

## RESEARCH ARTICLE



# The relationship between sleep difficulties and externalizing and internalizing problems in children and adolescents with mental illness

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## Summary

Sleep difficulties are presumably a transdiagnostic factor in the complex aetiology of psychiatric disorders in youth. This study assessed the prevalence of sleep difficulties in children and adolescents seeking specialized psychiatric care, examined the relationships of internalizing and externalizing problems, and considered the moderating role of sex and age on these relationships. Parent-reported data on difficulties initiating sleep, difficulties maintaining sleep, early morning awakenings and daytime fatigue from a large sample of children and adolescents referred for specialized psychiatric care ( $n = 4638$ ;  $< 18$  years) were used to estimate prevalence rates. To examine associations between these sleep difficulties and internalizing/externalizing problems, multiple linear regression analyses were conducted on available data ( $n = 3768$ ) stratified in three age groups (1.5–5 years; 6–11 years; 12–18 years). Overall prevalence, i.e. at least one sleep difficulty was reported to be often or always present, was 65%. Difficulties initiating sleep occurred the most, closely followed by daytime fatigue. In all age groups, sleep difficulties were positively related to internalizing and externalizing problems. In young children and school-age children, age moderated the interaction between sleep difficulties and internalizing problems. To conclude, prevalence rates of sleep difficulties in children with mental illness appear higher than it has been reported in the general youth population, especially difficulties initiating sleep and daytime fatigue. We observed that the associations between internalizing problems and sleep difficulties in young children and school-age children seemed to be amplified with age, suggesting a negative, bidirectional, spiral in development.

## KEYWORDS

child psychiatry, internalizing and externalizing problem behaviour, mental health, sleep difficulties

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## 1 | INTRODUCTION

Sleep is essential to our lives. Sufficient sleep is a basic condition for healthy physical and mental functioning, and is essential for development and growth (Davis, 2004; Stoffelsen & Shalini, 2022). Many children and adolescents, however, suffer from sleep difficulties (Owens & Mindell, 2011). Prevalence rates of sleep difficulties among children (age 1–12 years) are estimated to be about 20%–30% (Owens & Mindell, 2011), and among adolescents about 16%–23% (Gradisar et al., 2011; Moore & Meltzer, 2008; Roberts et al., 2008). The most common sleep difficulties in children are difficulties initiating sleep (i.e. falling asleep), difficulties maintaining sleep (e.g. nighttime awakenings), and early morning awakenings (Allen et al., 2016). In adolescents, daytime fatigue, caused by insufficient sleep, is most often experienced (Moore & Meltzer, 2008). If one or more of these sleep difficulties occur at least three nights per week for at least 3 months, and result in significant impairment in daytime functioning, the criteria for insomnia are met according to the Diagnostic and Statistical Manual of Mental Disorders (DSM-5; American Psychiatric Association, 2013).

Sleep difficulties affect children's cognitive, behavioural and emotional functioning, resulting in concentration problems, less positive affective responses, and poor emotion regulation skills (Vriend et al., 2013). Even years after such (prolonged) sleep difficulties, there may be residual negative effects on cognition and behaviour, such as depressive symptoms, higher impulsivity and hyperactivity, and lower performance on neurodevelopmental tests (Gregory & Sadeh, 2016; Touchette et al., 2007; Yoo et al., 2007). Furthermore, it has been found that a shorter sleep duration in children between the ages of 4 and 12 years was related to an increased risk of developing psychiatric symptoms, such as aggressive behaviour, anxiety and depression (Gregory et al., 2008). Besides these negative effects on children, paediatric sleep difficulties can also significantly affect parental functioning and induce parental stress (Byars et al., 2011; Caldwell & Redeker, 2015; Martin, 2019).

Sleep difficulties are more common among children with psychiatric diagnoses, compared with children in the general population (Blackmer & Feinstein, 2016; Fang et al., 2019; Muskens et al., 2023). For instance, 40%–80% of children with attention-deficit hyperactivity disorder (ADHD) or autism spectrum disorder (ASD) experience sleep difficulties (Cortese et al., 2009; Cortesi et al., 2010; Lecendreux et al., 2000; Muskens et al., 2023). Prevalence rates of 45%–90% have even been found in children with anxiety or depressive disorders (Fang et al., 2019; Kahn et al., 2013; Muskens et al., 2023). Sleep difficulties can manifest as both a symptom and a consequence of psychiatric disorders (e.g. posttraumatic stress disorder [PTSD] or psychosis; American Psychiatric Association, 2013; Moore & Meltzer, 2008). However, the relationship between psychiatric disorders and sleep difficulties, i.e. whether it involves causality or bidirectionality, may vary depending on the specific psychiatric disorder.

The concept of sleep as a transdiagnostic factor gains support from studies investigating the relationship between sleep difficulties

and both internalizing and externalizing behaviour problems in normative adult and adolescent populations (Pieters et al., 2015; Quach et al., 2018; Rubens, 2017). The current study aims to get insight into the association between sleep difficulties and internalizing and externalizing problems in a clinical population of children and adolescents with mental health problems.

This study has two primary objectives: (1) examining the prevalence of sleep difficulties (i.e. initiating sleep, maintaining sleep, early morning awakenings and daytime fatigue); and (2) examining the relation between sleep difficulties and internalizing and externalizing behaviour problems in a large sample of children and adolescents with mental illness. Based on existing literature, a positive association between sleep difficulties and both internalizing and externalizing problems is expected. In addition, the moderating roles of sex and age on these potential relationships will be explored.

## 2 | METHODS

### 2.1 | Design, procedures and participants

In this study, data from two subsamples of the Dutch Research in child and Adolescent Mental health (DREAMS) consortium were used. DREAMS is a collaboration of four large child and adolescent psychiatry centres in the Netherlands. These centres offer specialized outpatient and inpatient care to children and adolescents with various mental illnesses. Data from two samples (Karakter and Levvel) were used, located in the east and west of the Netherlands. Data were extracted from electronic health records of children and adolescents at time of admission to one of the two centres between May 2021 and September 2023. Prior to their first appointment, at each centre, parents were asked to complete a digital intake questionnaire that assessed various variables, such as age, sex and country of birth of the child. Also, inquiries related to the child's sleep behaviour were included.

Data from the two specialized psychiatric care centres ( $n = 4638$ ; < 18 years) were used to estimate prevalence rates of sleep difficulties in children and adolescents with mental health illness (research question 1). To examine associations between these sleep difficulties and internalizing/externalizing problems, multiple linear regression analyses were conducted on available data ( $n = 3768$ ) stratified in three age groups (1.5–5 years; 6–11 years; 12–18 years; research question 2). There were no exclusion criteria. Table 1 describes the primary DSM-5 diagnostic classes stratified by centre. Most children had a primary diagnosis of ASD (30.4%), followed by ADHD (14.7%).

All data used in this study were obtained retrospectively (and were pseudonymized). This study was not subject to the Dutch Medical Research Involving Human Subjects Act. Both patients and their legal caregivers were informed that data collected during regular care could be used in scientific research. They could opt out of having their data used for research purposes at any time, with the assurance that this decision would have no impact on their treatment.

**TABLE 1** Counts and percentages of primary DSM-5 diagnoses in the total population and per age group for the two child and adolescent psychiatry centres separately.

