

Anxiety disorders and sleep in children and adolescents

Willis, T.A. & Gregory, A.M.

Thomas A. Willis, BSc, PhD

Academic Unit of Primary Care,

Leeds Institute of Health Sciences,

University of Leeds

Leeds, LS2 9LJ

UK

Phone: +44(0)113 343 7119

Fax: +44(0)113 343 0862

Email: t.a.willis@leeds.ac.uk

Alice M. Gregory, BA, PhD (*Corresponding author*)

Department of Psychology

Goldsmiths

University of London

Lewisham Way

New Cross

London SE14 6NW

UK

Phone: +44 (0)20 7919 7959

Fax: +44 (0)20 7919 7873

Email: a.gregory@gold.ac.uk

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Synopsis

Sleep problems are common in children and adolescents. A growing body of research has explored the relationship between sleep problems and anxiety in youth. When reviewing the literature, methodological inconsistencies need to be considered, such as variation in: conceptualisation of sleep problems (e.g. general 'sleep-related problems' vs. specific sleep disorders), measurement of sleep (e.g. subjective vs. objective; self- vs. parent-report); and the classification of anxiety (e.g. combined anxiety/depression vs. specific anxiety subtypes). Despite this, there appears to be good evidence of concurrent and longitudinal associations between sleep difficulties and anxiety in both community and clinical samples of young people. Potential mechanisms are proposed. There is a need for further exploration of these relationships, with the hope of aiding preventive capability and developing useful treatments.

Key points

- There appears to be a robust association between sleep and anxiety in children and adolescents
- Evidence comes from cross-sectional and longitudinal studies, and both community and clinical samples
- Variation in the definitions and measurement methods used need to be considered when interpreting results
- Potential mechanisms suggested include both physiological and psychological processes

Introduction

Sleep problems are common in youth, with approximately 40% of children aged 4-11 years experiencing difficulties for at least brief periods ^[1]. In clinically anxious children, this proportion appears to be substantially higher: Alfano et al. ^[2] reported that 85% of a sample of anxiety-disordered 7-14 year olds had clinically significant sleep disturbance scores.

There are good reasons to focus on youth when considering the association between sleep difficulties and anxiety. First, it is known that disorders in adults typically begin early in life. For example, in anxiety-disordered adults, a substantial proportion (38%) were diagnosed with anxiety by age 15 years ^[3]. Second, many studies have identified that the two problems frequently co-occur in paediatric populations ^[4]. Third, a growing body of research has examined the directionality of the relationship, particularly the possibility that disturbed sleep in childhood may predict anxiety later in life ^[5]. If it is the case that sleep disturbance acts as an early risk factor for developing an anxiety disorder (or vice versa), then efforts can be made to identify those individuals at potential risk and who may benefit most from intervention.

This chapter considers associations between sleep disturbance and anxiety in children and adolescents. First, some important methodological issues and inconsistencies are considered. This is followed by a summary of some key findings from the literature, from both cross-sectional and longitudinal research. A variety of potential mechanisms by which sleep and anxiety may be related have been suggested, and a selection of these are then outlined.

Methodological issues

There are some important considerations when interpreting work in this field, which need to be outlined before introducing the literature:

- Definition of ‘sleep problems’
- Measurement of sleep
- Conceptualisations of anxiety

i. Definition of sleep problems

The term ‘sleep-related problems’ is commonly used in research in this field ^[1] and can encompass a variety of issues. These may include dyssomnias, such as symptoms of insomnia which may include difficulty falling asleep, or frequent night-time waking. Alternatively, they may refer to parasomnias, including sleep walking or night terrors. Moreover, some research has focused upon specific symptoms, such as sleep duration or sleep onset latency (i.e. time taken to fall asleep), while others have taken a broader perspective and considered a pool of sleep variables. For example, Gregory and O’Connor ^[6] investigated ‘total sleep problems’: a heterogeneous group of sleep difficulties providing a general sense of sleep quality. Furthermore, the classification of disorders may also vary depending upon the diagnostic system being utilised, e.g. the Diagnostic & Statistical Manual for Mental Disorders ^[7] or the International Classification of Sleep Disorders ^[8].

