media use were depicted in Figure 3.

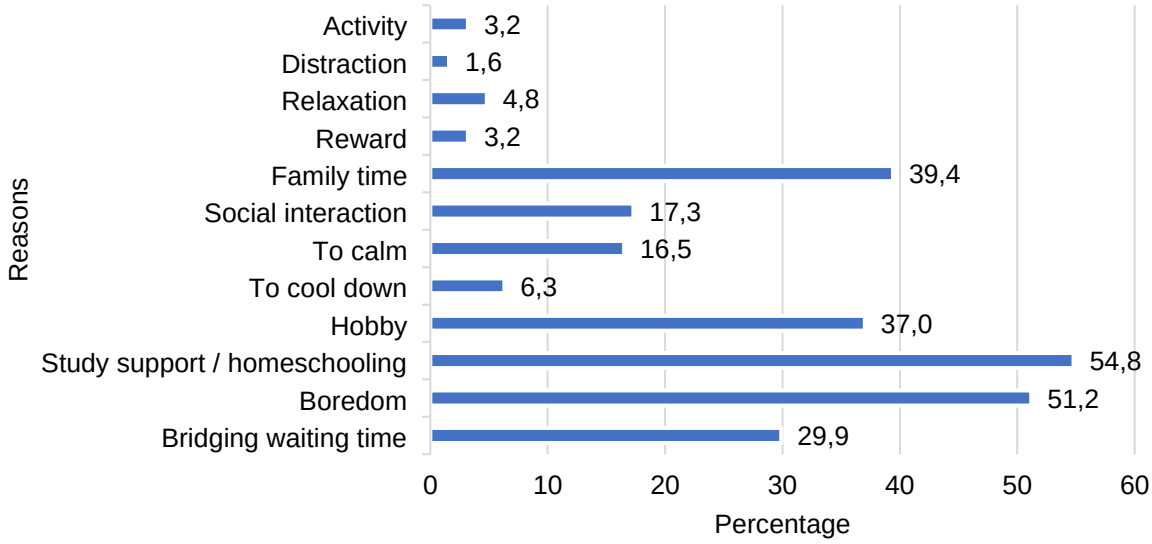

Figure 3. Stated reasons for media use.

Moreover, parents reported that 15.0% of children seemed tired after media use, 22.8% more active and 52.8% unchanged. Another 19.7% reported other impressions such as irritable, dissatisfied, agitated, absent, petulant and aggressive. Occasionally, whiny, uncooperative, stressed, interested and calm impressions were also mentioned. Tables C1 and C2 (Appendix C) provide further socio-demographic information.

3.3 Instruments

The measuring instruments used are described in the following. First, the parenting questionnaire is illustrated. Then the sleep questionnaire is outlined, followed by the ADHD questionnaire. Next, the questions on media use are delineated. Finally, the assessment of the control variables is explained.

3.3.1 Children's Sleep Habit Questionnaire

The German version of the Children's Sleep Habit Questionnaire (CSHQ-DE) by Schlarb, Schwerdtle and Hautzinger (2010) was used to assess children's sleep behaviour in parent-report form. This German version is an adapted version of the CSHQ by Owens et al. (2000). It was developed on the basis of the most common symptoms of sleep disorders in children formulated in the second edition of the ICSD (Owens et al., 2000) and consists of the eight subscales: Bedtime resistance, sleep onset delay, sleep duration, sleep anxiety, night wakings, parasomnias, SDB and daytime sleepiness. These subscales are composed of a total of 48 items

and further additional questions concerning the child's bedtime, the usual amount of sleep per day, the usual duration of night wakings and the morning wakeup time. Using a three-point scale, parents can rate 44 items with the following response categories: usually (5-7 times a week), sometimes (2-4 times a week) or rarely (0-1 times a week). In addition, the levels: Yes, No and Not Applicable to indicate whether the respective behaviour is a problem. The other four items have three different response categories: Not sleepy, Very sleepy, Falls asleep. For the subscales, it is assumed that high scores represent more severe sleep problems, whereas low values represent fewer sleep problems in the domains. Owens et al. (2000) calculated a total score of sleep problems whereby a cut-off score of 41 was determined to identify clinically relevant and significant sleep problems with a sensitivity of .80 and a specificity of .72.

The validation study from Schlarb et al. (2010) involved 298 parents of healthy children aged four to 10 years and 45 parents of a clinic sample of children. The results highlighted an internal consistency of $\alpha = .68$ and a retest reliability of $r = .76$. The internal consistency discovered can be classified by Blanz (2015, p. 249) in a questionable range bordering on the acceptable range. According to Schmidt-Atzert and Amelang (2012), the measured retest reliability for clinical procedures in children is in the average range, which spans from $r = .73$ to $r = .86$. Furthermore, Schlarb et al. (2010) established cut-off scores for the subscales based on the clinical sample: Bedtime resistance (cut-off score = 10), sleep duration (cut-off score = 5), sleep anxiety (cut-off score = 7), night wakings (cut-off score = 5), daytime sleepiness (cut-off score = 14). Within those cut-off scores the authors reached sensitivities for these subscales from .59 to .98 and specificities from .80 to .94. Up to now, no cut-off values have been determined for the aimed total score of sleep problems, because the clinical sample used for this purpose did not, according to the authors, represent all sleep disorders to be recorded with the questionnaire.

3.3.2 ADHD Questionnaire - DISYPS-III FBB-ADHS

To measure ADHD symptoms, the parent-report form for the ADHD Section (FBB-ADHS) from the Diagnostic System for Mental Disorders according to ICD-10 and DSM-5 for Children and Adolescents, third edition (DISYPS-III), by Döpfner and Görtz-Dorten (2017) was used.

The parent report of this questionnaire captures the disorder criteria for hyperkinetic disorders as defined by ICD-10 and attention deficit hyperactivity disorders according to DSM-V for children from four to 18 years of age. There are two report forms of the parent-report which consist of 20 and 21 items. The first version was created for the survey of parents of preschool and kindergarten children (FBB-ADHS-V). This version uses nine items to assess inattention and ten items to measure hyperactivity/impulsivity. The parent report version for

school children, on the other hand, uses nine items to investigate inattention but 11 items to record hyperactivity/impulsivity. Both questionnaires were constructed with a four-level categorical response format (0 = not at all, 1 = a little, 2 = to a large extent, 3 = especially). In both versions, there is one item in the dichotomous response format ("Agree" / "Disagree"). In the schoolchildren's version, the time of onset of the behavioural problems is additionally asked via three possible age ranges (1 = before the age of 7, 2 = between the ages of 7 and 11, 3 = after the age of 11). In both versions, an index of the total ADHD symptomatology can be determined in addition to the symptom triad. Furthermore, the children's competences are asked in a further part. It is suggested that high scores indicate difficulties in the symptom triad and the total score, whereas problems in the competency scale are suspected at low scores. Clinically relevant values can be identified by means of corresponding age norms.

The psychometric quality criteria of the diagnostic system were tested several times using representative and clinic samples. For the FBB-ADHS of schoolchildren, an internal consistency of $\alpha = .91$ in the representative sample and $\alpha = .86$ in the clinic sample was found for the scale inattention. Hyperactivity and impulsivity achieved values of $\alpha = .91$ and $\alpha = .90$. The overall ADHD symptomatology showed internal consistencies of $\alpha = .94$ and $\alpha = .91$. The competencies perseverance, attention and reflexivity yielded values of $\alpha = .86$ and $\alpha = .81$. The FBB-ADHS-V was validated using a sample of 75 parents of children aged three to six years, building on the 521 representative and 187 clinically relevant parent report data already collected by Breuer and Döpfner (2006). This resulted in the following reliabilities for the scales for the representative sample: inattention $\alpha = .88$, hyperactivity/impulsivity $\alpha = .92$, total symptomatology ADHD-V $\alpha = .94$. Slightly lower consistencies were found for the sample of parent reports of children assessed as conspicuous: inattention $\alpha = .87$, hyperactivity/impulsivity $\alpha = .90$ and total symptomatology ADHD-V $\alpha = .92$. The clinic sample showed lower reliabilities: inattention $\alpha = .82$, hyperactivity/impulsivity $\alpha = .86$ and total symptomatology ADHD-V $\alpha = .90$. Overall, according to Blanz (2015) these values can be classified in a good (Cronbach's $\alpha > .80$) to excellent range (Cronbach's $\alpha > .90$).

3.3.3 Media use

As there was no standardised questionnaire available to record media use in parent-report format, some self-generated questions were used (Appendix D). First, it was intended to indicate which media sources are available in the household and how much time the child spends with them during the week and on weekends. The answer categories based on previous studies as well as results of the International Political Science Association (IPSA) conference were used. Then, the daily total and the bedtime media use durations were requested. Listening to music

or radio before sleeping and being read to were also recorded. Afterwards, the content of the media was asked and the child's behaviour after media use was focused on and reasons for media use were explored. Finally, the parents were asked about their own media use. In this context, the daily as well as the bedtime media use duration was also addressed and the media source-specific usage during the week and at weekends was also surveyed.

3.3.4 Control variables

To reduce the influence of confounding variables on the analyses and to increase precision, some control variables were assessed and included (Eid, Gollwitzer, & Schmitt, 2017, p. 87ff.).

The first control variable that should be taken into account is gender. Based on former studies, there do not seem to be any gender-specific differences in sleep behaviour during childhood (Horne et al., 2020; Krishnan & Collop, 2006). Contrary to this, the results of one study indicate that boys report shorter sleep durations than girls (Biggs et al., 2013). Besides, according to studies, boys are more often affected by ADHD (Bauermeister et al., 2007; Skogli et al., 2013). In addition, the distinction is important because the symptoms are gender-divergent, so that boys with ADHD tend to show externalising symptoms and girls with ADHD tend to show internalising symptoms (Rucklidge, 2010; Skogli et al., 2013). Gender-specific differences are also evident in the area of media use. Girls spend more time on smartphones, social media, texting, general computer use and online, while boys spend more time gaming on electronic devices (Twenge & Martin, 2020). Gender was recorded as an item with three response categories (female, male, diverse).

Furthermore, it seems to be important to regard the socio-economic status (SES). Children with low SES seem to tend to have shorter sleep durations and more subjectively reported sleep problems (Bagley et al., 2015; Patel et al., 2010). Low SES was also shown in studies to be a risk factor for the prognosis of ADHD (Cheung et al., 2015; Lawson et al., 2017) and excessive media use (Grund & Schulz, 2017). According to Lampert and Kroll (2006), SES can be measured through the variables: Education, employment status and income. To measure SES, education, employment status and income are surveyed, using three items with six to eight response categories.

In addition, a possible migration background should also be recorded, since in some cases this leads to an increased risk of media addiction (Grund & Schulz, 2017) and ADHD (Knopf et al., 2012; Lehti et al., 2016). Furthermore, one study highlights that sleep behaviours can vary culturally (Biggs et al., 2013). Migration background is queried via the native language and the country of birth of the child as well as the parents.

Parental psychopathology should also be checked, as this could have an influence on parenting behaviour (Theule et al., 2013) and thus on the child. Since parental diagnosis itself does not lead to transgenerational transmission, resulting risk factors should be identified (van Santvoort et al., 2015). Van Santvoort et al. (2015) postulate that the identification of risk factors may be important because children with sufficiently high levels of stress and low levels of resilience tend to develop the same disorders as their parents. Parental psychopathology and psychopathology of the child are asked subdivided according to chronic and mental illnesses in a dichotomous response format, whereby if the child's pathology is affirmed, further questions are asked relating to the type of diagnosis (suspected diagnosis, confirmed diagnosis, other) and the time at which the diagnosis was obtained.

Parenting behaviour, particularly parenting stress, is associated with daytime behaviour problems and sleepiness in children with insomnia (Byars et al., 2011). Besides, it appears that parental personality, psychopathology and related cognitions are bidirectionally associated with child sleep behaviour, so that poor child sleep may influence parenting behaviour, or the other way round, that poor child sleep may be a stressor for parenting behaviour (Sadeh et al., 2010). Consistent parenting was also reported to be associated with decreased bedtime resistance, decreased sleep anxiety, whereas higher emotional warmth was associated with increased parasomnia and sleep anxiety (Sciberras et al., 2017). In relation to ADHD, children's ADHD symptoms are associated with inadequate parenting through household chaos (Wirth et al., 2019).

One questionnaire that measures parenting behaviour is the Alabama Parenting Questionnaire (APQ), which was developed by Frick et al. in 1991. In this paper, the short version, the APQ-9, by (Elgar et al., 2007) is used. The short version captures inconsistent parenting behaviour, poor supervision and positive parenting behaviour in parent-report form with nine items. The questionnaire is composed of a five-point Likert scale (never = 0, rarely = 1, sometimes = 2, often = 3, always = 4) whose categories are not linked to absolute frequencies according to the authors. Low scores depict more consistent parenting behaviour, much supervision and little positive parenting behaviour while high scores point out more inconsistent parenting behaviour, little supervision and a lot of positive parenting behaviour. From the validation study of the APQ-9 by Elgar et al. (2007), which included 1402 parents of children from four to nine years, internal consistencies are $\alpha = .58$ for poor supervision, $\alpha = .77$ for positive parenting behaviour and $\alpha = .74$ for inconsistent parenting behaviour. According to the authors, it is an informative tool for researchers and clinicians who need brief assessments of parenting practices related to disruptive behaviour disorders in children, which is why it is used despite the low reliability of the monitoring scale. As there is no German version of the APQ-9, the translation was based on the validated German version of the APQ by (Essau et al., 2006).

3.4 Preliminary study

The main survey could not be carried out as planned due to organisational difficulties and time delays. However, the preliminary study included the initially planned children's self-report questionnaires as an additional extension of perspective and the parent-report questionnaires. In order to identify problems in completing the questionnaire sets and to obtain information on applicability and feasibility a pilot study was conducted before the main survey (e.g. Blanz, 2021, p. 14; Langfeldt & Goltz, 2017). Six girls and four boys aged between five and 10 years (M = 7.6, SD = 1.8) and their parents were recruited through personal contact. Participants in the pilot study completed the questionnaires in paper form and had the opportunity to make requests for changes and report difficulties via a feedback sheet (Appendix E). The children took between nine and 30 minutes (average 23 minutes) to complete the questionnaires. Despite the support of the parents, two children did not manage to fill out the questionnaire completely. The response time of the parents' questionnaires was between 17 and 38 minutes. The average time taken to complete the questionnaires was 26 minutes for the parents' version of kindergarten children and 28 minutes for the parents' version of school children.

Four children complained that the questionnaires were difficult to understand. Another comment mentioned four times was the extension of the times of day of the media questions to include, for example, "afternoons". Three parents remarked on the CSHQ-DE that the answer options of the question "Is this a problem for you?" could be changed from "Yes", "No" and "N/A" to "Yes", "Rarely", "No". In addition, some content issues arose when answering the CSHQ-DE. Three parents asked via the feedback sheet how they should assess what too much and too little sleep is, to adequately answer the question. Twice it was noted that the CSHQ-DE statement "The child is ready for bed at bedtime." was very age-specific and in some cases rituals between parent and child at bedtime had caused uncertainty in assessing the statement.

