



Original Article

The bidirectional relationship between sleep problems and internalizing and externalizing problems in children with ADHD: a prospective cohort study



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ABSTRACT

Background: Behavioral sleep problems are common in children with attention deficit hyperactivity disorder (ADHD), and longitudinal studies have found sleep problems to be both a predictor and outcome of internalizing and externalizing problems. We investigated the potential bidirectional relationship between sleep problems and internalizing/externalizing problems.

Methods: Children with ADHD, aged 5–13 years, were recruited from 21 pediatric practices across Victoria, Australia ($N = 270$). Across a 12-month period, at three time points, parents reported on their child's sleep problems (Children's Sleep Habits Questionnaire) and emotional and behavioral functioning (Strengths and Difficulties Questionnaire). Data were analyzed using autoregressive cross-lagged panel models.

Results: Sleep problem severity and emotional/behavioral problem severity were very stable across the 12-month period. Sleep problems at baseline predicted emotional problems at six months ($r = 0.17$, $p < 0.01$), and emotional problems at baseline predicted sleep problems at six months ($r = 0.07$, $p < 0.05$). However, there was no predictive relationship between sleep problems and emotional problems from 6–12 months. No bidirectional relationship was observed between sleep problems and conduct problems.

Conclusions: In children with ADHD, there is weak evidence of a bidirectional relationship between sleep problems and emotional problems. These symptoms are also very stable over time; therefore, the best treatment approach to improve overall functioning may be to target both sleep and emotional functioning in these children.

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Up to 70% of children with ADHD experience caregiver-reported sleep problems, including difficulties initiating and maintaining sleep [1–3]. A cross-sectional analysis showed that sleep problems in children with ADHD are associated with poorer quality of life [1], caregiver mental health difficulties [1], ADHD medication use [4], ADHD symptom severity [4], and of particular interest, higher proportions of comorbid internalizing and externalizing problems [5–7]. However, the directionality of the relationship between internalizing and externalizing problems and sleep problems in children with ADHD is unknown – largely due to a paucity of longitudinal studies

in this area [4]. Over 50% of children with ADHD present with comorbid externalizing problems [8], and 25–64% present with comorbid internalizing disorders [9,10]. If sleep problems predict greater internalizing and externalizing problems over time, then managing sleep problems may be one way of reducing the burden of mental health problems for children with ADHD. Conversely, treating internalizing and externalizing problems may help to reduce sleep problems in this population. We aimed to elucidate the longitudinal relationship between internalizing and externalizing problems and sleep problems within a large clinical sample of school-aged children with ADHD.

Strong evidence of a cross-sectional association between internalizing problems and sleep problems has been found in children with ADHD [5,6,11,12]. However, the association between sleep and externalizing problems is less clear with some studies finding a link [4,11], while others have not [5]. For example, in a sample of 122

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children with ADHD, the presence of multiple anxiety disorders was the strongest predictor of sleep problems, while the presence of an externalizing disorder was only associated with increased bedtime resistance [11]. Similarly, a study of 681 children with ADHD found no difference in sleep problems between children with and without an externalizing disorder, whereas children with a comorbid internalizing disorder had more sleep problems than children without an internalizing disorder [5].

A number of studies in the general population (~5% of which have ADHD) have also found that sleep problems predict emotional and behavioral difficulties in early to mid-adolescence [13–16]. The vast majority of studies focus on the relationship between internalizing problems and sleep problems. The meta-analysis by Baglioni et al. [17] reported a twofold increase in risk of developing depression among nondepressed children and adolescents with insomnia compared to children and adolescents without insomnia. In a study that retrospectively investigated the onset of mental health problems in adolescents, insomnia preceded depression in 69% of cases, while anxiety preceded insomnia in 73% of cases [18]. Yet, studies investigating the relationship between sleep and behavioral difficulties are scarce. One of the few studies, by Gregory and Connor [16], investigated both internalizing and externalizing problems. In their community-based study of 490 children, sleep problems at four years of age predicted depression/anxiety, attention problems, and aggression 11 years later, even after controlling for gender, baseline symptoms, and stability of internalizing and externalizing problems. Thus, it would seem that, in the general population, the relationship between sleep problems and mental health is bidirectional and may partially be dependent upon the nature of the problem.