Primary DSM-5 diagnosis	Total (n = 4638) n (%)	Centre 1: Karakter			Centre 2: Levelel		
		Age group 1.5–5 years (n = 1014)	Age group 6–11 years (n = 1338)	Age group 12–18 years (n = 1431)	Age group 1.5–5 years (n = 92)	Age group 6–11 years (n = 235)	Age group 12–18 years (n = 527)
		n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
ASD	1411 (30.4)	389 (38.4)	394 (29.4)	489 (34.2)	21 (22.8)	40 (17.0)	78 (14.8)
ADHD	684 (14.7)	132 (13.0)	335 (25.0)	169 (11.8)	0 (0.0)	21 (8.9)	27 (5.1)
Anxiety	297 (6.4)	42 (4.1)	61 (4.6)	96 (6.7)	22 (23.9)	40 (17.0)	36 (6.8)
Trauma/PTSD	242 (5.2)	44 (4.3)	62 (4.6)	99 (6.9)	0 (0.0)	12 (5.1)	25 (4.7)
Depression	142 (3.1)	0 (0.0)	9 (0.7)	109 (7.6)	0 (0.0)	0 (0.0)	24 (4.6)
Eating disorders	111 (2.4)	12 (1.2)	9 (0.7)	60 (4.2)	0 (0.0)	3 (1.3)	27 (5.1)
Other	749 (16.1)	172 (17.0)	226 (16.9)	192 (13.4)	8 (8.7)	27 (11.5)	124 (23.5)
Missing	1002 (21.6)	223 (22.0)	242 (18.1)	217 (15.2)	41 (44.6)	92 (39.1)	186 (35.3)

Note: Only primary diagnoses were used.

Abbreviations: ADHD, attention-deficit hyperactivity disorder; ASD, autism spectrum disorder; DSM-5, Diagnostic and Statistical Manual of Mental Disorders; PTSD, posttraumatic stress disorder.

## 2.2 | Measures

### 2.2.1 | Sleep difficulties

The four DSM-5-based criteria of insomnia were used to assess sleep behaviour: difficulties initiating sleep; difficulties maintaining sleep; early morning awakenings; and daytime fatigue. Questions from the intake questionnaire that were used to assess these criteria were: “How often does it take more than 30 minutes for your child to fall asleep? Think of the past four weeks”; “How often does your child wake up more than three times a night, or lie awake for more than 20 minutes a night? Think of the past four weeks”; “How often does your child wake up before 6 AM? Think of the past four weeks”; and “How often does your child suffer from tiredness during the daytime? Think of the past four weeks”. Responses were given on 5-point Likert scales ranging from 1 = (Almost) Never to 5 = Always.

### 2.2.2 | Internalizing and externalizing problems

Internalizing and externalizing problem behaviours of children between 1.5 and 5 years were measured using the Dutch parent report version of the Child Behaviour Checklist (CBCL) 1.5–5 years (Achenbach & Rescorla, 2000). For children aged 6–18 years, the CBCL 6–18 years was used. These questionnaires assess a wide range of children's emotional and behavioural problems (Achenbach & Rescorla, 2000). The CBCL has well-established psychometric properties in clinical, non-clinical and cross-cultural populations (Verhulst & Van der Ende, 2013).

The CBCL 1.5–5 includes 99 items assessing behavioural and emotional problems that are answered by parents on a 3-point Likert

scale (0 = not true, 1 = somewhat or sometimes true, 2 = very true or often true). The scores display seven problem scales: emotionally reactive (1); anxious/depressed (2); somatic complaints (3); withdrawn (4); attention problems (5); aggressive behaviour (6); and sleep difficulties (7). The sum of the problem scales 1, 2, 3 and 4 represents “internalizing behaviour”, and 5 and 6 refer to “externalizing behaviour”.

The CBCL 6–18 includes 120 items assessing behavioural and emotional problems that are answered by parents on the same 3-point Likert scale. The problem scales of the CBCL 6–18 are: withdrawn/depressed (1); somatic complaints (2); anxious/depressed (3); social problems (4); thought problems (5); attention problems (6); rule-breaking behaviour (7); aggressive behaviour (8); and other problems. The sum of the problem scales 1, 2 and 3 represent the scale “internalizing behaviour”, and the sum of 7 and 8 represent “externalizing behaviour”, which were used as outcome measures (raw scores) in the current study.

### 2.2.3 | Statistical analysis

Data were analysed using SPSS V.29 for Windows (SPSS IBM). The overall prevalence of sleep difficulties was defined as the proportion of children and adolescents who scored at least 4 (“often” or “always”) on one of the four sleep items: difficulties initiating sleep; difficulties maintaining sleep; early morning awakenings; and daytime fatigue. To obtain more detailed insight into the prevalence of sleep difficulties, we examined the prevalence rates of the four sleep difficulties separately, and for the three age groups: 1.5–5 years (young children); 6–11 years (school-age children); and 12–18 years (adolescents).

To examine the association between sleep difficulties and internalizing and externalizing behaviour, the mean score of the

four sleep variables was calculated and used as an outcome measure. This score was only calculated for those with at least three out of four sleep variables available (95% of total sample). A higher mean score indicated more sleep difficulties. This sample was again stratified into three age groups (i.e. young children, school-age children and adolescents). Independent-samples *t*-tests were conducted on all normally distributed quantitative variables to examine differences between boys and girls. Additionally, correlations among all quantitative variables were assessed (see Supplementary Table S1). Subsequently, several multiple linear regression analyses were performed for each age group separately, with: (1) internalizing problems (raw scores) and (2) externalizing problems (raw scores) as the dependent variable, respectively. Three independent variables were included in these analyses: age (continuous, one participant was excluded from these analyses because of a missing variable value on the age variable); sex (0 = boy, 1 = girl; persons with non-binary gender identification were excluded from these analyses, due to limited sample size;  $n = 15$ ); and sleep difficulties (continuous). All two-way interactions between age, sleep and sex were added to the model. Significant interactions were further explored using the PROCESS macro in SPSS V.27 for Windows (Hayes, 2017).

### 3 | RESULTS

#### 3.1 | Prevalence of sleep difficulties

Overall, the prevalence estimate of sleep difficulties, i.e. at least one of the sleep items was scored as “often” or “always”, was 64.9%. Overall, difficulties initiating sleep were most common across all age groups (33%–54%), followed by daytime fatigue (25%–54%). Early awakenings (8%–20%) and difficulties maintaining sleep (10%–21%) were less common.

There were distinct differences in the occurrence of the four sleep difficulties between the three age groups (Figure 1).

Prevalence of the different types of sleep difficulties in young children varied between 17% and 33%. Difficulties initiating sleep (33%) and daytime fatigue (30%) were most prevalent in this young age group. In school-age children, the prevalence rates varied between 10% and 44% between the different sleep difficulties. In this age group, difficulties initiating sleep (44%) were most common, followed by daytime fatigue (25%). In the adolescent age group, difficulties initiating sleep (54%) and daytime fatigue (54%) occurred the most.

All sleep difficulties except for early morning awakenings were more prevalent among adolescent girls than boys. See Supplementary Table S2 for differences between boys and girls.

#### 3.2 | Descriptive statistics

Descriptive statistics of all quantitative study variables regarding the relationship between sleep difficulties and internalizing and externalizing problems are presented in Table 2. Sleep difficulties were

significantly more often reported for female adolescents, while this was not the case for younger age groups. Sex differences were also observed in internalizing problems in school-age children and adolescents: girls experienced more internalizing problems than boys. Boys, on the other hand, experienced more externalizing problems than girls in all three age groups.

Correlations between all quantitative study variables (i.e. age, sleep difficulties, internalizing and externalizing problems) are shown in Supplementary Table S1. In all three age groups, sleep difficulties were positively correlated with both internalizing and externalizing problems. Furthermore, a positive correlation was observed between age and sleep difficulties among adolescents. The correlation starts negative in the youngest age group and becomes positive among the adolescents. This shows that sleep difficulties seem to increase with age.