Since changes to the items of the questionnaires could possibly endanger the evaluability or validity (e.g. Jonkisz et al., 2012, p. 175), no changes were made on the basis of the comments from the pilot study. Further research should consider the suggestions for changes collected and develop a modified version of the questionnaires, which should then be validated again before being used in large surveys. It must be remembered that only a small sample was included in the piloting, so this may not be fully representative of the population. However, based on the difficulties encountered with the children's self-report during the preliminary study, only the parent-report perspective was included in the digitalisation of the survey. The reason for this was the assumption that it would be more difficult for children to receive adequate assistance in reading and understanding or answering the questions in the online format. Especially since there were such difficulties during the preliminary study in the paper-pencil

format, it seemed reasonable to assume that these could be intensified through the digitalisation of the survey (e.g. König, 2012, p. 35).

3.5 Data analysis

The questionnaires are entered manually into a database of the statistics programme IBM SPSS Statistics 25. Missing data should be completed via multiple imputations using the "linear trend at the point" method. This method was chosen because it estimates the missing values as accurately as possible for the predicted value using a regression equation based on the existing values of the sample, hence modelling a realistic value (Janssen & Laatz, 2017). Given the distribution of the dropouts and the data cleaning no addition of missings was necessary. A total of 290 parents started with the survey. But due to the elimination of dropouts in the process of data cleaning 162 reports must be excluded (N = 128). One parent report was completely answered with the comment to answer something only to give feedback afterwards, which was the reason to exclude this one as well, resulting in a sample of N = 127 participants. Due to the high drop-out rate, further consideration was given to this (Table 2).

Table 2. Dropout distribution.

Final progress status	Quantity	First missed item
1% - 3 %	56	Intro
10%	1	School graduation
12%	1	Monthly family income
16%	3	Parent's psychopathology
19% - 22%	3	Child's psychopathology
26%	2	Past surgeries of the child
37% - 38%	47	APQ-9
45% - 55%	28	CSHQ-DE
62% - 63%	3	Media use: audio play, getting read to
70% - 73%	7	Media use: media sources
79% - 90%	11	DISPYPS FBB-ADHS: attention section
97% - 100%	128	Completed all items

The number of dropouts at the beginning is probably due to the age range, as some parents reported that their child would be five years old in a few months, so they did not participate, but actually would have liked to. Nine people gave feedback via social media that they could not complete the APQ-9 because their parenting behaviour did not match their family's. For example, it was stated that they did not advocate parenting in the sense that they did or that they deliberately avoided reward systems.

The items were recoded according to the corresponding manuals of the questionnaires and the subscales and total scores were calculated accordingly. In order to be able to include the ADHD symptomatology for the kindergarten children and the school children together in the analysis, the calculated scale values for both DISYPS-III FBB-ADHS versions were combined into a total of three variables: inattention, hyperactivity/impulsivity and total ADHD symptomatology. The media use durations were assessed with four variables: daily media use during the week, daily media use at the weekend, bedtime media use during the week and bedtime media use at the weekend, which were combined by averaging due to only minor differences into a daily media use variable and a bedtime media use variable.

To evaluate hypothesis 1, correlations will be calculated including all subscales and the total scores of the CSHQ-DE and the FBB-ADHS as well as the daily and bedtime media use variables. For the moderation models in hypothesis 2.1 different sleep parameters from the CSHQ-DE will be used as independent variables and daily media use as moderator with ADHD scores from the FBB-ADHS as dependent variables. The same model will be applied to test hypothesis 2.2, where bedtime media use will be included instead of daily media use. Additionally, for hypotheses 2.1 and 2.2, the control variables described in chapter 3.3.3 are included in the regressions to test whether the influences and effect sizes change due to this.

The preconditions were evaluated by means of various tests. For the Bravais-Pearson correlations, linearity, independence of the participants, the scale level and normal distribution of both variables should be inspected (Eid, Gollwitzer, & Schmitt, 2017, p. 576-577; Schäfer & Schöttker-Königer, 2015, p. 152). The scale level of all variables used for the correlations could be classified as metric, so that this condition can be considered fulfilled. Linearity was checked via Scatterplots which revealed linear correlations for all tested variables. Based on the individual completion of the questionnaires, independence of the probands is assumed. The Kolmogorov-Smirnov test, which tests the variables for normal distribution, yielded a significant result for all variables ($p < .05$) except the CSHQ-DE's total score and the DISYPS-III's total ADHD symptomatology (Table 3). Due to the aforesaid significance there would actually be a violation of the normal distribution assumption, which can be rejected on the basis of the central limit theorem with a sample size of $N = 127$ and thus greater than $N = 30$ (Eid, Gollwitzer, & Schmitt, 2017, p. 236). Since a normal distribution of the variables is assumed from 30 study participants onwards a normal distribution of the variables can be assumed. Hence, all preconditions for the calculation of the Bravais-Pearson correlations were fulfilled.

Table 3. Kolmogorov-Smirnov test of the variables for normal distribution

Variables	*N*	*Z*	*p*
Total score of sleep problems	127	1.321	.061
Bedtime resistance	127	2.320	.000***
Sleep onset delay	127	3.944	.000***
Sleep duration	127	2.856	.000***
Sleep anxiety	127	2.057	.000***
Night wakings	127	2.662	.000***
Parasomnias	127	2.174	.000***
SDB	127	5.283	.000***
Daytime sleepiness	127	1.640	.009**
Daily media use	127	1.932	.001***
Bedtime media use	127	3.794	.000***
Inattention	127	1.634	.010*
Hyperactivity/impulsivity	127	1.596	.012*
Total ADHD symptomatology	127	1.240	.092

Note. * $p < .05$, ** $p < .01$, *** $p < .001$.

Since further preconditions must be checked in advance for the moderated regressions, the parameters: homoscedasticity, normal distribution of the residuals, independence of the residuals and distribution of the residuals were measured and influential data points were examined (Eid, Gollwitzer, & Schmitt, 2017, p. 704-721). To test homoscedasticity, the distributions of the residuals were plotted on graphs as functions of the predicted values (Appendix F). The graphs did not show unsystematic fluctuation around 0 required for homoscedasticity, as the values seemed to fluctuate more around 1. Accordingly, heteroscedasticity was assumed. The normal distributions of the residuals were tested via QQ-plots (Appendix G). Graphical inspection revealed deviations in the values, which would initially reject the normal distribution. Nevertheless, the normal distribution of the residuals is assumed due to the central limit theorem and the correspondingly large sample size (Eid, Gollwitzer, & Schmitt, 2017, p. 236). Due to the cross-sectional design of the study, it was assumed that the data are independent of each other, which means that the independence of the residuals was assumed. The preconditions for the evaluation with multiple moderated linear regressions were not all fulfilled. Based on this, the statistical analyses were applied and because of the precondition violations bootstrap sampling procedures were used with $m = 10000$ samples each (e.g. Hesterberg, 2015). The hypotheses of this study were tested two-sided, assuming a significance level of $\alpha = 0.05$.

4 Results

Within the context of hypothesis 1, various correlations between the ADHD symptoms, daily media use, bedtime media use and sleep problems should be investigated. Furthermore, sleep problems and (daily and bedtime) media use durations should correlate positively with each

other. It was presumed that ADHD symptoms and media use durations correlate positively with each other. Therefore, on the basis of the precondition tests, the Bravais-Pearson correlation coefficient was used to determine the correlations. The results are provided below in Table 4. Overall, the effect sizes ranged from very weak (r = .007) to very strong (r = .920) and also varied in the significance range from none to strong (p < .001). Inattention, hyperactivity/impulsivity and the total ADHD symptomatology showed significant correlations with some sleep problems. Bedtime media use showed significant correlations with some sleep problems. The correlations between bedtime media use and ADHD symptoms were lowly positive and non-significant. Daily media use, on the other hand, correlated only lowly and mostly negatively with the sleep problem scales and the ADHD symptom scales.

Table 4. Bravais-Pearson correlations (Part 1, N = 127)

	r			
	Sleep problems	Bedtime resistance	Sleep onset delay	Sleep duration
Sleep problems	1			
Bedtime resistance	.619***	1		
Sleep onset delay	.510***	.160	1	
Sleep duration	.463***	.059	.500***	1
Sleep anxiety	.704***	.675***	.264**	.169
Night wakings	.479***	.284***	.139	.067
Parasomnias	.647***	.266***	.232**	.059
SDB	.281**	.014	.119	.243**
Daytime sleepiness	.680***	.203*	.320***	.326***
IA	.295***	.077	.275***	.229*
HY-IM	.413***	.220*	.316***	.234**
Total ADHD	.425***	.182*	.342***	.281**
Daily media use	-.080	-.094	-.011	-.109
Bedtime media use	.194*	.210*	.157	.080

Note. * p < .05, ** p < .01, *** p < .001. IA = Inattention, HY-IM = Hyperactivity/impulsivity, Total ADHD = Total ADHD symptomatology.

Table 5. Bravais-Pearson correlations (Part 2, *N* = 127)

	r									
	Sleep anxiety	Night wakings	Parasomnias	SDB	DT sleepiness	IA	HY-IM	Total ADHD	Daily MU	Bedtime MU
Sleep problems										
Bedtime resistance										
Sleep onset delay										
Sleep duration										
Sleep anxiety	1									
Night wakings	.334***	1								
Parasomnias	.405***	.296**	1							
SDB	.128	.123	.218*	1						
DT sleepiness	.190*	.068	.332***	.065	1					
IA	.074	.186*	.164	.043	.322***	1				
HY-IM	.327***	.232**	.398***	.184*	.148	.521***	1			
Total ADHD	.261**	.210*	.360***	.171	.264**	.729***	.920***	1		
Daily MU	.040	-.054	-.037	.022	-.063	-.017	-.090	-.079	1	
Bedtime MU	.201*	.014	.110	-.030	.106	.093	.123	.127	.283**	1

Note. * $p < .05$, ** $p < .01$, *** $p < .001$. DT sleepiness = Daytime sleepiness, IA = Inattention, HY-IM = Hyperactivity/impulsivity, Total ADHD = Total ADHD symptomatology, Daily MU = Daily media use, Bedtime MU = Bedtime media use.

Bootstrap analyses of moderated linear regression models were calculated to test hypothesis 2.1. The total score for sleep problems was used as independent variable and the total ADHD symptomatology and the subscales inattention and hyperactivity/impulsivity as dependent variables. The daily media use was used as moderator. The bootstrap analysis for the moderation model with the total ADHD symptomatology as dependent variable revealed significance, F (3, 123) = 9.52, $p < .001$, clearing 18.8% of the variance (corrected $R^2 = .17$). The total sleep problems score was a significant predictor of the total ADHD symptomatology in this model, $b = .04$, 95 *BCa CI* [0.02; 0.05]. Daily media use as moderator did not show significance. The bootstrap analysis for the regression model with hyperactivity/impulsivity as dependent variable also showed to be significant, F (3,123) = 8.68, $p < .001$, clearing 17.5% of the variance (corrected $R^2 = .16$). Again the total sleep problems score was a significant predictor of hyperactivity/impulsivity in this model, $b = .04$, 95 *BCa CI* [0.02; 0.05]. The moderator did not result significant.

Moreover, the bootstrap analysis of the regression model with the predictors: sleep problems and daily media use as moderator to predict the criterion of inattention reached significance, F (3, 123) = 6.12, $p < .01$, and cleared 13.0% of the variance (corrected $R^2 = .11$). Here, significant predictors were the total sleep problem score, $b = .03$, 95 *BCa CI* [0.01; 0.05], and the moderator variable comprising daily media use, $b = .01$, 95 *BCa CI* [0.003; 0.03]. Further significant regression models in the context of hypothesis 2.1 resulted for the respective addition of the control variables poor supervision, F (4, 122) = 5.46, $p < .001$), and inconsistent parenting behaviour, F (4, 122) = 6.12, $p < .001$). The regression model with poor supervision, daily media use as moderator, and the total score of sleep problems as independent variables revealed a significant effect of sleep problems, $b = .03$, 95 *BCa CI* [0.001; 0.05], and the moderator, $b = .01$, 95 *BCa CI* [0.002; 0.03], on inattention. In the other regression model, the addition of inconsistent parenting behaviour as a predictor revealed significance for sleep problems, $b = .03$, 95 *BCa CI* [0.01; 0.05], the moderator, $b = .01$, 95 *BCa CI* [0.001; 0.03], and inconsistent parenting behaviour, $b = .08$, 95 *BCa CI* [0.01; 0.14], as independent variables predicting inattention. Thus, 15.2% of the variance could be explained by the model including poor supervision (corrected $R^2 = .12$) and 16.7% (corrected $R^2 = .14$) by the model with inconsistent parenting behaviour.

The significance regions for the simple slope coefficient were determined using the online tool by Preacher, Curran and Bauer (2006). The simple slopes as a function of the different levels of the moderator were shown in Figure 4 with the help of the tool mentioned above. The regions of significance showed significant differences of the correlation between sleep problems and inattention depending on the simple slope of daily media use for values up to

-4.53 and from 2.77 onwards. Accordingly, a significant influence on the connection between sleep problems and inattention by means of a positive association can be assumed from a daily media use duration of 2.77 hours. The media use value of -4.53 will not be considered any further, as negative media use durations cannot be meaningfully taken into account.

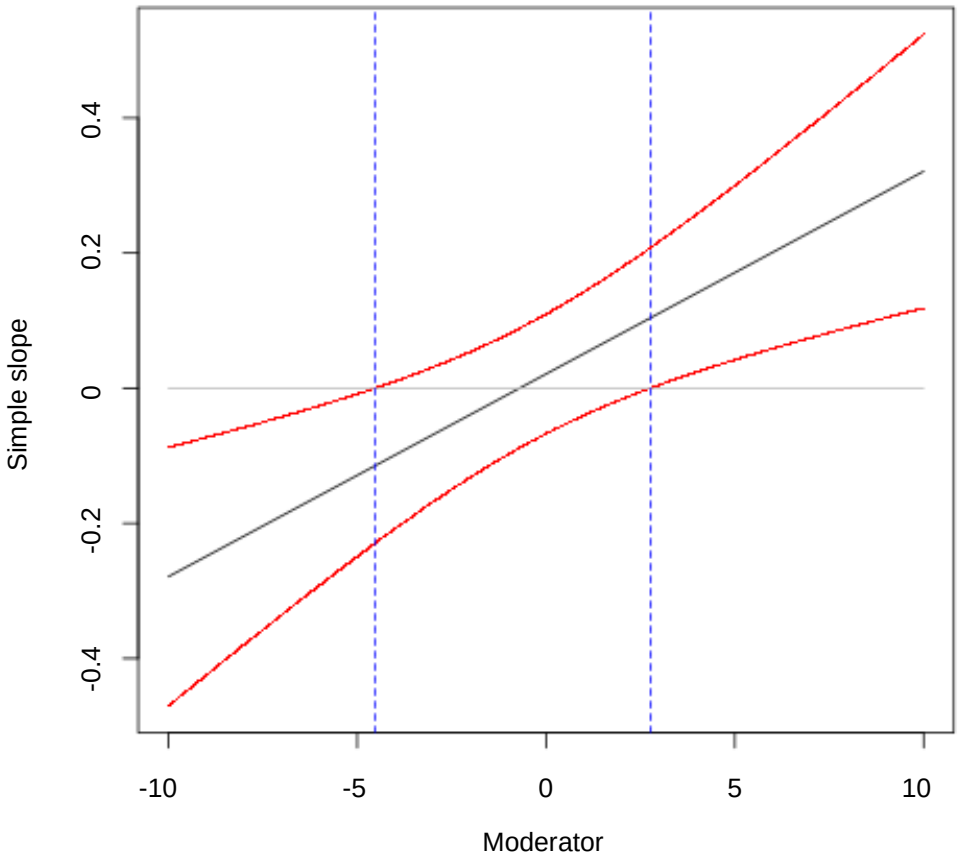

Figure 4. Region of significance of daily media use as a moderator.
Note. The red lines represent the confidence bands. Outside the two dashed lines, the coefficient is significantly different from zero.