i. Measurement of sleep

A second issue concerns the diverse range of methods used to assess sleep. For example, it is possible to use objective methods, such as actigraphy, a watch-like device which records movement and can be used to make inferences about sleep patterns, or polysomnography (PSG) – often considered the ‘gold-standard’ measurement technique. Furthermore, there are innovative new methods to assess sleep which may become more important in due course ^[9]. Largely for reasons of cost and ease of use, the majority of studies utilise subjective measures

of sleep, such as questionnaires or sleep diaries. Some studies use single-item measures. For instance, the children and adolescents investigated by Alfano and colleagues^[2] were asked if they have ‘trouble sleeping’ and/or ‘trouble waking in the morning’; or a longitudinal French cohort study where parents were asked, ‘Does your child have sleep problems?’^[10]. Others use multi-item measures, e.g.^[11]. Gregory and colleagues^[12] compared subjective (sleep items from the Child Behaviour Checklist) and objective measures (actigraphy, sleep laboratory) of sleep. While there was some evidence of correspondence between methods e.g. the CBCL item, “trouble sleeping” was associated with sleep diary and actigraphy assessed sleep latency), many variables showed no association. The employment of both subjective and objective measures of sleep is likely to offer the most comprehensive assessment of how an individual is sleeping.

As alluded to above, a further consideration is the informant: sleep data may be provided by parents or the child/adolescent themselves. The methods used may contribute to the results observed: some studies have shown that a greater number of sleep problems are revealed using child-reported (as against parent-reported) data^[13, 14]. Interestingly, this pattern appears to be reversed in clinical samples, with parents reporting more problems than the children themselves^[2, 15].

ii. Conceptualisation of anxiety

Finally, there is similar heterogeneity in the measurement of anxiety. For example, sleep has been examined in relation to combined anxiety-depression, e.g.^[6, 16], or the broader construct, ‘internalizing symptoms’, which includes depression and anxiety together with somatic complaints, e.g.^[10]. Others have focused upon specific anxiety subtypes, such as Obsessive-Compulsive Disorder (OCD), or – most commonly – Generalised Anxiety

Disorder (GAD) e.g. ^[2, 15]. Furthermore, as outlined below, samples may comprise community-based children and adolescents, or be drawn from clinically diagnosed anxious youth.

This chapter considers the results from studies that have used differing conceptualisations of sleep difficulties and anxiety, as well as a variety of assessment methods.

Concurrent associations

Sleep and combined anxiety/depression

Several studies have explored the association between sleep problems and combined anxiety/depression symptomatology. This latter phenotype has been found to be associated with various aspects of disturbed sleep in non-clinical samples. For example, nightmares have been associated with emotional difficulties ^[17] while trouble sleeping was associated with parent-reported anxiety/depression in children at age 6 years and again at age 11 ^[16].

Sleep and anxiety

Many studies have explored anxiety as distinct from depression, both as a general concept, and in terms of specific subtypes. Gregory et al. ^[14] investigated anxiety in relation to eight parent-reported components of sleep difficulties. Of these, bedtime resistance was associated with higher child-reported anxiety scores. However, child anxiety was not associated with the other seven aspects under consideration, including sleep onset delay and sleep duration. Others have reported a link between disturbing dreams and heightened anxiety. For example, Mindell & Barrett ^[18] found that anxiety rose in relation to the frequency of nightmares in a community sample of 5-11 year olds. In particular, the group

experiencing three or more nightmares per week had parent-rated anxiety scores approaching the clinical level.

Clinical samples

There is consistent evidence of an association between disturbed sleep and anxiety in non-clinical child and adolescent samples, but what of evidence from clinical samples? Alfano and colleagues have explored these issues in clinically-diagnosed anxious youth. For example, using a combination of items from parent- and clinician-rated scales, the prevalence of ‘sleep-related problems’ (e.g. nightmares, reluctance/refusal to sleep alone) was investigated in this group^[19]. The most commonly identified problems were difficulty initiating or maintaining sleep, nightmares, and a reluctance to sleep alone. Eighty-eight percent of the sample were found to display at least one sleep-related problem, with the majority (55%) having at least three. A positive association was identified, whereby the number of sleep-related problems reported rose with anxiety severity. Some studies have considered the association of specific sleep problems with specific anxiety subtypes. For example, Alfano et al.^[2] found that parasomnias were significantly more common in children with primary diagnoses of GAD or Separation Anxiety, than in those with Social Anxiety. Previous work by Alfano and colleagues also indicated that sleep problems are most closely associated with GAD and Separation Anxiety Disorder^[19,20]. It is suggested that going to bed and sleeping alone may be a more worrying event for children with diffuse anxiety or worries about separation than for those who are more troubled by particular social situations. Sleep-related problems have also been identified in children with OCD, with the total number of problems positively associated with OCD symptom severity and self-reported general anxiety^[15].