#### 3.2.1 | Associations between sleep difficulties and internalizing and externalizing problem behaviour

Multiple linear regression analyses were performed to explore the relationship between sleep difficulties and internalizing and externalizing problem behaviour. Before running the analyses, assumptions were checked and met, and outliers ( $Z > 3$ ;  $n = 29$ , see Table 3 for specification) were removed from the dataset.

#### 3.3 | Young children (1.5–5 years)

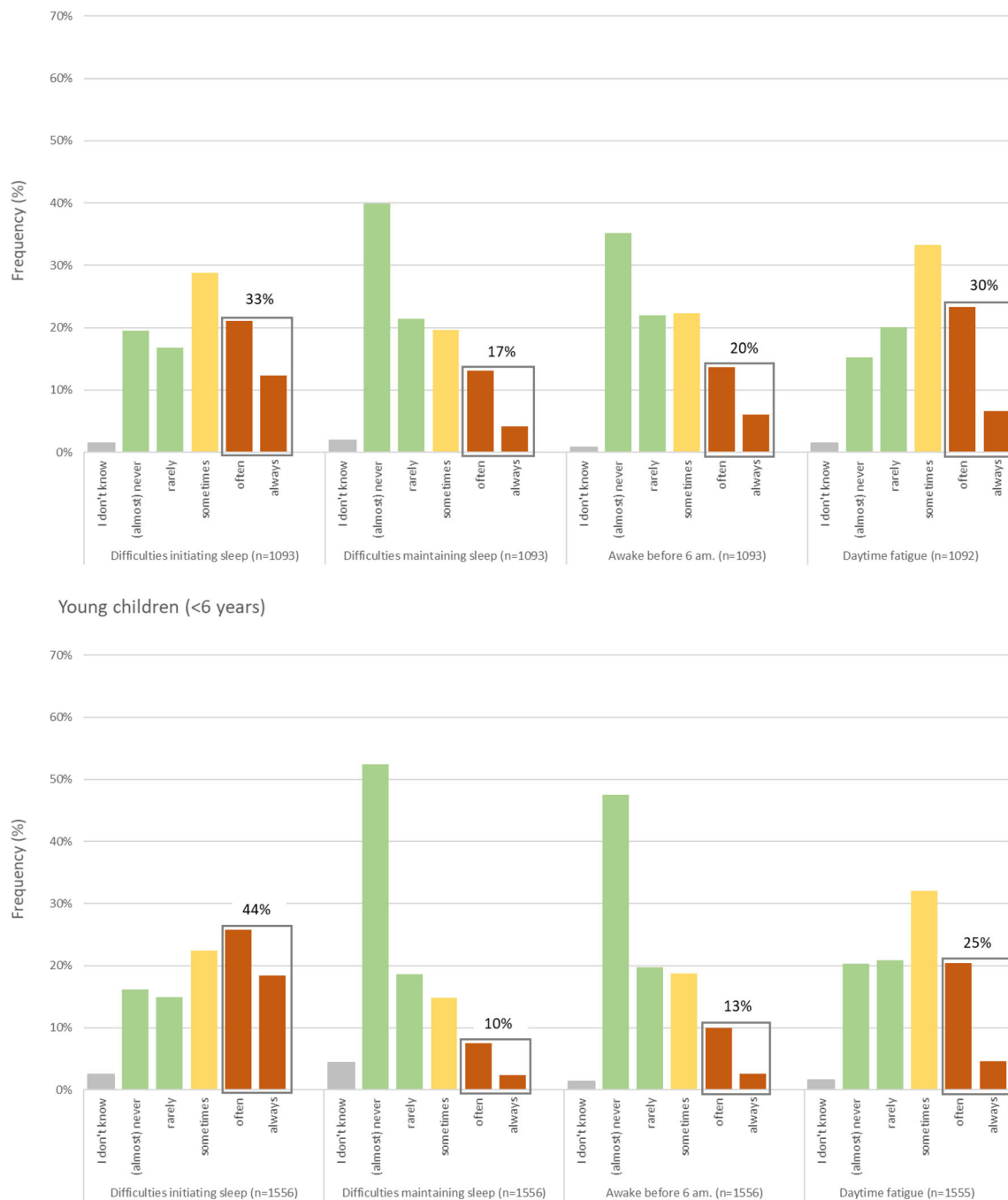
In the youngest age group, sleep difficulties were positively associated with both internalizing and externalizing problem behaviour (Table 3). Age significantly moderated the relationship between sleep difficulties and internalizing problems. Test of simple slopes revealed that the positive relationship between sleep difficulties and internalizing behaviour was stronger for children who were relatively older compared with children who were relatively younger (Figure 2).

#### 3.4 | School-age children (6–11 years)

In school-age children, sleep difficulties were also positively related to both internalizing and externalizing problem behaviour (Table 3), and age significantly moderated the relationship between sleep difficulties and internalizing problems. Test of simple slopes revealed that, similar as for young children, the relationship between sleep difficulties and internalizing behaviour was strongest for school-age children who were relatively older (Figure 3).

#### 3.5 | Adolescents (12–18 years)

Sleep difficulties were also positively associated with both internalizing and externalizing problem behaviour in the adolescent group (Table 3). Age and sex did not moderate these relationships.



**FIGURE 1** Prevalence of sleep difficulties in young children (1.5–5 years), school-age children (6–11 years) and adolescents (12–18 years).

## 4 | DISCUSSION

The first aim of this study was to estimate the prevalence of sleep difficulties in children and adolescents receiving specialized mental health care. Overall, the prevalence of sleep difficulties was 65%. There were differences in the prevalence of the four sleep difficulties between the three age groups. Difficulties initiating sleep was most prevalent across all age groups, followed by daytime fatigue. Both sleep difficulties were of especially high prevalence in the adolescent group. A recent meta-analysis with the same type of self-

reported and parent-reported sleep behaviour (i.e. difficulty maintaining sleep, difficulty initiating sleep and early morning awakenings; Kocevská et al., 2021) described prevalence rates of 4%–28% across children and adolescents from a normative population. Therefore, our findings suggest that, as expected, sleep difficulties are more common in children and adolescents admitted to specialized mental health care than in a normative population. Furthermore, similar to our findings, in this meta-analysis, more sleep difficulties were reported in adolescents than in children (Kocevská et al., 2021).