Subsequently, the simple slopes for selected values of the moderator were plotted using the aforementioned online tool. Low, medium and high values were used in the form of one standard deviation below the mean, the mean and one standard deviation above the mean of the daily media use. Different slopes arise for different values of the moderator. These simple slopes are outlined below in Figure 5. For low (z = -13.67) and medium (z = -.94) moderator values of daily media use and medium levels of sleep problems, the slopes trend slightly to moderately negative, so that inattention seems to decrease. In contrast, for large moderator values of daily media use (z = 11.79) and medium levels of sleep problems, the slope is moderately increasing, so that inattention appears to be increasing.

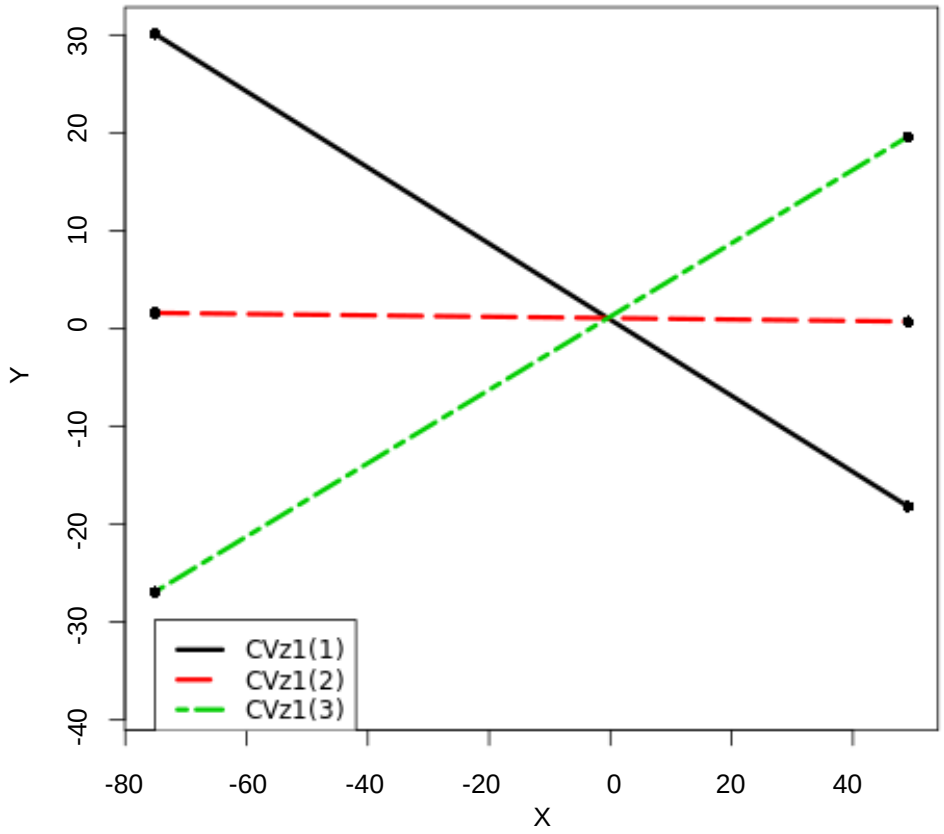

Figure 5. Simple slopes of daily media use as a moderator.
Note. X represents sleep problems, whereas Y depicts inattention.The black line depicts the slope of the mean minus one standard deviation, the red line represents the slope of the mean and the green line depicts the slope of the mean plus one standard deviation.

In addition to that, a bootstrap analysis of moderated regressions was conducted to evaluate hypothesis 2.2. Here, bedtime media use was used as the moderator variable. The other independent and dependent variables were used as in the previous hypothesis. There were significant regressions for the calculated models with the total ADHD symptomatology, F (3, 123) = 9.39, $p < .001$, hyperactivity/impulsivity, F (3, 123) = 8.57, $p < .001$, and inattention, F (3, 123) = 4.34, $p = .006$, but bedtime media use as moderator was no statistically significant predictor. Repeatedly, the total score of sleep problems proved to be a significant predictor in the models with the dependent variables total ADHD symptomatology, $b = .04$, 95 *BCa CI* [0.02; 0.05], hyperactivity/impulsivity, $b = .04$, 95 *BCa CI* [0.02; 0.06], and inattention, $b = .03$, 95 *BCa CI* [0.01; 0.05], clearing 9.6% (corrected $R^2 = .07$) to 18.6% (corrected $R^2 = .17$) of the variance.

5 Discussion

In the following part of this paper, the results will be summarised and discussed. Furthermore, the strengths and limitations of this study will be highlighted in order to derive implications for future research. Finally, a conclusion will be drawn.

5.1 Summary and interpretation of the results

In this study hypothesis 1 should investigate the associations between several sleep problems, media use durations and ADHD symptoms, whereby a positive direction of effect was assumed. The hypothesis was pathwise statistically strengthened with regard to the positive correlations between several sleep problems and ADHD symptoms as well as between various sleep problems and bedtime media use. These results are congruent with many studies supporting the conjunction of sleep problems and bedtime media use and sleep problems and ADHD (e.g. Abi-Jaoude et al., 2020; Craig et al., 2017; Grünwald & Schlarb, 2017; Wajszilber, 2018; Wong et al., 2020). The fact that bedtime media use leads to delayed sleep latencies, increased cognitive arousal and a shifted circadian rhythm provides a possible explanation of the significant results (Abi-Jaude et al., 2020; Cain & Gradisar, 2010; Scott et al., 2018). One further explanation could be that sleep problems are significantly associated with bedtime media use due to disturbances caused by electromagnetic radiation. The aforementioned hypothesis-congruent connections could possibly occur due to the chain of effects leading from chronic sleep deprivation to sleep pressure causing ADHD symptoms (Stein, 2012). In addition, ADHD medications in the form of stimulants, regularly taken by 8.8% of the children reported in this study, can possibly lead to sleep problems as side effects which would reinforce the exposed correlations.

But low positive, non-significant correlations between daily media use and sleep problems as well as low negative non-significant associations between daily and bedtime media use with ADHD symptoms contradict the assumed associations of hypothesis 1. The result differs from the state of research due to several divergent studies (e.g. Abi-Jaoude et al., 2020; Genuneit et al., 2018; Limtrakul et al., 2018; Rydell & Brocki, 2021; Schmid, 2018). But there are a few studies highlighting only slight or no correlations between media use and ADHD symptoms and thus support the results of this study (Fuller et al., 2017; van der Heijden et al., 2018). Beyond the random, unsystematic degree to which these contradictory findings may have arisen, there are some possible alternative explanations. A speculated idea for the low associations between sleep problems and daily media use could be that children are able to cope media use during the day for example through physical activity and thus do not experience sleep problems. Another possible assumption could be that homeschooling due to the pandemic have led to a habituation to the overuse of media, so that the influence on sleep may no longer be as

strong after more than a year of pandemic-related restrictions (e.g. Montag & Elhai, 2020; Thorell et al., 2020). The weak associations between media use and ADHD symptoms could be explained due to the assumption that children could possibly counterbalance ADHD symptoms through higher media use durations as it is recognised for calming effects (e.g. Hale et al., 2018, Peralta et al., 2018).

Hypothesis 2.1 should focus particularly on daily media use as a moderating variable in the relationship between sleep problems and ADHD symptoms. The hypothesis received pathwise statistical support from the results. The sleep problems' total score was always a significant predictor in the calculated bootstrap sampled regressions, but the daily media use as moderator did only show significance for inattention as dependent variable, but not for hyperactivity/impulsivity or the total ADHD symptomatology. The mentioned significant prediction revealed that high daily media use affected the association between sleep problems and inattention in a positive, increasing direction, resulting in higher levels of inattention. Moreover, low daily media use changed the association in a negative inattention-reducing direction, both with moderate levels of sleep problems. This result is in line with the current state of research supporting influences of daily media use on sleep behaviour and ADHD symptoms (e.g. Abi-Jaoude et al., 2020; Cain & Gradisar, 2010; Genuneit et al., 2018; Limtrakul et al., 2018; Wong et al., 2020). Nevertheless, there are also studies that contradict the observed results by claiming that bedtime media use has a greater influence on sleep behaviour than daily media use (e.g. Garrison et al., 2011; Thoma et al., 2018).

Based on the reported tired and absent moods of the children after media use, it can be assumed that the significant effects on inattention compared to hyperactivity and impulsivity might occur due to a possible inability to perceive or process stimuli as a result of the effects of media use. In addition, it could be speculated that cognitive capacities for attention are depleted by media use, as it mainly requires attention rather than physical activity, which could possibly explain why only the influence on inattention was significant. The non-significance for the regression model with the total ADHD symptomatology as dependent variable can presumably be explained, since the subscale inattention only makes up one part in the score of the total ADHD symptomatology. Furthermore, the other symptom scale did not show to be significantly influenced as well, which supports the assumption that the total ADHD symptomatology score composed of them was probably not significantly influenced because of this. Further reasons to explain the results are not provided by the current state of research, as mainly the bedtime media use is focused on and the daily media use is rather neglected.

By means of exploring hypothesis 2.2, in contrast to 2.1, bedtime media use as a moderator was investigated. The results are inconsistent with those of several studies highlighting

the significant influence of bedtime media use on sleep and ADHD symptoms (e.g. Guram et al., 2018; Reid et al., 2016; Tong et al., 2018). With regard to the interpretation of the hypothesis-incongruent result, it should first be considered that the reported average bedtime media use was only 0.3 hours and thus markedly lower than assumed on the basis of literature. It is possible that bedtime media use in the sample of this study was too low to have a significant impact on the associations between sleep problems and ADHD symptoms. Another explanation for the incongruent result can be derived from the aspect of calming effects of media use on children. Parents in this study reported that 50.4% of children listen to audio plays before going to sleep and 52.0% are read to. In addition, 27.6% reported calming effects as reasons for media use. It might be that listening to music and having stories read to the children at bedtime can promote sleep and have calming effects. Continuing from this point, the results could be explained by the assumption that children use media around bedtime especially TV and audio plays via tablets or mobile phones as an aid for falling asleep (e.g. Cain et al., 2010; Hale et al., 2018; Hepp & Roeser, 2014). Furthermore, children with ADHD could possibly counterbalance their symptoms through the calming effects of media use. Accordingly, it is quite conceivable that there are types of bedtime media used as sleep rituals, which support sleep hygiene in a positive way.

According to the results of hypothesis 2.1 and 2.2, daily media use compared to bedtime media use appears to have a significant influence on the relationship between sleep problems and ADHD symptoms. This result is consistent with the study by Beyens and colleagues (2018) but contrary to several other studies (e.g. Abi-Jaoude et al., 2020; Cater et al., 2016; Guram et al., 2018; LeBourgeois et al., 2017; Tong et al., 2018). From a methodological point of view, it could be speculated that, as mentioned before, the reported bedtime media use in this study was too small to distinguish systematic effects from random effects.

5.2 Limitations and strengths of the study

In the following, certain limitations are described that should definitely be considered when interpreting the results.

Overall, it must be noted that due to the cross-sectional design, no statements about causal inferences are possible (Eid, Gollwitzer & Schmidt, 2018, p. 84, 630). Accordingly, only trends for effect directions can be assumed here. Additionally, ADHD symptoms and sleep problems are difficult to classify as independent and dependent variables for the statistical methods here for example because of a missing temporal precedence (Eid, Gollwitzer &

Schmidt, 2018, p. 84). The study design also implies that intraindividual changes and differential developmental trajectories cannot be captured due to the one measurement point and likewise no interindividual differences in change are measurable (Lohaus, 2018).

An important aspect to consider relates to the high perceived dropout rate of the study. The overall dropout rate was 56.2%. Based on the literature, this can be classified as average, since questionnaire surveys usually result in dropout rates between 40% and 60% (e.g. Gräf, 2010; Joinson & Reips, 2007; Möhring & Schlütz, 2013).

In addition, distortions and biases due to the questionnaire methodology cannot be excluded, as only parent-report questionnaires were used whose results may have been influenced by social desirability and stigmatisation leading to self-deception and other-deception (Schmidt-Atzert & Amelang, 2012, p. 90). It would be useful to include objective procedures in addition to the subjective assessment in the future.

Another limitation is the Covid 19 pandemic, during which the survey took place and was a stressful time for many people. During this time the risk for psychopathology in children and adolescents increased (Via et al., 2020) and, due to the elimination of structures, the development of sleep disorders increased (Lecuelle et al., 2020). Beyond that, homeschooling was not explicitly recorded separately from daily media use, so it is conceivable that there might have been discrepancies in the indication of media usage times. A clearer separation of daily media use with and without homeschooling would possibly show larger effect sizes.

Critically, bedtime media use may not have been defined clearly enough in the questions for some parents, so that distortions may have occurred as a result. Furthermore, nighttime media use was not assessed but is assumed to have an important impact on the triad investigated here (Becker & Lienesch, 2018; Guram & Heinz, 2018; Scott & Woods, 2018). In order to better investigate the effects of bedtime and nighttime media use and to identify sleep-promoting and sleep-preventing media use, it might be useful to distinguish the type of media use (e.g. internet in contrast to audio play) and to analyse it separately.

Continuing the intelligence quotient was not controlled which is why confoundings or distortions of ADHD symptoms and giftedness cannot be ruled out. It is highly relevant to include this parameter, because highly gifted children sometimes have similar symptoms to children with ADHD, so that the ADHD symptoms could also represent over- or under-challenging of highly gifted children (e.g. Mullet & Rinn, 2015; Rinn & Reynolds, 2012). But, highly gifted children are able to hide their problems, which can lead to lower correlations even in the case of a confounding of ADHD symptoms and giftedness. It must be taken into account that a low intelligence quotient is a risk factor for increased media use (Grund & Schulz, 2017), which is

why the control of the children's intelligence would also have been relevant from this perspective and cannot be eliminated here as a favouring factor of bias.