A small number of studies have utilised objective measures of sleep with clinical samples. For instance, Rapoport et al. ^[21] used electroencephalography (EEG) to investigate the sleep of nine adolescents diagnosed with OCD. Compared to matched controls, those with OCD showed shortened total sleep, reduced sleep efficiency and double the sleep latency. Similarly, Forbes et al. ^[22] used EEG to assess sleep in anxiety-disordered children. Relative to those with depression and controls, anxious children displayed longer sleep latency on their second night in the laboratory. In addition, the anxious group displayed more nighttime waking compared to the depressed children. More recently, Alfano and colleagues ^[23] utilised PSG to investigate the sleep of children diagnosed with GAD. Relative to controls, the children with GAD showed significantly longer sleep latency as well as a marginal reduction in sleep efficiency (i.e. the length of time asleep relative to the total time spent in bed). The groups did not differ in terms of their pre-sleep anxiety or cortisol levels, however.

Longitudinal associations

Most studies exploring disturbed sleep and anxiety have utilised cross-sectional designs. Consequently, they are unable to provide information concerning the possible directionality of any associations between the two phenotypes. However, some studies have been conducted longitudinally, providing indications as to the direction of effects of the sleep disturbance – anxiety relationship. For example, Gregory & O'Connor ^[6] reported that sleep problems in children aged 4 years were significant predictors of combined anxiety/depression at age 13-15 years. Not all studies support this relationship though: Johnson et al. ^[16] reported cross-sectional associations between trouble sleeping and anxiety/depression, but found that sleep problems at 6 years were not predictive of anxiety/depression at 11 years.

A small but growing number of studies have examined the bidirectionality of the relationship, i.e. whether a sleep disturbance independently predicts later anxiety, and vice versa. Generally, there is stronger evidence for the former of these pathways ^[24]. In the aforementioned study, Gregory & O'Connor ^[6] found no evidence that early anxiety/depression was predictive of later sleep problems. In a further study that looked beyond childhood, it was found that of children reported to have persistent sleep problems at 5-9 years, 46% proceeded to develop an anxiety disorder as an adult ^[5]. Jansen et al. ^[25] have attempted to explore these relationships in very young children. A large sample (n=4782) of newborns were assessed at 2, 24 and 36 months. Dyssomnia (measured as the number of night wakings), parasomnia (the occurrence of nightmares) and short sleep duration identified at infancy or early toddlerhood were associated with a heightened risk of anxiety or depression symptoms at 3 years. The study found little evidence for the reverse relationship of anxiety or depressive symptoms preceding later sleep problems.

Recent work by Goldman-Mellor and colleagues ^[26] demonstrated that the presence of anxiety and internalising symptoms during childhood (5-11 years) and/or adolescence (11-15 years) was strongly predictive of insomnia in mid-adulthood. This study analysed data from a population-representative birth cohort in New Zealand (n=1,037) where participants were assessed at regular intervals, with the most recent data from age 38 years. Of note, a dose-response relationship was observed whereby the presence of anxiety diagnoses at multiple timepoints was associated with heightened risk of later insomnia. In particular, this effect was stronger when the anxiety disorder was observed during adolescence. Here, each additional anxiety diagnosis predicted a 28% increased insomnia risk. Similar results were found for depression.

However, some have demonstrated a bidirectional relationship. In a sample of over 1000 North American children assessed between the ages of 9-16, sleep problems predicted

increased GAD, while GAD also predicted elevated sleep problems over time ^[24]. Further evidence for a reciprocal relationship comes from Kelly & El-Sheikh ^[27]. Here, sleep disturbance at age 8 years was predictive of poorer psychological adjustment (which included anxiety, depression and externalizing symptoms) five years later. To a lesser extent, adjustment predicted changes in sleep too.