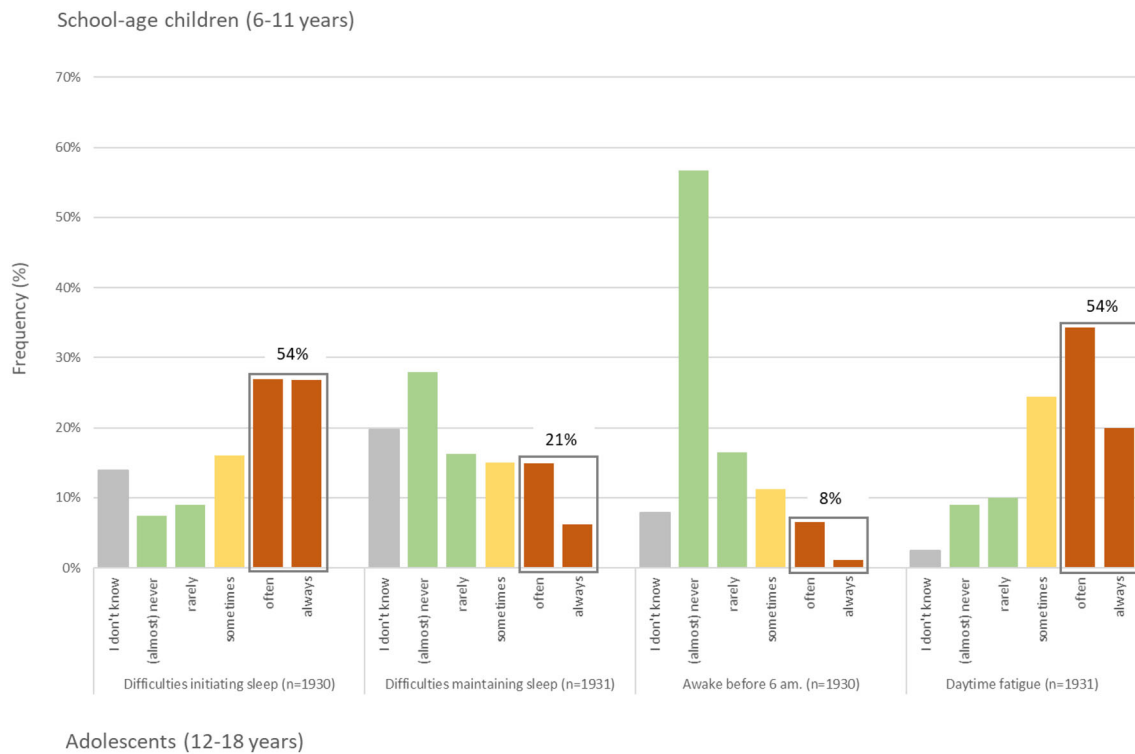


FIGURE 1 (Continued)

TABLE 2 Descriptive statistics of all quantitative study variables (centre: Karakter).

Young children (1.5–5 years) (n = 1014)	Boys (n = 716)		Girls (n = 298)		Group difference	
	M (SD)	Clinical score %	M (SD)	Clinical score %	p-value	Cohen's d
Age	3.68 (1.17)		3.69 (1.19)		0.429	−0.01
Sleep difficulties	1.58 (0.82)		1.64 (0.81)		0.111	−0.09
Internalizing problems	19.18 (9.58)	57.9%	20.45 (10.64)	61.3%	0.084	−0.13
Externalizing problems	24.60 (10.36)	55.7%	22.41 (9.89)	43.4%	0.002	0.21
School-age children (6–11 years) (n = 1337)	Boys (n = 895)		Girls (n = 442)		Group difference	
	M (SD)	Clinical score %	M (SD)	Clinical score %	p-value	Cohen's d
Age	8.38 (1.68)		8.60 (1.69)		0.013	−0.13
Sleep difficulties	1.42 (0.77)		1.54 (0.82)		0.007	−0.15
Internalizing problems	14.86 (8.95)	54.7%	17.51 (10.18)	70.7%	< 0.001	−0.28
Externalizing problems	17.22 (10.26)	57.4%	15.09 (9.97)	47.9%	< 0.001	0.21
Adolescents (12–18 years) (n = 1417)	Boys (n = 533)		Girls (n = 884)		Group difference	
	M (SD)	Clinical score %	M (SD)	Clinical score %	p-value	Cohen's d
Age	14.00 (1.50)		14.49 (1.49)		< 0.001	−0.33
Sleep difficulties	1.61 (0.86)		2.02 (0.85)		< 0.001	−0.48
Internalizing problems	19.20 (10.82)	65.0%	26.25 (10.93)	89.4%	< 0.001	−0.65
Externalizing problems	15.27 (11.22)	89.4%	12.84 (9.98)	28.7%	< 0.001	0.23

Note: The internalizing and externalizing problem scores presented are raw scores. The column “clinical score” refers to the percentage of children who had a *t*-score  $\geq 63$  (90th percentile) on the CBCL. This is an indicator that the child needs professional help.

In all three age groups, difficulties initiating sleep occurred the most, whereas in previous research on sleep difficulties among children without mental illness difficulties maintaining sleep was most

prevalent in these three age groups (Kocevska et al., 2021). A possible explanation for this contrast could lie in chronotype. Chronotype is a relatively stable trait that indicates preferences for the timing of



**TABLE 3** Associations between internalizing problem behaviour, externalizing problem behaviour and sleep difficulties per age group.

Young children (1.5–5 years)	Internalizing problem behaviour		Externalizing problem behaviour	
	b (SE)	p-value	b (SE)	p-value
Sleep difficulties	3.34 (0.35)	<0.001**	3.55 (0.37)	<0.001**
Sex	0.72 (0.67)	0.280	−2.48 (0.70)	<0.001**
Age	0.83 (0.37)	0.024	2.22 (0.38)	<0.001**
Interaction sex * age	−0.03 (0.71)	0.968	−0.04 (0.74)	0.959
Interaction sleep difficulties * age	0.87 (0.31)	0.005*	0.34 (0.32)	0.288
Interaction sleep difficulties * sex	0.14 (0.69)	0.838	0.77 (0.71)	0.277
	$F_{6,870} = 22.83$		$F_{6,875} = 30.10$	
	$p < 0.001^{***}$		$p < 0.001^{***}$	
	$R^2 = 0.136$		$R^2 = 0.171$	
School-age children (6–11 years)	Internalizing problem behaviour		Externalizing problem behaviour	
	b (SE)	p-value	b (SE)	p-value
Sleep difficulties	3.28 (0.31)	<0.001**	2.12 (0.37)	<0.001**
Sex	1.76 (0.53)	<0.001**	−2.52 (0.62)	<0.001**
Age	1.90 (0.30)	<0.001**	0.23 (0.36)	0.517
Interaction sex * age	0.03 (0.52)	0.960	−0.26 (0.62)	0.681
Interaction sleep difficulties * age	0.51 (0.26)	0.047	−0.39 (0.30)	0.199
Interaction sleep difficulties * sex	0.06 (0.52)	0.908	0.85 (0.62)	0.169
	$F_{6,1141} = 46.88$		$F_{6,1145} = 14.00$	
	$p < 0.001^{***}$		$p < 0.001^{***}$	
	$R^2 = 0.198$		$R^2 = 0.068$	
Adolescents (12–18 years)	Internalizing problem behaviour		Externalizing problem behaviour	
	b (SE)	p-value	b (SE)	p-value
Sleep difficulties	5.50 (0.51)	<0.001**	1.69 (0.51)	<0.001**
Sex	4.87 (0.65)	<0.001**	−2.48 (0.65)	<0.001**
Age	−0.39 (0.50)	0.439	−0.62 (0.50)	0.214
Interaction sex * age	0.36 (0.64)	0.571	−0.004 (0.64)	0.995
Interaction sleep difficulties * age	0.31 (0.31)	0.324	0.48 (0.31)	0.130
Interaction sleep difficulties * sex	−0.50 (0.64)	0.437	−0.81 (0.65)	0.212
	$F_{6,1088} = 72.26$		$F_{6,1078} = 5.08$	
	$p < 0.001^{***}$		$p < 0.001^{***}$	
	$R^2 = 0.285$		$R^2 = 0.027$	