Apart from the limitations named previously, there are several strengths of this study. First, for obtaining acceptability and feasibility (e.g. Blanz, 2021, p. 14; Langfeldt & Goltz, 2017) a preliminary study was conducted before the actual main survey started, which is to be seen as a methodological quality criterion. The questionnaire packages were constructed according to the latest research standards, so recent recommendations from research conferences such as the IPSA were included, for example, with regard to the answer categories of the added media use questions. With the exception of the CSHQ-DE, whose psychometric properties are partly discussed critically as not being the most valid (Markovich et al., 2014). Nevertheless, this questionnaire was used in this study because it is widely used in practice and since it is the only parent-report questionnaire on sleep behaviour of which a German version is available.

Furthermore, it was ensured that the participants had the opportunity to ask questions via e-mail, meaning that it was possible to solve comprehension problems despite the digital format. Especially the subsequent treatment options in the form of sleep training and links to adequate help centres of the corresponding sleep labs represent a strength of the study and an appropriate motivator for participation in the study.

Another point that strengthens the study is that the research question addresses a research gap and helps to fill it and provide new, relevant information for scientific and clinical practice. In this process, numerous potentially influential control variables such as comorbidities, parental psychopathologies and parenting behaviour were included. A suitable sample size was achieved, which is consistent with the a priori calculated size. Moreover, this research was carried out in a time-efficient, cost-saving and economical form (Lohaus, 2018).

Despite limitations, the statistical procedures could be carried out as planned with the help of bootstrap sampling. Some of the results showed hypothesis conformity and were therefore consistent with the state of research. Other results initiated new considerations and showed a need for further research. On the basis of the collected data, investigations of further questions are also possible, which will be discussed in more detail in chapter 5.3.

5.3 Implications for future research

The above-mentioned limitations lead to a number of implications for future research approaches.

First, the children's self-report and objective parameters such as polysomnography or actigraphy for sleep parameters and electroencephalography for media use should be urgently added in order to be able to assess the constructs correctly and in greater detail. A combination

of both, parent- and child-report, seems to be useful, since, on the one hand, parent-reports collect data on for example children's behaviour during sleep, which cannot be stated, perceived or remembered by the children themselves (Fricke-Oerkermann et al., 2007; Meltzer et al., 2013). On the other hand, children are better able than their parents to assess areas such as problems falling asleep or internal processes, which include anxiety and thinking at night, in addition to nighttime awakenings or bedtime media use (Chase & Pincus, 2011). It is conceivable that the same applies to bedtime media use, for example when the children sleep alone in a room (e.g. Orben & Przybylski, 2019; Robinson et al., 2006). But before using child-report questionnaires, the implications resulting from the preliminary study should be considered and the questionnaires modified accordingly to be used as adequate measurement instruments in a larger survey.

Second, gender differences could also be investigated, because it is assumed that ADHD occurs more often in boys (e.g. Bachmann et al., 2017; Skogli et al., 2013). Furthermore, the prefered media sources seem to diverge by gender, as mobile phone use and listening to music seem to be more common among girls, while boys appear to use the computer, played video games and screen media more often (Lange et al., 2017). It could be investigated whether gender-specific strengths of influence in the triad of sleep, media use and ADHD exist, which would be particularly relevant for recommendations and interventions in clinical practice.

Third, on the basis of the collected data, investigations of further research questions are also possible, for example gender-specific or on a categorical, disorder-classified level by using cut-offs in order to be able to apply the disorder focus and not only refer to trait characteristics. However, in order to examine the individual correlations of hyperactivity and impulsivity in the triad investigated in this study, these two cardinal symptoms of ADHD should be examined separately. In addition, a qualitative evaluation could be carried out on the basis of the answers from the text fields or the media use duration of individual media sources in association with sleep problems and ADHD symptoms could be elucidated.

Finally, including the motives for media use and more specific scales could be a future study's focus. In order to investigate the possible functions of evening media use as sleep-aid and nighttime media use as re-sleep-aid, a distinction should be made between daily, bedtime and nighttime media use. Through such a specification, comparisons between the daily media use duration, the bedtime media use duration and the nighttime media use duration could also be aimed at. Future studies should investigate media use as a kind of treatment in order to be able to make more substantiated statements about a potentially sleep-preventing or sleep-promoting effect. For this purpose, the above-mentioned objective measurements could be carried out taking pre and postmeasurements focussing the effects of the media use. Future studies need

to clearly define to which category media use at a certain time of day belongs, for example "bedtime media use from 6 p.m. onwards" or "nighttime media use from 9 p.m. onwards". Equally, recording the availability of media sources in the child's bedroom could be an important aid in approximating a realistic assessment of children's actual bedtime and nighttime media use. These further investigations would be important in terms of possible interventions through reducing screen time to mitigate sleep problems and ADHD symptoms (e.g. Lissak, 2018) but also with regard to the often negatively connoted effect of media, which could thus also be highlighted as conducive to sleep.

5.4 Conclusion

From the study, it can be concluded that important relationships exist between sleep problems and ADHD symptoms, especially between sleep problems and inattention, which tend to be influenced by daily media use. Additional research is needed to investigate the influences in more detail. Future studies should test causal effects longitudinally and differentiate categorically between disorder-specific sleep problems and ADHD symptoms and, with regard to media use, between daily, bedtime and nighttime use. Since sleep-promoting effects of bedtime media use have been shown in this study, future studies should differentiate between sleep-promoting and clinically relevant, sleep-disrupting media use and include the effect of media as a sleep supportive tool. Based on that, enormous optimisations of clinical interventions would be possible, which could reduce the children's suffering as well as improve their functionality and quality of life.

References

Abi-Jaoude, E., Naylor, K. T., & Pignatiello, A. (2020). Smartphones, social media use and youth mental health. *CMAJ : Canadian Medical Association Journal = Journal De L'association Medicale Canadienne*, *192*(6), E136-E141.

American Psychiatric Association. (2013). Disorders of neuronal and mental development. In: Diagnostic and statistical manual of mental disorders (5th ed.).

Auhuber, L., Vogel, M., Grafe, N., Kiess, W., & Poulain, T. (2019). Leisure Activities of Healthy Children and Adolescents. *International Journal of Environmental Research and Public Health*, *16*(12).

Bachmann, C. J., Philipsen, A., & Hoffmann, F. (2017). Adhd in Germany: Trends in Diagnosis and Pharmacotherapy. *Deutsches Arzteblatt International*, *114*(9), 141–148.

Bagley, E. J., Kelly, R. J., Buckhalt, J. A., & El-Sheikh, M. (2015). What keeps low-SES children from sleeping well: The role of presleep worries and sleep environment. *Sleep Medicine*, *16*(4), 496–502.

Barth, G. M., & Renner, T. J. (2015). ADHS und Mediensucht bei Kindern und Jugendlichen. *SUCHT*, *61*(5), 293–301.

Batra, A., & Fallgatter, A. J. (2015). ADHS und Sucht, *61*(5), 275–277.

Bauermeister, J. J., Shrout, P. E., Chávez, L., Rubio-Stipec, M., Ramírez, R., Padilla, L., Anderson, A., García, P., & Canino, G. (2007). Adhd and gender: Are risks and sequela of ADHD the same for boys and girls? *Journal of Child Psychology and Psychiatry, and Allied Disciplines*, *48*(8), 831–839.

Becker, S. P., & Lienesch, J. A. (2018). Nighttime media use in adolescents with ADHD: Links to sleep problems and internalizing symptoms. *Sleep Medicine*, *51*, 171–178.

Beyens, I., Valkenburg, P. M., & Piotrowski, J. T. (2018). Screen media use and ADHD-related behaviors: Four decades of research. *Proceedings of the National Academy of Sciences of the United States of America*, *115*(40), 9875–9881.

Biederman, J., Petty, C. R., Evans, M., Small, J., & Faraone, S. V. (2010). How persistent is ADHD? A controlled 10-year follow-up study of boys with ADHD. *Psychiatry Research*, *177*(3), 299–304.

Biggs, S. N., Lushington, K., James Martin, A., van den Heuvel, C., & Declan Kennedy, J. (2013). Gender, socioeconomic, and ethnic differences in sleep patterns in school-aged children. *Sleep Medicine*, *14*(12), 1304–1309.

Billari, F. C., Giuntella, O., & Stella, L. (2018). Broadband internet, digital temptations, and sleep. *Journal of Economic Behavior & Organization*, *153*, 58–76.

Blanz, M. (2021). Forschungsmethoden und Statistik für die Soziale Arbeit: Grundlagen und Anwendungen. Kohlhammer Verlag.

Blunden, S., Lushington, K., Lorenzen, B., Martin, J., & Kennedy, D. (2005). Neuropsychological and psychosocial function in children with a history of snoring or behavioral sleep problems. *The Journal of Pediatrics*, *146*(6), 780–786.

Boer, M., Stevens, G., Finkenauer, C., & van den Eijnden, R. (2020). Attention Deficit Hyperactivity Disorder-Symptoms, Social Media Use Intensity, and Social Media Use Problems in Adolescents: Investigating Directionality. *Child Development*, *91*(4), e853-e865.

Byars, K. C., Yeomans-Maldonado, G., & Noll, J. G. (2011). Parental functioning and pediatric sleep disturbance: An examination of factors associated with parenting stress in children clinically referred for evaluation of insomnia. *Sleep Medicine*, *12*(9), 898–905.

BZgA - Bundes Zentrale für gesundheitliche Aufklärung (2019). Empfehlungen zur Höchstdauer der Mediennutzung: Stand Mai 2019. www.kindergesundheit-info.de

Cain, N., & Gradisar, M. (2010). Electronic media use and sleep in school-aged children and adolescents: A review. *Sleep Medicine*, *11*(8), 735–742.

Carter, B., Rees, P., Hale, L., Bhattacharjee, D., & Paradkar, M. S. (2016). Association Between Portable Screen-Based Media Device Access or Use and Sleep Outcomes: A Systematic Review and Meta-analysis. *JAMA Pediatrics*, *170*(12), 1202–1208.

Chase, R. M., & Pincus, D. B. (2011). Sleep-related problems in children and adolescents with anxiety disorders. *Behavioral Sleep Medicine*, *9*(4), 224–236.

Cheung, C. H. M., Rijdijk, F., McLoughlin, G., Faraone, S. V., Asherson, P., & Kuntsi, J. (2015). Childhood predictors of adolescent and young adult outcome in ADHD. *Journal of Psychiatric Research*, *62*, 92–100.

Chin, W.-C., Huang, Y.-S., Chou, Y.-H., Wang, C.-H., Chen, K.-T., Hsu, J. F., & Hsu, S.-C. (2018). Subjective and objective assessments of sleep problems in children with attention deficit/hyperactivity disorder and the effects of methylphenidate treatment. *Biomedical Journal*, *41*(6), 356–363.

Craig, S. G., Weiss, M. D., Hudec, K. L., & Gibbins, C. (2017). The Functional Impact of Sleep Disorders in Children With ADHD. *Journal of Attention Disorders*, *24*(4), 499–508.

Dewald, J. F., Meijer, A. M., Oort, F. J., Kerkhof, G. A., & Bögels, S. M. (2010). The influence of sleep quality, sleep duration and sleepiness on school performance in children and adolescents: A meta-analytic review. *Sleep Medicine Reviews*, *14*(3), 179–189.

Döpfner, M., & Görtz-Dorten, A. (2017). Diagnostik-System für psychische Störungen nach ICD-10 und DSM-5 für Kinder-und Jugendliche (DISYPS-III). *Göttingen: Hogrefe*.

Döpfner, M., & Görtz-Dorten, A. (2017). *DISYPS-III Manual: Diagnostik-System für psychische Störungen nach ICD-10 und DSM-5 für Kinder und Jugendliche - III*. Hogrefe.

Döpfner, M., Hautmann, C., Görtz-Dorten, A., Klasen, F., & Ravens-Sieberer, U. (2015). Long-term course of ADHD symptoms from childhood to early adulthood in a community sample. *European Child & Adolescent Psychiatry*, *24*(6), 665–673.

Eid, M., Gollwitzer, M., & Schmitt, M. (2017). Statistik und Forschungsmethoden.

Elgar, F. J., Waschbusch, D. A., Dadds, M. R., & Sigvaldason, N. (2007). Development and Validation of a Short Form of the Alabama Parenting Questionnaire. *Journal of Child and Family Studies*, *16*(2), 243–259.

Emond, J. A., Tantum, L. K., Gilbert-Diamond, D., Kim, S. J., Lansigan, R. K., & Neelon, S. B. (2018). Household chaos and screen media use among preschool-aged children: A cross-sectional study. *BMC Public Health*, 1210.

Engelhardt, C. R., Mazurek, M. O., & Sohl, K. (2013). Media use and sleep among boys with autism spectrum disorder, ADHD, or typical development. *Pediatrics*, *132*(6), 1081–1089.

Eschenbeck, H., Kohlmann, C.-W., & Lohaus, A. (2007). Gender Differences in Coping Strategies in Children and Adolescents. *Journal of Individual Differences*, *28*(1), 18–26.

Essau, C. A., Sasagawa, S., & Frick, P. J. (2006). Psychometric Properties of the Alabama Parenting Questionnaire. *Journal of Child and Family Studies*, *15*(5), 595–614.

Faul, F., Erdfelder, E., Lang, A.-G. & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. Behavior Research Methods, 39, 175-191. G*POWER 3.1.9.2 (Shareware). accessed on: 21.06.2021 available at: http://gpower.hhu.de/

Feierabend, S., Plankenhorn, T., & Rathgeb, T. (2017). Kindheit, Internet, Medien. Basisstudie zum Medienumgang 6- bis 13-Jähriger in Deutschland. KIM-Studie 2016. *Medienpädagogischer Forschungsverbund Südwest.*

Felt, B., Biermann, B., Christner, J. G., Kochhar, P., & van Harrison, R. (2014). Diagnosis and Management of ADHD In Children. *American Family Physician*, *90*(7), 456–464.

Fricke-Oerkermann, L., & Lehmkuhl, G. (2007). Nichtorganische Schlafstörungen im Kindesalter. *Monatsschrift Kinderheilkunde*, *155*(7), 616–623.

Frölich, J., Lehmkuhl, G., & Wiater, A. (2003). Schlafstörungen bei hyperkinetischen Kindern--Zusammenhänge zu Arousalstörungen, differential diagnostische Abgrenzungen und Komorbiditäten [Sleep disorders in hyperkinetic children--correlation with arousal disorders, differential diagnosis and comorbidity]. *Zeitschrift fur Kinder- und Jugendpsychiatrie und Psychotherapie, 31*(2), 133–143.

Fuller, C., Lehman, E., Hicks, S., & Novick, M. B. (2017). Bedtime Use of Technology and Associated Sleep Problems in Children. *Global Pediatric Health, 4*, 2333794X17736972.

Garrison, M. M., Liekweg, K., & Christakis, D. A. (2011). Media use and child sleep: The impact of content, timing, and environment. *Pediatrics, 128*(1), 29–35.