Very few studies have investigated sleep problems in children with ADHD using longitudinal designs. Lycett et al. [19] found that co-occurring internalizing and externalizing comorbidities were the strongest predictor of both transient and persistent sleep problems in children with ADHD. Becker et al. [20] found that, after controlling for baseline symptoms, sleep problems in children with ADHD predicted both externalizing symptoms and depressive symptoms 12 months later. It is possible that the relationship between sleep and mental health is bidirectional and that sleep problems may predict mental health problems in children with ADHD. However, existing studies have yet to examine the potential bidirectional relationship between sleep and internalizing and externalizing problems in children with ADHD.

Delineating associations between sleep problems and internalizing and externalizing problems in children with ADHD, and understanding how these relationships develop over time, requires repeated measures of sleep and internalizing and externalizing problems. Over a 12-month period, at three time points, we collected data on sleep and internalizing and externalizing problems in children with ADHD. As such, we aimed to explore the mutual influence of children's sleep problems and their internalizing and externalizing problems. It was hypothesized that there would be bidirectional relationships between sleep problems and internalizing problems, and sleep problems and externalizing difficulties.

1. Methods

1.1. Design and setting

This study comprises two harmonized samples of children with ADHD, those with (1) a moderate/severe sleep problem participating in a randomized-controlled trial (RCT) of a behavioral sleep intervention [21], and (2) no/mild sleep problem participating in a prospective cohort study [22]. Both samples were drawn from the same sample frame – 21 private and public pediatric practices across the state of Victoria (population 5.8 million [23]), Australia. The methods for these studies have been published elsewhere [22] and are briefly summa-

rized below. Children from the RCT intervention arm were excluded from this study, given that the intervention was found to improve sleep problems in children with ADHD over time [24].

1.2. Eligibility and recruitment

Through convenience sampling, 50 of the 87 pediatricians who were invited to take part in recruitment participated. Pediatricians sent study invitation letters to caregivers of all children who were diagnosed with ADHD, aged 5–12 years, whom they had seen in the past 12 months. After a 2-week period, pediatricians provided the contact details of all the families that had not “opted out” of hearing more about the study to the research team. Families were then telephoned to assess eligibility and ascertain interest. This study recruited children between August 2010 and October 2012.

1.2.1. Inclusion criteria

Children were eligible if at the time of the recruitment call they (1) were aged 5–13 years, and (2) met full Diagnostic and Statistical Manual of Mental Disorders 4th edition (DSM-IV) criteria for ADHD. All children approached had an ADHD diagnosis from their pediatrician, which in accordance with national guidelines requires cross-situational impairment at kindergarten or school as well as home [25]. At the time of recruitment, children also need to meet DSM-IV criteria for ADHD as assessed by caregiver report on the validated 18-item ADHD Rating Scale IV [26] (also used to define ADHD subtype) and study-designed questions. As per DSM-IV, children were rated off medication and were eligible if they were often/very often experiencing at least six of the nine symptoms within inattention and/or hyperactivity/impulsivity domains and had symptom duration of at least six months, age of onset before seven years, and cross-situational impairment (ie, home, school, and/or peers). Parents also needed to be able to report on the child's *sleep problem severity*. They were asked “Has your child's sleep been a problem for you over the past four weeks?” If “yes,” they were asked to rate the severity (mild/moderate/severe) [1]. If a moderate/severe sleep problem was reported, caregivers were asked several questions to ensure that the sleep problem met the International Classification of Sleep Disorders diagnostic criteria for at least one behavioral sleep disorder (eg, limit-setting disorder, sleep-onset association disorder, delayed sleep phase, insomnia) [27] or nighttime anxiety. Sleep problem severity was dichotomized into two groups: no/mild and moderate/severe. Children with a caregiver reported moderate/severe behavioral sleep problem were eligible for the RCT, while children whose caregiver reported that they had no/mild sleep problem were eligible for the cohort study.

1.2.2. Exclusion criteria

Children were excluded if (1) their primary caregiver had insufficient English to take part; (2) they were receiving specialist sleep assistance from someone other than their pediatrician; (3) they had a serious medical condition (e.g., cerebral palsy) or intellectual disability (IQ <70 as identified and assessed by their pediatrician) – as this is likely to impact on child sleep; or (4) they screened positive for obstructive sleep apnea (assessed using the Children's Sleep Habits Questionnaire – CSHQ [28]) – a common sleep problem in children with ADHD [2], but not behavioral in nature.

1.3. Procedures

Eligible families were sent an enrolment pack comprising an information sheet, consent form, baseline survey, and reply paid envelope. Upon receipt of the completed consent form and survey, families were enrolled, and primary caregivers were telephoned to complete a semi-structured diagnostic interview (Anxiety Disorders Interview Schedule for Children IV). Primary caregivers also

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