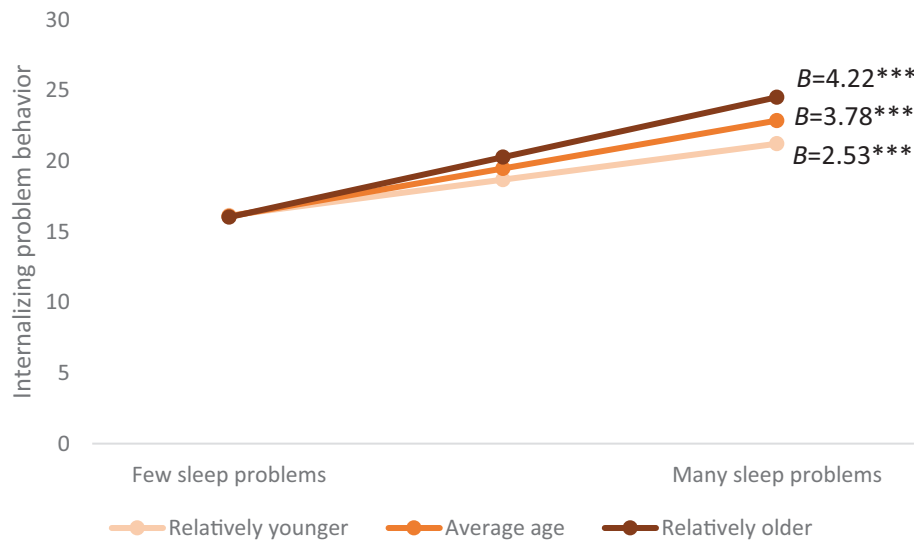
Note: Outliers ( $Z > 3$ )  $n = 3$  on age in age-group (1.5–5 years old). Outliers ( $Z > 3$ )  $n = 1$  on sleep difficulties in school-age children (6–11 years old). Outliers ( $Z > 3$ )  $n = 6$  on internalizing problems in young children (1.5–5 years old). Outliers ( $Z > 3$ )  $n = 6$  on internalizing problems in school-age children (6–11 years old). Outliers ( $Z > 3$ )  $n = 2$  on externalizing problems in school-age children (6–11 years old). Outliers ( $Z > 3$ )  $n = 11$  on externalizing problems in adolescents (12–18 years old).

\*Significant at the Bonferroni corrected  $p$ -value  $< 0.0083$ . \*\*Significant at  $p$ -value  $< 0.001$ .

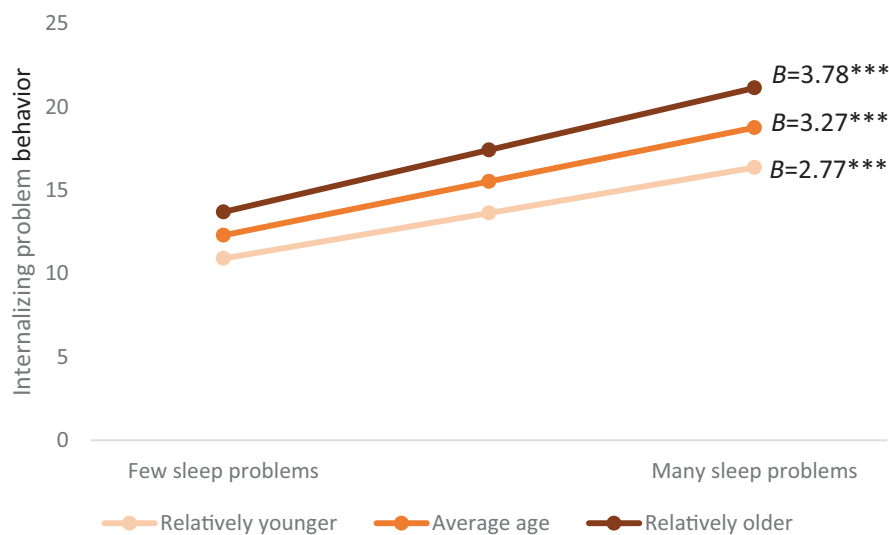
activity and rest throughout the day (Roenneberg, 2012). Sleep onset or insomnia issues may arise when children have a relatively late chronotype. Research has shown that children with ADHD have a stronger preference for scheduling activities later in the day (“evening preference”) compared with children without ADHD (Durmuş et al., 2017). Additionally, abnormalities in melatonin release in children with ASD have been found (Melke et al., 2008). A delayed release of melatonin is associated with difficulties in regulating rhythms linked to the biological clock, and with a late chronotype

(Kantermann et al., 2015). This could contribute to the high occurrence of difficulties initiating sleep in our population, given the substantial number of children in our population with ADHD or ASD.

Despite the lack of a longitudinal design, the prevalence of “difficulties initiating sleep” seems to increase during development. This is also observed in the general population, where difficulties initiating sleep appears to increase as children grow older (Kocevska et al., 2021). We might understand this from the fact that the biological clock shifts during development, which delays the circadian rhythm of adolescents,



**FIGURE 2** Interaction between age and sleep difficulties on internalizing problems in young children (1.5–5 years). \*\*\*Effects are significant at the 0.001 level.



**FIGURE 3** Interaction between age and sleep difficulties on internalizing problems in school-age children (6–11 year). \*\*\*Effects are significant at the 0.001 level.

and leads to a later onset of sleepiness and a naturally later wake-up time (Carskadon et al., 1997). Our findings thus appear to be consistent with the development of sleep difficulties in a normative population, albeit in general notably elevated in our clinical population. As mentioned before, the majority of our population consists of children with ADHD and ASD. Based on earlier research, sleep difficulties and neurodevelopmental disorders may have a shared aetiology, associated with a disruption of internal biological clock functioning (Durmuş et al., 2017; Melke et al., 2008; Neufeld et al., 2021).

The second aim of this study was to investigate the association between sleep difficulties and internalizing and externalizing behaviour problems in children and adolescents with mental illness. In all age groups, a positive association was found between sleep difficulties and both internalizing and externalizing problem behaviour. This is in line with other studies among non-clinical samples showing associations between sleep difficulties and internalizing and externalizing behaviour in toddlers (Reid et al., 2009), school-age children (Calhoun

et al., 2017) and in adolescents (Pieters et al., 2010; Pieters et al., 2015; Quach et al., 2018; Roberts et al., 2008).

Interestingly, a longitudinal study in 217 children with ADHD aged 5–13 years displayed a weak bidirectional relationship between sleep difficulties and internalizing and externalizing problems from baseline to 6 months. However, this effect attenuated from 6 to 12 months (Mulraney et al., 2016). This may be explained by the differences in populations, as our population includes children with different mental health illnesses, where the abovementioned study only included children with ADHD.

Various potential mechanisms have been suggested to explain the connection between sleep and internalizing and externalizing problems (Bayes & Bullock, 2020). Before falling asleep, anxious children (Peterman et al., 2015) and adolescents with depression have been found to experience an elevation in cortisol levels, leading to heightened cognitive and somatic arousal, thereby making the initiation of sleep more challenging (Forbes et al., 2006; Richardson, 2007). The



abovementioned response leads to shorter sleep duration, which could result in daytime fatigue and in its turn may further increase internalizing problems, resulting in a vicious cycle (Bayes & Bullock, 2020). This is in line with the strong correlation we observed between internalizing problems and daytime fatigue. The strong correlation we found between difficulties maintaining sleep and internalizing problems also corresponds with previous research in adolescents showing that a sleeping profile characterized by difficulties initiating sleep and maintaining sleep was associated with internalizing problems (Cooper et al., 2023). Regarding externalizing problems, an underlying mechanism explaining the relationship with sleep difficulties could be related to genes linked to the circadian system, including so-called CLOCK genes. Altered clock gene function is related to both alterations in sleep as well as hyperactivity and aggressive behaviour (Mogavero et al., 2018). Although further research is needed, it could be suggested that the circadian system might function as an overarching factor affecting both sleep and problem behaviours.