Gau, S. S. F., Kessler, R. C., Tseng, W.-L., Wu, Y.-Y., Chiu, Y.-N., Yeh, C.-B., & Hwu, H.-G. (2007). Association between sleep problems and symptoms of attention-deficit/hyperactivity disorder in young adults. *Sleep, 30*(2), 195–201.

Genuneit, J., Brockmann, P. E., Schlarb, A. A., & Rothenbacher, D. (2018). Media consumption and sleep quality in early childhood: Results from the Ulm SPATZ Health Study. *Sleep Medicine*, 7–10.

Gottschalk, C., Scheuermann, P., & Wiater, A. (2011). Schlafstörungen im Kindesalter [Sleep disorders during infancy and childhood]. *Bundesgesundheitsblatt, Gesundheitsforschung, Gesundheitsschutz, 54*(12), 1303–1310.

Gräf, L. (2010). Online-Befragung: Eine praktische Einführung für Anfänger. Sozialwissenschaftliche Methoden: Vol. 3. Berlin: Lit-Verl.

Grund, J., & Schulz, W. (2017). Der Einfluss von frühkindlichem Medienkonsum auf die Mediennutzung und psychische Auffälligkeiten im Jugendalter [The Influence of Media Consumption During Early Childhood on Media Use and Psychological Disorders in Adolescence]. *Praxis der Kinderpsychologie und Kinderpsychiatrie, 66*(8), 558–575.

Grünwald, J., & Schlarb, A. A. (2017). Relationship between subtypes and symptoms of ADHD, insomnia, and nightmares in connection with quality of life in children. *Neuropsychiatric Disease and Treatment, 13*, 2341–2350.

Guram, S., & Heinz, P. (2018). Media use in children: American Academy of Pediatrics recommendations 2016. *Archives of Disease in Childhood. Education and Practice Edition, 103*(2), 99–101.

Hale, L., Kirschen, G. W., LeBourgeois, M. K., Gradisar, M., Garrison, M. M., Montgomery-Downs, H., Kirschen, H., McHale, S. M., Chang, A.-M., & Buxton, O. M. (2018). Youth Screen Media Habits and Sleep: Sleep-Friendly Screen Behavior Recommendations for Clinicians, Educators, and Parents. *Child and Adolescent Psychiatric Clinics of North America*, *27*(2), 229–245.

Hepp, A., & Röser, J. (2014). Beharrung in Mediatisierungsprozessen: Das mediatisierte Zuhause und die mediatisierte Vergemeinschaftung. In F. Krotz, C. Despotović, & M.-M. Kruse (Eds.), *Die Mediatisierung sozialer Welten* (Vol. 23, pp. 165–187). Springer Fachmedien Wiesbaden.

Hesterberg, T. C. (2015). What Teachers Should Know About the Bootstrap: Resampling in the Undergraduate Statistics Curriculum. *The American Statistician*, *69*(4), 371–386.

Horne, R. S. C., Ong, C., Weichard, A., Nixon, G. M., & Davey, M. J. (2020). Are there gender differences in the severity and consequences of sleep disordered in children? *Sleep Medicine*, *67*, 147–155.

Hvolby, A. (2015). Associations of sleep disturbance with ADHD: Implications for treatment. *Attention Deficit and Hyperactivity Disorders*, *7*(1), 1–18.

Hvolby, A., Jørgensen, J., & Bilenberg, N. (2009). Parental rating of sleep in children with attention deficit/hyperactivity disorder. *European Child & Adolescent Psychiatry*, *18*(7), 429–438.

IBM Corp. Released (2011). IBM SPSS Statistics for Windows (Version 20.0) [Computer Software]. Armonk, NY: IBM Corp.

Janssen, J., & Laatz, W. (2017). Statistische Datenanalyse mit SPSS. Berlin, Heidelberg: Springer Berlin Heidelberg.

Joinson, A. N., & Reips, U.-D. (2007). Personalized salutation, power of sender and response rates to Web-based surveys. Computers in Human Behavior, 23(3), 1372–1383.

Jonkisz E., Moosbrugger H., Brandt H. (2012) Planung und Entwicklung von Tests und Fragebogen. In Moosbrugger H., Kelava A. (eds) Testtheorie und Fragebogenkonstruktion. Springer-Lehrbuch. Springer, Berlin, Heidelberg.

Kieling, R., & Rohde, L. A. (2012). Adhd in children and adults: Diagnosis and prognosis. *Current Topics in Behavioral Neurosciences*, *9*, 1–16.

Kirov, R., & Brand, S. (2014). Sleep problems and their effect in ADHD. *Expert Review of Neurotherapeutics*, *14*(3), 287–299.

Knopf, H., Hölling, H., Huss, M., & Schlack, R. (2012). Prevalence, determinants and spectrum of attention-deficit hyperactivity disorder (ADHD) medication of children and adolescents in Germany: Results of the German Health Interview and Examination Survey (KiGGS). *BMJ Open*, *2*(6).

König, S. (2012). *Online-Forschung mit Kindern*. Budrich UniPress.

Konofal, E., Lecendreux, M., & Cortese, S. (2010). Sleep and ADHD. *Sleep Medicine*, *11*(7), 652–658.

Krishnan, V., & Collop, N. A. (2006). Gender differences in sleep disorders. *Current Opinion in Pulmonary Medicine*, *12*(6), 383–389.

Lampert, T., & Kroll, L. E. (2006). Messung des sozioökonomischen Status in sozialepidemiologischen Studien. In M. Richter & K. Hurrelmann (Eds.), *Gesundheitliche Ungleichheit* (Vol. 59, pp. 297–319). VS Verlag für Sozialwissenschaften.

Lange, K., Cohrs, S., Skarupke, C., Görke, M., Szagun, B., & Schlack, R. (2017). Electronic media use and insomnia complaints in German adolescents: Gender differences in use patterns and sleep problems. *Journal of Neural Transmission (Vienna, Austria : 1996)*, *124*(Suppl 1), 79–87.

Langfeldt, B., & Goltz, E. (2017). Die Funktion qualitativer Vorstudien bei der Entwicklung standardisierter Erhebungsinstrumente. KZfSS Kölner Zeitschrift für Soziologie und Sozialpsychologie, 69(2), 313-335

Lawson, G. M., Nissley-Tsiopinis, J., Nahmias, A., McConaughy, S. H., & Eiraldi, R. (2017). Do Parent and Teacher Report of ADHD Symptoms in Children Differ by SES and Racial Status? *Journal of Psychopathology and Behavioral Assessment*, *39*(3), 426–440.

LeBourgeois, M. K., Hale, L., Chang, A.-M., Akacem, L. D., Montgomery-Downs, H. E., & Buxton, O. M. (2017). Digital Media and Sleep in Childhood and Adolescence. *Pediatrics*, *140*(Suppl 2), S92-S96.

Lecuelle, F., Leslie, W., Huguelet, S., Franco, P., & Putois, B. (2020). Did the COVID-19 lockdown really have no impact on young children's sleep? *Journal of Clinical Sleep Medicine : JCSM : Official Publication of the American Academy of Sleep Medicine*, *16*(12), 2121.

Lehmkuhl, G., Fricke-Oerkermann, L., Wiater, A., & Mitschke, A. (2008). Sleep disorders in children beginning school: Their causes and effects. *Deutsches Arzteblatt International*, *105*(47), 809–814.

Lehti, V., Chudal, R., Suominen, A., Gissler, M., & Sourander, A. (2016). Association between immigrant background and ADHD: A nationwide population-based case-control study. *Journal of Child Psychology and Psychiatry, and Allied Disciplines*, *57*(8), 967–975.

Levine, L. E., Waite, B. M., & Bowman, L. L. (2012). Mobile Media Use, Multitasking and Distractibility. *International Journal of Cyber Behavior, Psychology and Learning*, *2*(3), 15–29.

Limtrakul, N., Louthrenoo, O., Narkpongphun, A., Boonchooduang, N., & Chonchaiya, W. (2018). Media use and psychosocial adjustment in children and adolescents. *Journal of Paediatrics and Child Health*, *54*(3), 296–301.

Lissak, G. (2018). Adverse physiological and psychological effects of screen time on children and adolescents: Literature review and case study. *Environmental Research*, *164*, 149–157.

Lohaus, A. (Ed.). (2018). *Springer-Lehrbuch. Entwicklungspsychologie des Jugendalters*. Springer Berlin Heidelberg.

Lycett, K., Mensah, F. K., Hiscock, H., & Sciberras, E. (2014). A prospective study of sleep problems in children with ADHD. *Sleep Medicine*, *15*(11), 1354–1361.

Markovich, A. N., Gendron, M. A., & Corkum, P. V. (2014). Validating the Children's Sleep Habits Questionnaire Against Polysomnography and Actigraphy in School-Aged Children. *Frontiers in Psychiatry*, *5*, 188.

Meltzer, L. J., Avis, K. T., Biggs, S., Reynolds, A. C., Crabtree, V. M., & Bevans, K. B. (2013). The Children's Report of Sleep Patterns (CRSP): A self-report measure of sleep for school-aged children. *Journal of Clinical Sleep Medicine : JCSM : Official Publication of the American Academy of Sleep Medicine*, *9*(3), 235–245.

Microsoft Corporation. (2018). Microsoft Excel (Version 2013) [Computer Software]. Redmond, USA: Microsoft Corporation

Microsoft Corporation. (2018). Microsoft Windows (Version 10) [Computer Software]. Redmond, USA: Microsoft Corporation

Microsoft Corporation. (2018). Microsoft Word (Version 2013) [Computer Software]. Redmond, USA: Microsoft Corporation

Möhring, W., & Schlütz, D. (2013). Handbuch standardisierte Erhebungsverfahren in der Kommunikationswissenschaft. Wiesbaden: Springer Fachmedien Wiesbaden.

Montag, C., & Elhai, J. D. (2020). Discussing digital technology overuse in children and adolescents during the COVID-19 pandemic and beyond: On the importance of considering Affective Neuroscience Theory. *Addictive Behaviors Reports*, *12*, 100313.

Mullet, D. R., & Rinn, A. N. (2015). Giftedness and ADHD: Identification, Misdiagnosis, and Dual Diagnosis. *Roeper Review*, *37*(4), 195–207.

Nikkelen, S. W. C., Valkenburg, P. M., Huizinga, M., & Bushman, B. J. (2014). Media use and ADHD-related behaviors in children and adolescents: A meta-analysis. *Developmental Psychology*, *50*(9), 2228–2241.

Orben, A., & Przybylski, A. K. (2019). The association between adolescent well-being and digital technology use. *Nature Human Behaviour*, *3*(2), 173–182.

Owens, J. (2008). Classification and epidemiology of childhood sleep disorders. *Primary Care*, *35*(3), 533-46, vii.

Owens, J. A., Spirito, A., & McGuinn, M. (2000). The Children's Sleep Habits Questionnaire (CSHQ): Psychometric Properties of A Survey Instrument for School-Aged Children. *Sleep*. Advance online publication.

Patel, N. P., Grandner, M. A., Xie, D., Branas, C. C., & Gooneratne, N. (2010). "Sleep disparity" in the population: Poor sleep quality is strongly associated with poverty and ethnicity. *BMC Public Health*, *10*, 475.

Pea, R., Nass, C., Meheula, L., Rance, M., Kumar, A., Bamford, H., Nass, M., Simha, A., Stillerman, B., Yang, S., & Zhou, M. (2012). Media use, face-to-face communication, media multitasking, and social well-being among 8- to 12-year-old girls. *Developmental Psychology*, *48*(2), 327–336.

Peralta, G. P., Forns, J., La García de Hera, M., González, L., Guxens, M., López-Vicente, M., Sunyer, J., & Garcia-Aymerich, J. (2018). Sleeping, TV, Cognitively Stimulating Activities, Physical Activity, and Attention-Deficit Hyperactivity Disorder Symptom Incidence in Children: A Prospective Study. *Journal of Developmental and Behavioral Pediatrics : JDBP*, *39*(3), 192–199.

Preacher, K. J., Curran, P. J., & Bauer, D. J. (2006). Computational tools for probing interaction effects in multiple linear regression, multilevel modeling, and latent curve analysis. Journal of Educational and Behavioral Statistics, 31, 437–448.

Prehn-Kristensen, A., Schlarb, A. A., Alfer, D., Dück, A., Frölich, J., Göder, R., Kirchhoff, F., Schneider, B., & Schwerdtle, B. (2018). S1-Leitlinie: Nichtorganische Schlafstörungen (F51). *AWMF Online. Das Portal Der Wissenschaftlichen Medizin*(028-012).

Reale, L., Bartoli, B., Cartabia, M., Zanetti, M., Costantino, M. A., Canevini, M. P., Termine, C., & Bonati, M. (2017). Comorbidity prevalence and treatment outcome in children and adolescents with ADHD. *European Child & Adolescent Psychiatry*, *26*(12), 1443–1457.

Reid, C., Yolanda, L., Radesky, J., Christakis, D., Moreno, M. A., & Cross, C. (2016). Children and Adolescents and Digital Media. *Pediatrics*, *138*(5).

Rescorla, L., Achenbach, T. M., Ivanova, M. Y., Dumenci, L., Almqvist, F., Bilenberg, N., Bird, H., Broberg, A., Dobrean, A., Döpfner, M., Erol, N., Forns, M., Hannesdottir, H., Kanbayashi, Y., Lambert, M. C., Leung, P., Minaei, A., Mulatu, M. S., Novik, T. S., . . . Verhulst, F. (2007). Epidemiological comparisons of problems and positive qualities reported by adolescents in 24 countries. *Journal of Consulting and Clinical Psychology*, *75*(2), 351–358.

Rideout, V., Foehr, U. G., & Roberts, D. F. (2010). Generation M2: Media in the Lives of 8- to 18-Year-Olds - Report.

Rideout, V. (2016). Measuring time spent with media: the Common Sense census of media use by US 8- to 18-year-olds. *Journal of Children and Media*, *10*(1), 138–144.

Rinn, A. N., & Reynolds, M. J. (2012). Overexcitabilities and ADHD in the Gifted: An Examination. *Roeper Review*, *34*(1), 38–45.

Robinson, J. L., Winiewicz, D. D., Fuerch, J. H., Roemmich, J. N., & Epstein, L. H. (2006). Relationship between parental estimate and an objective measure of child television watching. *The International Journal of Behavioral Nutrition and Physical Activity*, *3*, 43.

Rucklidge, J. J. (2010). Gender differences in attention-deficit/hyperactivity disorder. *The Psychiatric Clinics of North America*, *33*(2), 357–373.

Rydell, A.-M., & Brocki, K. C. (2021). Adhd symptoms and callous-unemotional traits as predictors of violent media use in adolescence. *Scandinavian Journal of Psychology*, *62*(1), 25–33.

Sadeh, A., Tikotzky, L., & Scher, A. (2010). Parenting and infant sleep. *Sleep Medicine Reviews*, *14*(2), 89–96.

Schäfer, A., & Schöttker-Königer, T. (Eds.). (2015). *Statistik und quantitative Methoden für Gesundheitsfachberufe*. Springer Berlin Heidelberg.