However, results from the current study showed that the explained variance from the model was greater for internalizing problems than for externalizing problems, suggesting a stronger relationship between sleep difficulties and internalizing problems than for externalizing problems. This is in line with previous longitudinal research, which found also a relationship between internalizing problems and sleep difficulties. In line with these findings, scholars have also suggested that attending to sleep difficulties in treatments could prevent the progression of internalizing problems (Williamson et al., 2020). This association can potentially be explained by the evidence that sleep disturbances have been demonstrated to impair emotional processes involving the amygdala and prefrontal cortex (Dahl, 1996; Silk et al., 2007; Talbot et al., 2010). This may lead to various emotional problems such as internalizing problem behaviour, which can lead to externalizing problem behaviour on the long term (Williamson et al., 2020).

On the other hand, from the literature we do find associations between sleep difficulties and externalizing problem behaviour, which seems to be driven by an underlying behavioural profile (Bayes & Bullock, 2020). In this scenario, sleep difficulties appear to be explained by childhood behavioural insomnia (Holley et al., 2011), which is characterized by bedtime resistance and learned associations with sleep onset (dependent on a particular person or item) that the child relies on to facilitate the process of falling asleep (Bayes & Bullock, 2020). Furthermore, frequent sleep difficulties have a self-perpetuating effect, including negatively affecting emotion regulation and cognitive processes, thereby posing a significant risk for the development of behavioural addictions and other problematic coping styles (Palmer et al., 2018; Pieters et al., 2010; Pieters et al., 2015). As problems with sleep patterns appear to play a significant role in the complex aetiology of mental disorders, sleep rhythm is regarded as an important transdiagnostic process (Harvey & Buysse, 2017). Based on previous research and our results, we speculate on the existence of a bidirectional process between the increase of sleep difficulties and the increase of both internalizing and externalizing problem behaviour.

Moreover, a moderating role of age was found on the association between sleep difficulties and internalizing problem behaviour for the youngest children and school-aged children; the relationship was stronger with increasing age, in line with other studies (Baglioni et al., 2011; Hysing et al., 2016; Sivertsen et al., 2015). This may reflect a negative spiral where sleep difficulties and internalizing problems reinforce each other when children become older, further supporting the idea of a bidirectional relationship. However, the underlying mechanism involved in this association is not yet fully understood. Surprisingly, we did not find a moderating effect of age on the association between sleep difficulties and internalizing problem behaviour for adolescents, which contradicts the hypothesis that the association between sleep difficulties and internalizing problems is strengthened with age. This could be explained by the fact that the majority of adolescents in our sample were girls, and most of these girls had a clinically elevated score on internalizing problems. The small range of variation (restriction of range) may explain why no significant moderating effect of age on association between sleep difficulties and internalizing problems was found in this group.

It was further hypothesized that we would find a sex difference in sleep difficulties and that sex would potentially play a moderating role on the association between sleep difficulties and internalizing or externalizing problem behaviour. We did find differences between boys and girls in sleep difficulties, especially in school-age children and adolescents, such that girls showed relatively more difficulties in various sleep behaviour. This is in line with previous research among school-age children with autism that has identified sex differences in sleep problems, with girls exhibiting more sleep problems than boys (Estes et al., 2023). Furthermore, also a study on a normative population of children and adolescents did find differences in sex on sleeping difficulties, where these difficulties were more frequently observed in girls (Lewien et al., 2021). On the contrary, a systematic review among a normative population of children did not find sex as a predictor of sleep problems (Newton et al., 2020). Although we found a difference in sleep difficulties between boys and girls, we did not find a moderating role of sex on the association for all three age-groups. This is in contrast with a study in adolescents that showed that the relationship between sleep problems and internalizing problems was moderated by sex (Mathew et al., 2019). Previous research investigating the moderating role of sex did find stronger associations for girls than for boys. This was mostly explained by the pubertal status, which lead to more sleep difficulties for girls than for boys (i.e. the influence of hormones on sleep behaviour, the menstrual cycle that worsens sleep quality, and a delayed sleep phase during puberty that causes sleep difficulties; Haufe & Leeners, 2023; Sadeh et al., 2009; Zhang et al., 2016). Because we did not control for pubertal status in our study, this could be a potential explanation for why we did not find a moderating role of sex within our sample.

One of the strengths of the current study is that it included a large sample of children and adolescents with mental illness, covering a relatively large part of the Netherlands, leading to increased heterogeneity. This study also has some limitations. First, the intake questionnaire that was used to estimate sleep difficulties is not a clinically

validated instrument with norm scores. This questionnaire was designed for clinical screening purposes, and the effort for parents had to be low. As a result, only essential questions related to sleep were included, based on items from the validated “Sleep Habit Questionnaire” (CHSQ; Bonuck et al., 2017). Second, to examine the occurrence of sleep difficulties, we established an artificial cut-off score by aggregating the outcome options “often” and “always”. This score attenuates the severity measure. Third, only parent-reported data were available, resulting in a lack of subjective and/or objective data from the children and adolescents themselves. It is plausible that parents have less insight into sleep behaviour of older children, potentially rendering the data from adolescents less accurate than that of younger children. Furthermore, another limitation is that we did not utilize norm scores of sleep difficulties among the normative population. In this way, it was not possible to compare scores of the normative population with the clinical population, which makes it harder to indicate whether these sleep difficulties are actually different from those of the normative population.

In future studies it is important to look at longitudinal associations between sleep difficulties and internalizing and externalizing problem behaviour within clinical populations, to shed light on possible causal relationships. In addition, adding objective measurements to examine sleep can help us with conclusively asserting the presence of sleep difficulties (e.g. the use of actigraphy and sleep diaries; van Tetering et al., 2023). Finally, it is important to obtain norm scores from a normative population to compare the clinical population with.

To conclude, the occurrence of sleep difficulties among children with mental illness seems to be higher than for children without mental illness, with difficulties initiating sleep being the most common sleep problem in all age groups. Moreover, a positive association was found between sleep difficulties and both internalizing and externalizing problems. The public health implications of these associations are important. They underline the importance of a transdiagnostic approach in sleep interventions and of focusing on both areas of concern: sleep difficulties and mental health illness. Additionally, based on previous research, focusing on chronotype and sleep rhythm seems to be important, especially in children with ADHD and ASD. In addition to including sleep in mental health care, it is also important to take into account overall lifestyle, and thereby the general health, of a child or adolescent (van Tetering et al., 2023).

## AUTHOR CONTRIBUTIONS

**Emilie M. A. van Tetering:** Conceptualization; investigation; methodology; writing – review and editing; formal analysis; writing – original draft. **Gabry W. Mies:** Conceptualization; investigation; writing – review and editing; formal analysis; supervision. **Helen Klip:** Writing – review and editing. **Sigrid Pillen:** Writing – review and editing. **Jet B. Muskens:** Writing – review and editing. **Tinca J. C. Polderman:** Writing – review and editing. **Malindi van der Mheen:** Writing – review and editing. **Wouter G. Staal:** Writing – review and editing. **Sara Pieters:** Writing – review and editing; supervision; methodology; formal analysis; conceptualization; investigation.

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## CONFLICT OF INTEREST STATEMENT

The authors declare no financial or non-financial conflict of interest.

## DATA AVAILABILITY STATEMENT

The original data supporting the conclusions of this article are available from the corresponding author upon reasonable request, conforming to the journal's guidelines. This paper was already published on preprint on Research square, the DOI is: [10.21203/rs.3.rs-4600082/v1](https://doi.org/10.21203/rs.3.rs-4600082/v1).

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## REFERENCES

- Achenbach, T. M., & Rescorla, L. A. (2000). *Manual for the ASEBA preschool forms and profiles* (Vol. 30). University of Vermont, Research center for children, youth ....
- Allen, S. L., Howlett, M. D., Coulombe, J. A., & Corkum, P. V. (2016). ABCs of SLEEPING: A review of the evidence behind pediatric sleep practice recommendations. *Sleep Medicine Reviews*, 29, 1–14.
- American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). American Psychiatric Association.
- Baglioni, C., Battagliese, G., Feige, B., Spiegelhalter, K., Nissen, C., Voderholzer, U., Lombardo, C., & Riemann, D. (2011). Insomnia as a predictor of depression: A meta-analytic evaluation of longitudinal epidemiological studies. *Journal of Affective Disorders*, 135(1–3), 10–19.
- Bayes, D. M., & Bullock, B. (2020). Sleep problems in school aged children: A common process across Internalising and Externalising Behaviours? *Clocks & Sleep*, 2(1), 7–18.
- Blackmer, A. B., & Feinstein, J. A. (2016). *Management of sleep disorders in children with neurodevelopmental disorders: A review*. Pharmacotherapy: The journal of human pharmacology and drug. *Therapy*, 36(1), 84–98.
- Bonuck, K. A., Goodlin-Jones, B. L., Schechter, C., & Owens, J. (2017). Modified Children's sleep habits questionnaire for behavioral sleep problems: A validation study. *Sleep Health*, 3(3), 136–141.
- 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.
- Caldwell, B. A., & Redeker, N. S. (2015). Maternal stress and psychological status and sleep in minority preschool children. *Public Health Nursing*, 32(2), 101–111.
- Calhoun, S. L., Fernandez-Mendoza, J., Vgontzas, A. N., Mayes, S. D., Liao, D., & Bixler, E. O. (2017). Behavioral profiles associated with objective sleep duration in young children with insomnia symptoms. *Journal of Abnormal Child Psychology*, 45(2), 337–344.
- Carskadon, M. A., Acebo, C., Richardson, G. S., Tate, B. A., & Seifer, R. (1997). An approach to studying circadian rhythms of adolescent humans. *Journal of Biological Rhythms*, 12(3), 278–289.
- Cooper, R., di Biase, M. A., Bei, B., Quach, J., & Cropley, V. (2023). Associations of changes in sleep and emotional and behavioral problems from late childhood to early adolescence. *JAMA Psychiatry*, 80(6), 585–596.

- Cortese, S., Faraone, S. V., Konofal, E., & Lecendreux, M. (2009). Sleep in children with attention-deficit/hyperactivity disorder: Meta-analysis of subjective and objective studies. *Journal of the American Academy of Child & Adolescent Psychiatry*, 48(9), 894–908.
- Cortesi, F., Giannotti, F., Ivanenko, A., & Johnson, K. (2010). Sleep in children with autistic spectrum disorder. *Sleep Medicine*, 11(7), 659–664.
- Dahl, R. E. (1996). The regulation of sleep and arousal: Development and psychopathology. *Development and Psychopathology*, 8(1), 3–27.
- Davis, K. F. (2004). Sleep in infants and young children: Part one: Normal sleep. *Journal of Pediatric Health Care*, 18(2), 65–71.
- Durmuş, F. B., Arman, A. R., & Ayaz, A. B. (2017). Chronotype and its relationship with sleep disorders in children with attention deficit hyperactivity disorder. *Chronobiology International*, 34(7), 886–894.
- Estes, A., Munson, J., St. John, T., Finlayson, R., Pandey, J., Gottlieb, B., Herrington, J., & Schultz, R. T. (2023). Sleep problems in autism: Sex differences in the school-age population. *Autism Research*, 16(1), 164–173.
- Fang, H., Tu, S., Sheng, J., & Shao, A. (2019). Depression in sleep disturbance: A review on a bidirectional relationship, mechanisms and treatment. *Journal of Cellular and Molecular Medicine*, 23(4), 2324–2332.
- Forbes, E. E., Williamson, D. E., Ryan, N. D., Birmaher, B., Axelson, D. A., & Dahl, R. E. (2006). Peri-sleep-onset cortisol levels in children and adolescents with affective disorders. *Biological Psychiatry*, 59(1), 24–30.
- Gradisar, M., Gardner, G., & Dohnt, H. (2011). Recent worldwide sleep patterns and problems during adolescence: A review and meta-analysis of age, region, and sleep. *Sleep Medicine*, 12(2), 110–118.
- Gregory, A. M., & Sadeh, A. (2016). Annual research review: Sleep problems in childhood psychiatric disorders—a review of the latest science. *Journal of Child Psychology and Psychiatry*, 57(3), 296–317.
- Gregory, A. M., van der Ende, J., Willis, T. A., & Verhulst, F. C. (2008). Parent-reported sleep problems during development and self-reported anxiety/depression, attention problems, and aggressive behavior later in life. *Archives of Pediatrics & Adolescent Medicine*, 162(4), 330–335.
- Harvey, A. G., & Buysse, D. J. (2017). *Treating sleep problems: A transdiagnostic approach*. Guilford Publications.
- Haufe, A., & Leeners, B. (2023). Sleep disturbances across a Woman's lifespan: What is the role of reproductive hormones? *Journal of the Endocrine Society*, 7(5), bvad036.
- Hayes, A. F. (2017). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach*. Guilford publications.
- Holley, S., Hill, C., & Stevenson, J. (2011). An hour less sleep is a risk factor for childhood conduct problems. *Child: Care, Health and Development*, 37(4), 563–570.
- Hysing, M., Sivertsen, B., Garthus-Niegel, S., & Eberhard-Gran, M. (2016). Pediatric sleep problems and social-emotional problems. A population-based study. *Infant Behavior and Development*, 42, 111–118.
- Kahn, M., Sheppes, G., & Sadeh, A. (2013). Sleep and emotions: Bidirectional links and underlying mechanisms. *International Journal of Psychophysiology*, 89(2), 218–228.
- Kantermann, T., Sung, H., & Burgess, H. J. (2015). Comparing the Morningness-Eveningness questionnaire and Munich ChronoType questionnaire to the dim light melatonin onset. *Journal of Biological Rhythms*, 30(5), 449–453.
- Kocevska, D., Lysen, T. S., Dotinga, A., Koopman-Verhoeff, M. E., Luijk, M. P. C. M., Antypa, N., Biermasz, N. R., Blokstra, A., Brug, J., Burk, W. J., Comijs, H. C., Corpeleijn, E., Dashti, H. S., de Bruin, E. J., de Graaf, R., Derks, I. P. M., Dewald-Kaufmann, J. F., Elders, P. J. M., Gemke, R. J. B. J., ... Tiemeier, H. (2021). *Sleep characteristics across the lifespan in 1.1 million people from The Netherlands, United Kingdom and United States: A systematic review and meta-analysis*. *Nature human Behaviour*, 5(1), 113–122.
- Lecendreux, M., Konofal, E., Bouvard, M., Falissard, B., & Mouroen-Siméoni, M. C. (2000). Sleep and alertness in children with ADHD. *The Journal of Child Psychology and Psychiatry and Allied Disciplines*, 41(6), 803–812.
- Lewien, C., Genuneit, J., Meigen, C., Kiess, W., & Poulain, T. (2021). Sleep-related difficulties in healthy children and adolescents. *BMC Pediatrics*, 21, 1–11.
- Martin, C. A. (2019). Associations between parenting stress, parent mental health and child sleep problems for children with ADHD and ASD: Systematic review. *Research in Developmental Disabilities*, 93, 103463.
- Mathew, G. M., Hale, L., & Chang, A.-M. (2019). Sex moderates relationships among school night sleep duration, social jetlag, and depressive symptoms in adolescents. *Journal of Biological Rhythms*, 34(2), 205–217.
- Melke, J., Goubran Botros, H., Chaste, P., Betancur, C., Nygren, G., Anckarsäter, H., Rastam, M., Ståhlberg, O., Gillberg, I. C., Delorme, R., Chabane, N., Mouroen-Simeoni, M. C., Fauchereau, F., Durand, C. M., Chevalier, F., Drouot, X., Collet, C., Launay, J. M., Leboyer, M., ... and the PARIS study. (2008). Abnormal melatonin synthesis in autism spectrum disorders. *Molecular Psychiatry*, 13(1), 90–98.
- Mogavero, F., Jager, A., & Glennon, J. C. (2018). Clock genes, ADHD and aggression. *Neuroscience & Biobehavioral Reviews*, 91, 51–68.
- Moore, M., & Meltzer, L. J. (2008). The sleepy adolescent: Causes and consequences of sleepiness in teens. *Paediatric Respiratory Reviews*, 9(2), 114–121.
- Mulroney, M., Giallo, R., Lycett, K., Mensah, F., & Sciberras, E. (2016). The bidirectional relationship between sleep problems and internalizing and externalizing problems in children with ADHD: A prospective cohort study. *Sleep Medicine*, 17, 45–51.
- Muskens, J. B., Ester, W. A., Klip, H., Zinkstok, J., van Dongen-Boomsma, M., & Staal, W. G. (2023). Novel insights into somatic comorbidities in children and adolescents across psychiatric diagnoses: an explorative study. *Child Psychiatry & Human Development*, 1–11.
- Neufeld, J., Hederos Eriksson, L., Hammarsten, R., Lundin Remnélius, K., Tillmann, J., Isaksson, J., & Bölte, S. (2021). The impact of atypical sensory processing on adaptive functioning within and beyond autism: The role of familial factors. *Autism*, 25(8), 2341–2355.
- Newton, A. T., Honaker, S. M., & Reid, G. J. (2020). Risk and protective factors and processes for behavioral sleep problems among preschool and early school-aged children: A systematic review. *Sleep Medicine Reviews*, 52, 101303.
- Owens, J. A., & Mindell, J. A. (2011). Pediatric insomnia. *Pediatric Clinics*, 58(3), 555–569.
- Palmer, C. A., Oosterhoff, B., Bower, J. L., Kaplow, J. B., & Alfano, C. A. (2018). Associations among adolescent sleep problems, emotion regulation, and affective disorders: Findings from a nationally representative sample. *Journal of Psychiatric Research*, 96, 1–8.
- Peterman, J. S., Carper, M. M., & Kendall, P. C. (2015). Anxiety disorders and comorbid sleep problems in school-aged youth: Review and future research directions. *Child Psychiatry & Human Development*, 46, 376–392.
- Pieters, S., Burk, W. J., van der Vorst, H., Dahl, R. E., Wiers, R. W., & Engels, R. C. M. E. (2015). Prospective relationships between sleep problems and substance use, internalizing and externalizing problems. *Journal of Youth and Adolescence*, 44(2), 379–388.
- Pieters, S., van der Vorst, H., Burk, W. J., Wiers, R. W., & Engels, R. C. M. E. (2010). Puberty-dependent sleep regulation and alcohol use in early adolescents. *Alcoholism: Clinical and Experimental Research*, 34(9), 1512–1518.
- Quach, J. L., Nguyen, C. D., Williams, K. E., & Sciberras, E. (2018). Bidirectional associations between child sleep problems and internalizing and externalizing difficulties from preschool to early adolescence. *JAMA Pediatrics*, 172(2), e174363.
- Reid, G. J., Hong, R. Y., & Wade, T. J. (2009). The relation between common sleep problems and emotional and behavioral problems among 2- and 3-year-olds in the context of known risk factors for psychopathology. *Journal of Sleep Research*, 18(1), 49–59.
- Richardson, G. S. (2007). Human physiological models of insomnia. *Sleep Medicine*, 8, S9–S14.