Schlarb, A. A., Schwerdtle, B., & Hautzinger, M. (2010). Validation and psychometric properties of the German version of the Children's Sleep Habits Questionnaire (CSHQ-DE). *Somnologie : Schlafforschung Und Schlafmedizin = Somnology : Sleep Research and Sleep Medicine*, *14*(4), 260–266.

Schlarb, A. A., Gulewitsch, M. D., Weltzer, V., Ellert, U., & Enck, P. (2015). Sleep Duration and Sleep Problems in a Representative Sample of German Children and Adolescents. *Health*, *07*(11), 1397–1408.

Schmid, R. (2018). Medienkonsum – nicht ohne zeitliche Nutzungslimits. *Praxis Konkret Pädiatrie*, *30*(3).

Schmidt-Atzert, & Amelang (2012). PsychologischeDiagnostik.

Schwerdtle, B., Kanis, J., Kahl, L., Kübler, A., & Schlarb, A. A. (2012). Children's Sleep Comic: Development of a new diagnostic tool for children with sleep disorders. *Nature and Science of Sleep*, *4*, 97–102.

Schwerdtle, B., Kanis, J., Kübler, A., & Schlarb, A. A. (2016). The Children's Sleep Comic: Psychometrics of a Self-rating Instrument for Childhood Insomnia. *Child Psychiatry and Human Development*, *47*(1), 53–63.

Sciberras, E., Song, J. C., Mulraney, M., Schuster, T., & Hiscock, H. (2017). Sleep problems in children with attention-deficit hyperactivity disorder: Associations with parenting style and sleep hygiene. *European Child & Adolescent Psychiatry*, *26*(9), 1129–1139.

Scott, H., & Woods, H. C. (2018). Fear of missing out and sleep: Cognitive behavioural factors in adolescents' nighttime social media use. *Journal of Adolescence*, *68*, 61–65.

Skogli, E. W., Teicher, M. H., Andersen, P. N., Hovik, K. T., & Øie, M. (2013). Adhd in girls and boys--gender differences in co-existing symptoms and executive function measures. *BMC Psychiatry*, *13*, 298.

Spruyt, K., & Gozal, D. (2011). Sleep disturbances in children with attention-deficit/hyperactivity disorder. *Expert Review of Neurotherapeutics*, *11*(4), 565–577.

Stein, M. A., Weiss, M., & Hlavaty, L. (2012). Adhd treatments, sleep, and sleep problems: Complex associations. *Neurotherapeutics : The Journal of the American Society for Experimental NeuroTherapeutics*, *9*(3), 509–517.

Theule, J., Wiener, J., Tannock, R., & Jenkins, J. M. (2013). Parenting Stress in Families of Children With ADHD. *Journal of Emotional and Behavioral Disorders*, *21*(1), 3–17.

Thoma, V. K., Schulz-Zhecheva, Y., Oser, C., Fleischhaker, C., Biscaldi, M., & Klein, C. (2018). Media Use, Sleep Quality, and ADHD Symptoms in a Community Sample and a Sample of ADHD Patients Aged 8 to 18 Years. *Journal of Attention Disorders*, *24*(4), 576–589.

Thorell, L. B., Skoglund, C. B., La Peña, A. G. de, Baeyens, D., Fuermaier, A., Groom, M., Mammarella, I., van der Oord, S., van den Hoofdakker, B., Luman, M., Miranda, D. M. de, Siu, A., Steinmayr, R., Idrees, I., Soares, L. S., Sörlin, M., Luque, J. L., moscardino, u., Roch, M., . . . Christiansen, H. (2020). *Psychosocial effects of homeschooling during the COVID-19 pandemic: Differences between seven European countries and between children with and without mental health conditions.*

Tong, L., Ye, Y., & Yan, Q. (2018). The moderating roles of bedtime activities and anxiety/depression in the relationship between attention-deficit/hyperactivity disorder symptoms and sleep problems in children. *BMC Psychiatry*, *18*(1), 298.

Tsai, M.-H., Hsu, J.-F., & Huang, Y.-S. (2016). Sleep Problems in Children with Attention Deficit/Hyperactivity Disorder: Current Status of Knowledge and Appropriate Management. *Current Psychiatry Reports*, *18*(8), 76.

Turgay, A., Goodman, D. W., Asherson, P., Lasser, R. A., Babcock, T. F., Pucci, M. L., & Barkley, R. (2012). Lifespan persistence of ADHD: The life transition model and its application. *The Journal of Clinical Psychiatry*, *73*(2), 192–201.

Twenge, J. M., & Martin, G. N. (2020). Gender differences in associations between digital media use and psychological well-being: Evidence from three large datasets. *Journal of Adolescence*, *79*, 91–102.

van der Heijden, K. B., Stoffelsen, R. J., Popma, A., & Swaab, H. (2018). Sleep, chronotype, and sleep hygiene in children with attention-deficit/hyperactivity disorder, autism spectrum disorder, and controls. *European Child & Adolescent Psychiatry*, *27*(1), 99–111.

van Santvoort, F., Hosman, C. M. H., Janssens, J. M. A. M., van Doesum, K. T. M., Reupert, A., & van Loon, L. M. A. (2015). The Impact of Various Parental Mental Disorders on Children's Diagnoses: A Systematic Review. *Clinical Child and Family Psychology Review*, *18*(4), 281–299.

Via, E., Estrada-Prat, X., Tor, J., Virgili, C., Fàbrega, M., Duran, L., Alda, J. A., Keating, C., & Dolz, M. (2020). *COVID-19 Pandemic: Increased risk for psychopathology in Children and Adolescents?*

Virring, A., Lambek, R., Thomsen, P. H., Møller, L. R., & Jennum, P. J. (2016). Disturbed sleep in attention-deficit hyperactivity disorder (ADHD) is not a question of psychiatric comorbidity or ADHD presentation. *Journal of Sleep Research*, *25*(3), 333–340.

Wajszilber, D., Santiseban, J. A., & Gruber, R. (2018). Sleep disorders in patients with ADHD: Impact and management challenges. *Nature and Science of Sleep*, *10*, 453–480.

Wiater, A., & Scheuermann, P. (2007). Diagnostik von Schlafstörungen. *Monatsschrift Kinderheilkunde*, *155*(7), 600–607.

Wirth, A., Reinelt, T., Gawrilow, C., Schwenck, C., Freitag, C. M., & Rauch, W. A. (2019). Examining the Relationship Between Children's ADHD Symptomatology and Inadequate Parenting: The Role of Household Chaos. *Journal of Attention Disorders*, *23*(5), 451–462.

Wolraich, M., Brown, L., Brown, R. T., DuPaul, G., Earls, M., Feldman, H. M., Ganiats, T. G., Kaplanek, B., Meyer, B., Perrin, J., Pierce, K., Reiff, M., Stein, M. T., & Visser, S. (2011). Adhd: Clinical practice guideline for the diagnosis, evaluation, and treatment of attention-deficit/hyperactivity disorder in children and adolescents. *Pediatrics*, *128*(5), 1007–1022.

Wong, H. Y., Mo, H. Y., Potenza, M. N., Chan, M. N. M., Lau, W. M., Chui, T. K., Pakpour, A. H., & Lin, C.-Y. (2020). Relationships between Severity of Internet Gaming Disorder, Severity of Problematic Social Media Use, Sleep Quality and Psychological Distress. *International Journal of Environmental Research and Public Health*, *17*(6).

World Health Organization. (1992). The ICD-10 classification of mental and behavioural disorders: Clinical descriptions and diagnostic guidelines. Geneva: World Health Organization.

Yen, J.-Y., Ko, C.-H., Yen, C.-F., Wu, H.-Y., & Yang, M.-J. (2007). The comorbid psychiatric symptoms of Internet addiction: Attention deficit and hyperactivity disorder (ADHD), depression, social phobia, and hostility. *The Journal of Adolescent Health : Official Publication of the Society for Adolescent Medicine*, *41*(1), 93–98.

Zimmermann, P., Podewski, F., Çelik, F., & Iwanski, A. (2018). Emotionale Entwicklung. In A. Lohaus (Ed.), *Springer-Lehrbuch. Entwicklungspsychologie des Jugendalters* (Vol. 30, pp. 75–90). Springer Berlin Heidelberg.

Appendix

Appendix A. Study flyer.

Link zur Studie: https://bielefeldpsych.eu.qualtrics.com/jfe/form/SV_6xskvIq7Ap1kxUy

Studie zu Schlaf, Medienkonsum und ADHS-Symptomen

• Untersuchung der Zusammenhänge von **Schlafproblemen** (Einschlafstörungen, Atmungsstörungen, uvm.), **Medienkonsum** (TV, Smartphone, Spielekonsole, etc.) und **Aufmerksamkeit, Hyperaktivität und Impulsivität**

• Fragebogenstudie
• **Eltern** von Kindern zwischen **5** und **10** Jahren (gerne auch Kontrollgruppen-teilnehmer => Eltern von Kindern ohne o.g. Problematiken)

• circa 25 Minuten

• auf Wunsch erhalten Sie ein PDF mit Informationen und Links zum Thema Schlafschwierigkeiten, Medienkonsum und ADHS bei Kindern
• Wichtiger Beitrag zu Forschung

Bei Fragen können Sie sich gerne jederzeit per Mail an Lhimmelmeier@uni-bielefeld.de wenden.

UNIVERSITÄT BIELEFELD
Fakultät für Psychologie und Sportwissenschaft

Appendix B. Ethical vote of the Ethics Committee of Bielefeld University.

UNIVERSITÄT BIELEFELD

Ethik-Kommission der Universität Bielefeld, Postfach 10 01 31, 33501 Bielefeld

Stellungnahme der Ethik-Kommission der Universität Bielefeld zu Antrag Nr. 2021-122 vom 21.05.2021

21. Mai 2021

Kurzbezeichnung der Studie: Zusammenhänge von ADHS Symptomen, Schlafproblemen und Medienkonsum bei Kindern

Kommissarische Leitung
Prof. Dr. Gerd Bohner

Geschäftsstelle der Ethik-Kommission
Dr. Eva-Maria Berens
Raum: T5-241
Tel: +49(0)521 106-4468
ethikkommission@uni-bielefeld.de

Postanschrift:
Geschäftsstelle der Ethik-Kommission
Fakultät für Psychologie und Sportwissenschaft
Universität Bielefeld

Postfach 10 01 31
33501 Bielefeld

Az.: 1266

Hauptansprechpartner*in: Luisa Himmelmeier

Betreuer*in: Anna-Lena Zurmühlen

Die Ethik-Kommission der Universität Bielefeld hat den Antrag nach den ethischen Richtlinien der Deutschen Gesellschaft für Psychologie e.V. und des Berufsverbands Deutscher Psychologinnen und Psychologen e.V. begutachtet.

Auf der Grundlage der eingereichten Unterlagen hält die Ethik-Kommission der Universität Bielefeld die Durchführung der Studie in der beschriebenen Form für ethisch unbedenklich.

Allgemeine Hinweise:
Die Verantwortung für die Durchführung der Studie und die Einhaltung des Datenschutzes verbleibt uneingeschränkt bei den Forschenden.

Für die Ethik-Kommission

Gerd Bohner

Prof. Dr. Gerd Bohner
Kommissarische Leitung

1/1

Appendix C.

Table C1. Sociodemographic information Part 1.

variables	subcategories	frequencies (%)
Children‘s country of birth		
	Germany	116 (91.3%)
	Italy	1 (0.8 %)
	Austria	4 (3.2 %)
	Russia	1 (0.8%)
	Swiss	3 (2.4%)
	Turkey	1 (0.8%)
Childrens‘ mother tongue		
	German	116 (93.3%)
	German and polish	1 (0.8%)
	German and english	1 (0.8%)
	German and spanish	1 (0.8%)
	German and hungarian	1 (0.8%)
	Indonesian	1 (0.8%)
	Romanian	1 (0.8%)
	Russian	2 (1.6%)
	Turkish	2 (1.6%)
	Vietnamese	1 (0.8%)
Parents’ highest educational qualification		
	Still going to school	4 (3.1%)
	Intermediate school/technical college entrance qualification/secondary school leaving certificate	37 (29.1%)
	Advanced technical college entrance qualification, vocational baccalaureate	22 (17.3%)
	A-levels	56 (44.1%)
	Other (university degrees were named)	8 (6.3%)
Parents‘ current occupation		
	Full-time employed	31 (24.4%)
	Part-time employed	65 (51.2%)
	Pupil/student	5 (3.9%)
	Unemployed/seeking work	2 (1.6%)
	Parenthood period	14 (11%)
	Not working	6 (4.7%)
	Others: Self-employed (3), housewife (1)	4 (3.1%)
Parents‘ monthly income		
	501€ -1000€	2 (1.6%)
	1001€ - 1500€	3 (2.4%)
	1501€ -2000€	11 (8.7%)
	2001€ -2500€	13 (10.2%)
	2501€ -3000€	21 (16.5%)
	> 3000€	70 (55.1%)
	Not applicable	7 (5.5%)

Appendix C.

Table C2. Sociodemographic information Part 2.

variables	subcategories	frequencies (%)
Parental Psychopathology	None	109 (85.5%)
	Maternal	11 (8.7%)
	Paternal	5 (3.9%)
	Both	2 (1.6%)
Chronic illness of the children		
	Yes	24 (18.9%)
	No	103 (81.1%)
Mental illness of the children		
	Yes	10 (7.9%)
	No	117 (92.1%)
Children‘s medication		
	Antiallergics	3 (2.4%)
	Atomoxetine	1 (0.8%)
	Elvanse	2 (1.6%)
	Medikinet (retard, itunis)	6 (4.8%)
	Omega 3 and 6	2 (1.6%)
	Ritalin	2 (1.6%)
	None	111 (88.8%)

Appendix D. Self-generated questions assessing media use.

Bitte kreuzen Sie an, welche der folgenden Geräte in Ihrem Haushalt vorhanden sind.

- Computer / Laptop
- Tablet
- Handy / Smartphone
- Fernseher
- Spielekonsole (z.B. Wii, Playstation)

Wie viel Zeit verbringt Ihr Kind an Schultagen / an Kindergarten Tagen mit diesen Medien?

	Gar nicht	0-30 Minuten	etwa 30-60 Minuten	etwa 1-2 Stunden	etwa 2-3 Stunden	etwa 3-4 Stunden	mehr als 4 Stunden
Handy / Smartphone	○	○	○	○	○	○	○
Computer / Laptop / Tablet	○	○	○	○	○	○	○
Fernseher	○	○	○	○	○	○	○
Spielekonsole	○	○	○	○	○	○	○

Wie viel Zeit verbringt Ihr Kind am Wochenende mit diesen Medien?

	Gar nicht	0-30 Minuten	etwa 30-60 Minuten	etwa 1-2 Stunden	etwa 2-3 Stunden	etwa 3-4 Stunden	mehr als 4 Stunden
Handy / Smartphone	○	○	○	○	○	○	○
Computer / Laptop / Tablet	○	○	○	○	○	○	○
Fernseher	○	○	○	○	○	○	○
Spielekonsole	○	○	○	○	○	○	○

Wie viel Zeit verbringt Ihr Kind insgesamt mit elektronischen Medien (TV, PC, Tablet, Handy, etc.)?
(Format: „Std. : Min.“, z.B: „04:10“)

Montag bis Freitag (durchschnittlich PRO Tag) ☐
Am Wochenende (durchschnittlich PRO Tag) ☐

Wie viel Zeit nutzt Ihr Kind Handy / Tablet & Laptop im Bett, vor dem Schlafen?
(Format: „Std. : Min.“, z.B: „04:10“)

Montag bis Freitag (durchschnittlich PRO Tag) ☐
Am Wochenende (durchschnittlich PRO Tag? ☐

Appendix D. Self-generated questions assessing media use.

Hört Ihr Kind vor dem Schlafen Musik oder Hörspiele?

Ja	Wenn ja, wie lange?
Nein	Format: Std.: Min., z.B. 04:10 ☐

Lesen Sie Ihrem Kind vor dem Einschlafen etwas vor?

Nein	Wenn ja, wie lange?
Ja	Format: Std.: Min., z.B. 04:10 ☐

Mit welchen Inhalten beschäftigt sich Ihr Kind hauptsächlich an den Geräten? (Es können mehrere Antworten gegeben werden)

Soziale Medien (z.B. WhatsApp, Instagram): ☐
Spiele: ☐
Filme / Serien: ☐
andere: ☐

Ihr Kind wirkt nach dem Medienkonsum... (Es können mehrere Antworten gewählt werden)

- müde
- übermäßig aktiv
- unverändert
- anders

Warum benutzt Ihr Kind digitale Geräte? (Es können mehrere Antworten gewählt werden)

- um Wartezeit zu überbrücken
- wenn sich Ihr Kind langweilt
- zur Lernunterstützung / Homeschooling
- als Hobby
- um sich abzureagieren
- um sich zu beruhigen
- um Kontakt zu Freunden / Freundinnen zu haben
- als gemeinsame Familienzeit
- andere

andere: ☐

Appendix D. Self-generated questions assessing media use.

Anschließend möchten wir Sie noch kurz zu Ihrem eigenen Medienkonsum befragen.
Wie viel Zeit verbringen Sie **insgesamt** mit elektronischen Medien (TV, PC, Tablet, Handy, etc.)?

(Format: „Std. : Min.“, z.B: „04:10“)

Montag bis Freitag (durchschnittlich PRO Tag)	
Am Wochenende (durchschnittlich PRO Tag)	

Wie viel Zeit nutzen Sie Ihr Handy / Tablet / Laptop **im Bett, vor dem Schlafen?**

(Format: „Std. : Min.“, z.B: „04:10“)

Montag bis Freitag (durchschnittlich PRO Tag)	
Am Wochenende (durchschnittlich PRO Tag)	

Wie viel Zeit verbringen Sie **in der Woche** mit diesen Medien?

	Gar nicht	0-30 Minuten	etwa 30-60 Minuten	etwa 1-2 Stunden	etwa 2-3 Stunden	etwa 3-4 Stunden	mehr als 4 Stunden
Handy / Smartphone	○	○	○	○	○	○	○
Computer / Laptop / Tablet	○	○	○	○	○	○	○
Fernseher	○	○	○	○	○	○	○
Spielekonsole	○	○	○	○	○	○	○

Wie viel Zeit verbringen Sie **am Wochenende** mit diesen Medien?

	Gar nicht	0-30 Minuten	etwa 30-60 Minuten	etwa 1-2 Stunden	etwa 2-3 Stunden	etwa 3-4 Stunden	mehr als 4 Stunden
Handy / Smartphone	○	○	○	○	○	○	○
Computer / Laptop / Tablet	○	○	○	○	○	○	○
Fernseher	○	○	○	○	○	○	○
Spielekonsole	○	○	○	○	○	○	○

Appendix E. Feedback sheet of the pilot study.

Rückmeldebogen: Pilotierung der Fragebogenpakete

Vielen Dank, dass Sie sich die Zeit nehmen und unsere Fragebögen testen. Dies ist sehr wichtig, damit wir notwendige Verbesserungen vornehmen können, bevor wir eine größere Stichprobe mit den Fragebogenpaketen befragen.

Über Rückmeldungen zu den folgenden Aspekten würden wir uns sehr freuen:

- Welche Elternversion haben Sie ausgefüllt? ☐ Kindergartenkind-Version
  (Erkennen Sie an der Endung des Studienteilnahmecodes (EK, ES) ☐ Schulkind-Version
- Wie lange hat die Beantwortung der Fragebogenpakete ungefähr gedauert?
  - Elternbogen: ____ Minuten
  - Kinderbogen: ____ Minuten

- Gab es Formulierungen, die Ihrer Meinung nach verändert werden sollten?
  _____
  _____
  _____
  _____

- Sind Ihnen kritische Fragen aufgefallen, die aus der Befragung gestrichen werden sollten?
  _____
  _____
  _____
  _____

- Waren die Formulierungen des Kinderfragebogenpakets altersangemessen?
  (Wenn Ihr Kind Fragen nicht verstanden hat, geben Sie diese bitte gemeinsam mit dem Alter Ihres Kindes an)
  _____

- Gibt es sonst noch etwas, was Sie uns rückmelden möchten?
  _____
  _____
  _____
  _____

Appendix F. Diagrams for testing homoscedasticity.

Hypothesis 2.1:

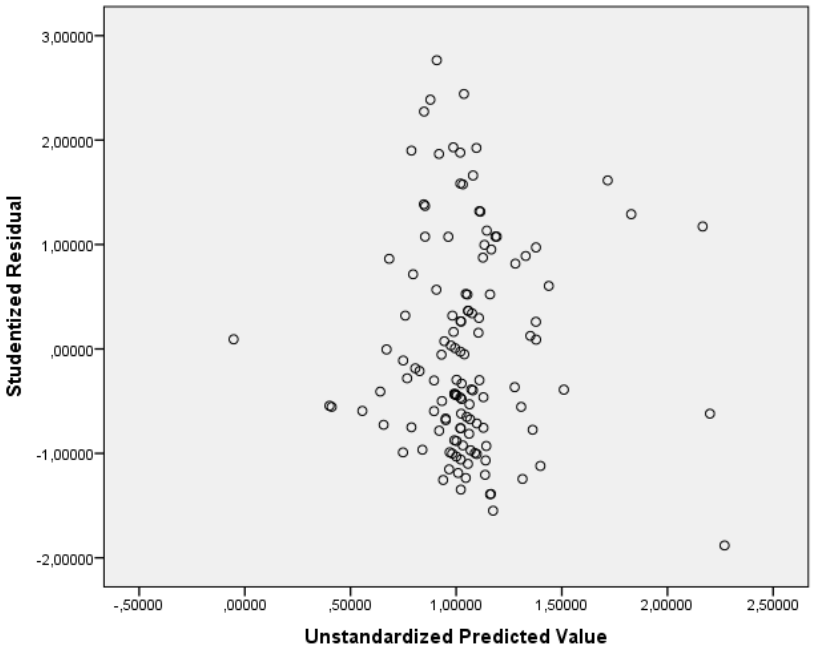

Figure F1. Plot of residuals to test homoscedasticity.
Note. Independent variables were sleep problems, daily media use and the moderator of sleep problems and daily media use, the dependent variable was inattention. The diagram shows a violation of the precondition, and thus heteroscedasticity.

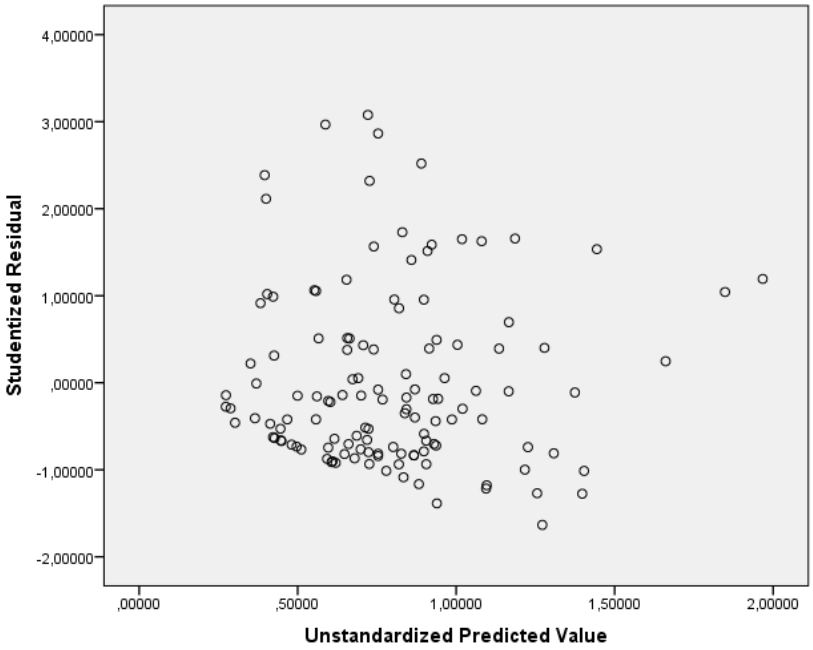

Figure F2. Plot of residuals to test homoscedasticity.
Note. Independent variables were sleep problems, daily media use and the moderator of sleep problems and daily media use, the dependent variable was hyperactivity/impulsivity. The diagram shows a violation of the precondition, and thus heteroscedasticity.

Appendix F. Diagrams for testing homoscedasticity.

Hypothesis 2.1:

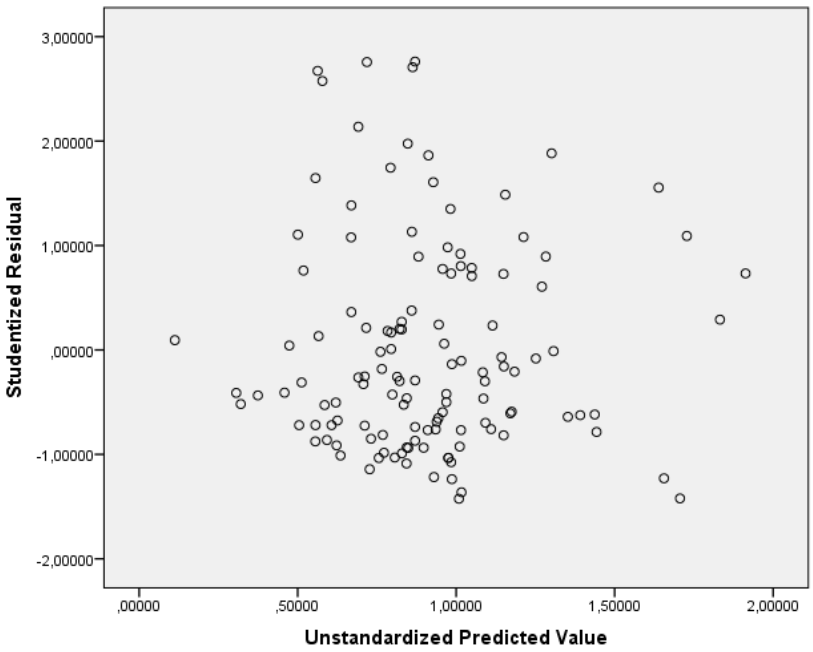

Figure F3. Plot of residuals to test homoscedasticity.
Note. Independent variables were sleep problems, daily media use and the moderator of sleep problems and daily media use, the dependent variable was the total ADHD symptomatology. The diagram shows a violation of the precondition, and thus heteroscedasticity.

Hypothesis 2.2:

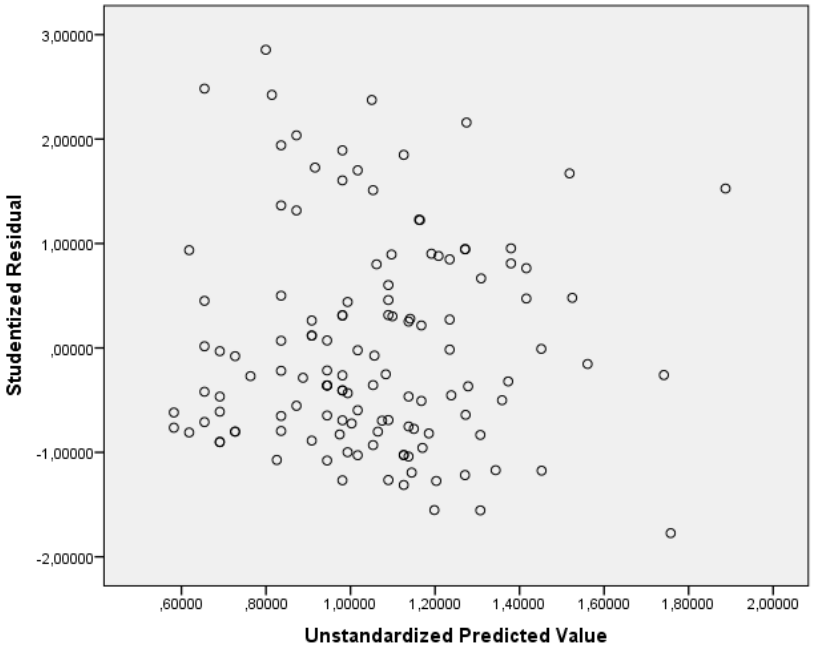

Figure F4. Plot of residuals to test homoscedasticity.
Note. Independent variables were sleep problems, bedtime media use and the moderator of sleep problems and bedtime media use, the dependent variable was inattention. The diagram shows a violation of the precondition, and thus heteroscedasticity.

Appendix F. Diagrams for testing homoscedasticity.

Hypothesis 2.2:

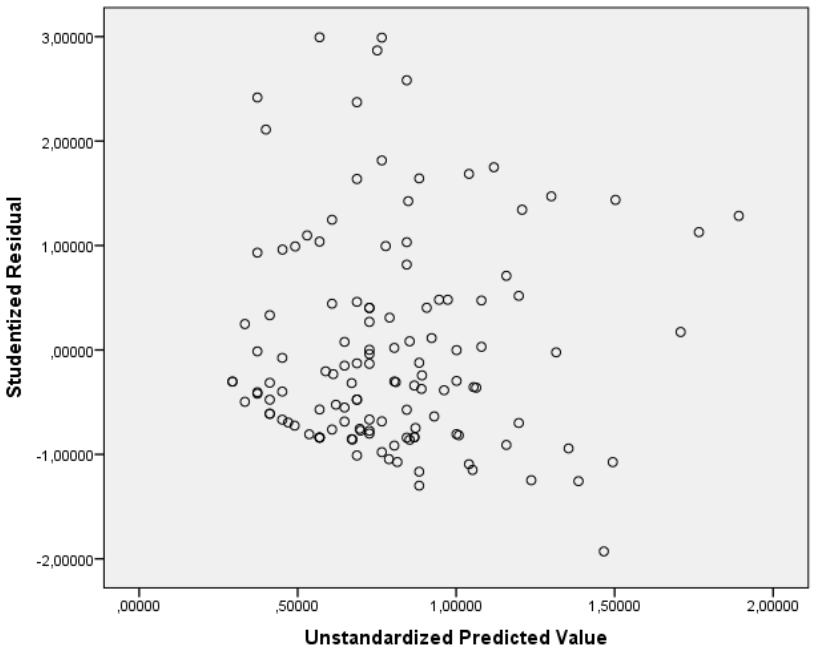

Figure F5. Plot of residuals to test homoscedasticity.
Note. Independent variables were sleep problems, bedtime media use and the moderator of sleep problems and bedtime media use, the dependent variable was hyperactivity/impulsivity. The diagram shows a violation of the precondition, and thus heteroscedasticity.