- Roberts, R. E., Ramsay Roberts, C., & Chan, W. (2008). Persistence and change in symptoms of insomnia among adolescents. *Sleep*, 31(2), 177–184.
- Roenneberg, T. (2012). What is chronotype? *Sleep and Biological Rhythms*, 10, 75–76.
- Rubens, S. L. (2017). Self-reported time in bed and sleep quality in association with internalizing and externalizing symptoms in school-age youth. *Child Psychiatry and Human Development*, 48(3), 455–467.
- Sadeh, A., Dahl, R. E., Shahar, G., & Rosenblat-Stein, S. (2009). Sleep and the transition to adolescence: A longitudinal study. *Sleep*, 32(12), 1602–1609.
- Silk, J. S., Vanderbilt-Adriance, E., Shaw, D. S., Forbes, E. E., Whalen, D. J., Ryan, N. D., & Dahl, R. E. (2007). Resilience among children and adolescents at risk for depression: Mediation and moderation across social and neurobiological contexts. *Development and Psychopathology*, 19(3), 841–865.
- Sivertsen, B., Harvey, A. G., Reichborn-Kjennerud, T., Torgersen, L., Ystrom, E., & Hysing, M. (2015). Later emotional and behavioral problems associated with sleep problems in toddlers: A longitudinal study. *JAMA Pediatrics*, 169(6), 575–582.
- Stoffelsen, R., & Shalini, S. (2022). Handboek kinder- en jeugdpsychiatrie. In *Hoodstuk 24 Slaap-waakstoornissen* (pp. 454–466). Boom uitgevers.
- Talbot, L. S., McGlinchey, E. L., Kaplan, K. A., Dahl, R. E., & Harvey, A. G. (2010). Sleep deprivation in adolescents and adults: Changes in affect. *Emotion*, 10(6), 831–841.
- Touchette, É., Petit, D., Séguin, J. R., Boivin, M., Tremblay, R. E., & Montplaisir, J. Y. (2007). Associations between sleep duration patterns and behavioral/cognitive functioning at school entry. *Sleep*, 30(9), 1213–1219.
- van Tetering, E. M. A., Muskens, J. B., Deenik, J., Pillen, S., Cahn, W., von Rosenstiel, I., Oomen, M., Rommelse, N. N., Staal, W. G., & Klip, H. (2023). The short and long-term effects of a lifestyle intervention in children with mental illnesses: A randomized controlled trial (Movementss study). *BMC Psychiatry*, 23(1), 529.
- Verhulst, F. C., & Van der Ende, J. (2013). *Handleiding ASEBA-Vragenlijsten voor leeftijden 6 t/m 18 jaar: CBCL/6–18, YSR en TRF*. ASEBA Nederland.
- Vriend, J. L., Davidson, F. D., Corkum, P. V., Rusak, B., Chambers, C. T., & McLaughlin, E. N. (2013). Manipulating sleep duration alters emotional functioning and cognitive performance in children. *Journal of Pediatric Psychology*, 38(10), 1058–1069.
- Williamson, A. A., Zendarski, N., Lange, K., Quach, J., Molloy, C., Clifford, S. A., & Mulraney, M. (2020). Sleep problems, internalizing and externalizing symptoms, and domains of health-related quality of life: Bidirectional associations from early childhood to early adolescence. *Sleep*, 44(1), 1–11.
- Yoo, S.-S., Gujar, N., Hu, P., Jolesz, F. A., & Walker, M. P. (2007). The human emotional brain without sleep – A prefrontal amygdala disconnect. *Current Biology*, 17(20), R877–R878.
- Zhang, J., Chan, N. Y., Lam, S. P., Li, S. X., Liu, Y., Chan, J. W. Y., Kong, A. P. S., Ma, R. C. W., Chan, K. C. C., Li, A. M., & Wing, Y. K. (2016). Emergence of sex differences in insomnia symptoms in adolescents: A large-scale school-based study. *Sleep*, 39(8), 1563–1570.

## SUPPORTING INFORMATION

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