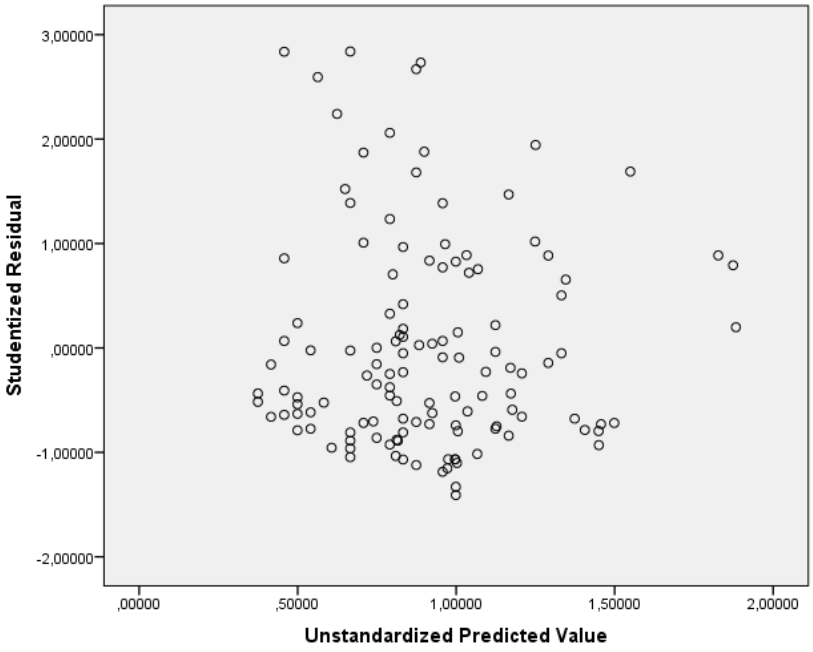

Figure F6. Plot of residuals to test homoscedasticity.
Note. Independent variables were sleep problems, bedtime media use and the moderator of sleep problems and bedtime media use, the dependent variable was the total ADHD symptomatology. The diagram shows a violation of the precondition, and thus heteroscedasticity.

Appendix G. Diagrams for testing the normal distribution of the residuals.

Hypothesis 2.1:

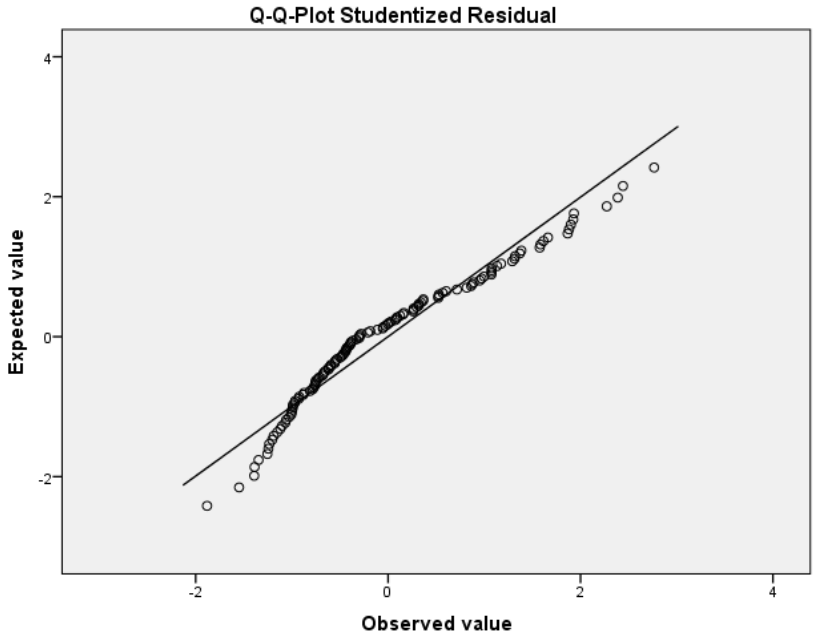

Figure G1. Q-Q-Plot of the distribution of the residuals.
Note. Independent variables were sleep problems, daily media use and the moderator of sleep problems and daily media use, the dependent variable was inattention. The diagram shows a violation of the precondition, and thus no normal distribution.

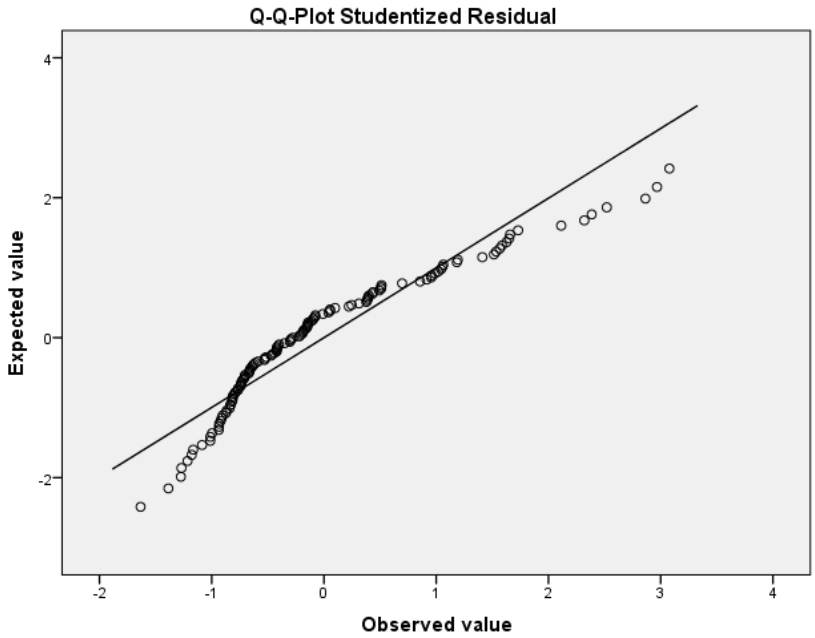

Figure G2. Q-Q-Plot of the distribution of the residuals.
Note. Independent variables were sleep problems, daily media use and the moderator of sleep problems and daily media use, the dependent variable was hyperactivity/impulsivity. The diagram shows a violation of the precondition, and thus no normal distribution.

Appendix G. Diagrams for testing the normal distribution of the residuals.

Hypothesis 2.1:

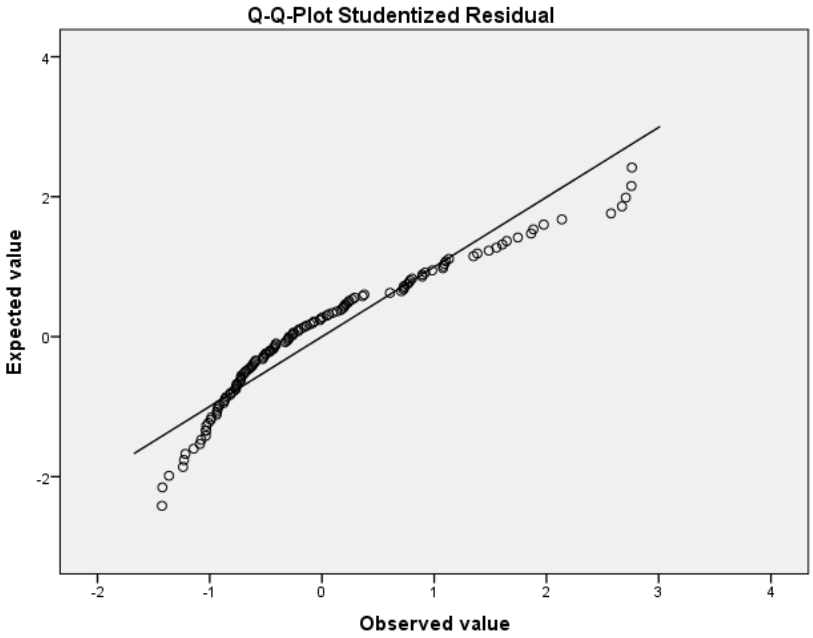

Figure G3. Q-Q-Plot of the distribution of the residuals.
Note. Independent variables were sleep problems, daily media use and the moderator of sleep problems and daily media use, the dependent variable was the total ADHD symptomatology. The diagram shows a violation of the precondition, and thus no normal distribution.

Hypothesis 2.2:

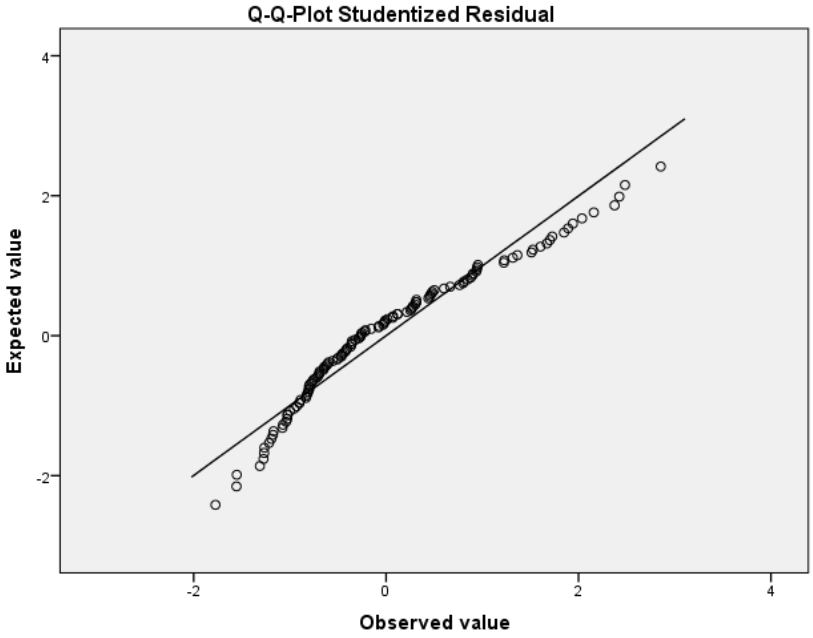

Figure G4. Q-Q-Plot of the distribution of the residuals.
Note. Independent variables were sleep problems, bedtime media use and the moderator of sleep problems and bedtime media use, the dependent variable was inattention. The diagram shows a violation of the precondition, and thus no normal distribution.

Appendix G. Diagrams for testing the normal distribution of the residuals.

Hypothesis 2.2:

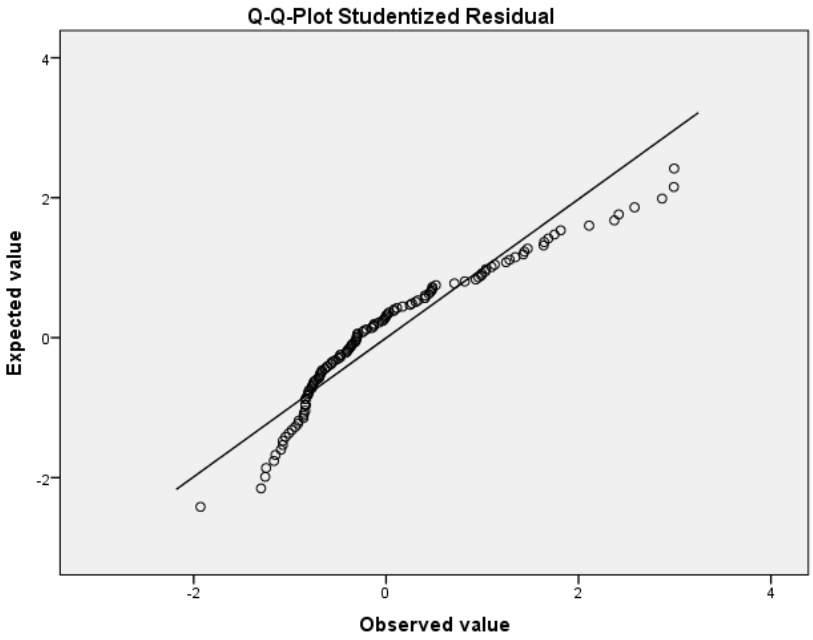

Figure G5. Q-Q-Plot of the distribution of the residuals.
Note. Independent variables were sleep problems, bedtime media use and the moderator of sleep problems and bedtime media use, the dependent variable was hyperactivity/impulsivity. The diagram shows a violation of the precondition, and thus no normal distribution.

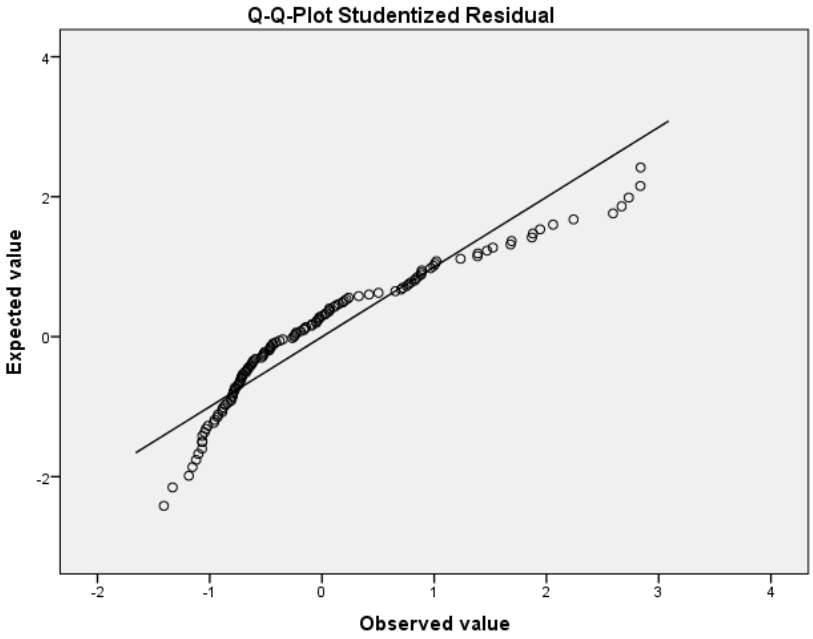

Figure G6. Q-Q-Plot of the distribution of the residuals.
Note. Independent variables were sleep problems, bedtime media use and the moderator of sleep problems and bedtime media use, the dependent variable was the total ADHD sympto-matology. The diagram shows a violation of the precondition, and thus no normal distribution.

Declaration of Independence

I hereby declare that I have written this Master Thesis independently and that I have created the data sets, drawings, sketches and graphical representations used independently. I have not used any sources other than those indicated and have indicated in each individual case that passages in the thesis which are taken from other works - including tables and figures used - are borrowed, indicating the source.

Bielefeld, 08.07.2021

L. Himmelmeier

Signature