Potential mechanisms

Further investigation to explore the pathways by which sleep and anxiety may be associated is necessary. Nevertheless, some potential mechanisms – which are not necessarily independent and are likely to interact – have been proposed. A selection of these is briefly outlined, together with possible pathways by which their effects may emerge.

Twin studies

Twin studies typically compare the similarity of identical and non-identical twins in order to draw inferences about genetic and environmental influences on traits. These studies have been informative in elucidating reasons for associations between variables (for discussion of twin studies, see ^[28]). A small number of twin studies of children have reported on sleep and associated traits, with one finding that parent-reported sleep disturbance in three year olds appeared to be genetically unrelated to all other scales assessed, including anxious behaviour ^[29]. In contrast, common ‘shared environmental factors’ (i.e. those environmental factors which act to make individuals within a family alike) appeared to influence the range of difficulties under investigation. A different picture has emerged when older youth (aged 8-16 years) were considered ^[30]. In particular, there did appear to be strong overlap between genetic influences on overanxious disorder and symptoms of insomnia. Although twin studies

are instructive in estimating the magnitude of genetic influences on traits, they typically do not reveal much about specific genes that influence traits. This information typically comes from elsewhere (e.g. association and linkage studies).

Specifying genetic and environmental factors

The specific genes implicated in the overlap between various phenotypes and sleep disturbance is likely to depend on the variable with which sleep is being associated. Given the association between serotonin and both sleep and anxiety, e.g. [31,32], it is likely that genes involved in the serotonin pathways, as well as a host of others, are likely to play a role in any sleep-anxiety relationship. Complex phenotypes are likely to be influenced by multiple genes of small effect size, and therefore there is a need to further specify genes involved in sleep disturbances and associations with other traits. With the employment of increasingly large-scale Genome-Wide Association Studies (GWAS), it is likely that further candidates will soon emerge. Indeed, there have been three GWAS on subjective sleep phenotypes [33-35] which have highlighted candidates – some of which may be associated with internalising difficulties.

Similarly, it is also necessary to specify environmental factors that account for the association between difficulties. Elements of the family and home environment are known to influence children's sleep and emotion. In their longitudinal study of infant sleep, Jansen et al. [25] found that certain parental behaviours (e.g. the absence of set bedtimes, parental presence during sleep onset) preceded later emotional symptoms. It has been demonstrated that anxious parents are differentially involved in their children's bedtime routine [36]. Relative to those with non-anxious parents, the children of anxious parents were found to display disturbed sleep. Another study found that both family disorganisation and maternal

depression each correlated moderately with both sleep disturbance and anxiety symptoms in children aged 3 and 4 years and accounted for some of the association between the two difficulties^[37]. Such findings emphasize the need to consider child sleep problems in the context of the family^[38].

Stress and trauma have also been implicated in altered biobehavioral functioning and have also been associated with both psychopathology and sleep disorders^[39,40]. Stressful life events or traumatic history could therefore be an additional bridge between sleep and psychopathology.

Genetic and environmental influences are commonly considered separately, but it is likely that they do not work independently but together to exert their effects. Indeed, interactions between genes and environmental factors are shown for difficulties including sleep quality^[41] as well as various associated traits, including depression and behavioural difficulties (see^[42]).

Pathways through which genetic and environmental factors work

In addition to understanding genetic and environmental influences on sleep disturbances and anxiety, further research needs to identify the pathways by which these influences have their effects. As described below, genetic and environmental factors are likely to impact upon hormones as well as psychological processes known to be associated with sleep and emotional problems.

Hormonal factors

In response to a perceived threat, the body releases stress hormones, including cortisol, which promote vigilance and prepare the individual for 'fight-or-flight' behaviours

[43]. These hormones are likely to have insomnogenic actions [44] and thus a state of arousal in the pre-sleep period is likely to make sleep less likely. The Hypothalamic-Pituitary-Adrenal axis which controls reactivity to stress is likely to be involved in the association between sleep and anxiety. In the aforementioned study by Warren et al. [36], the children of anxious parents were found to display elevated levels of cortisol as well as disturbed sleep. In addition, elevated pre-sleep cortisol levels have been observed in children with anxiety disorders [45].

Regulatory systems

Dahl [46] outlines how sleep, arousal and affect are overlapping regulatory systems, with dysregulation in one system impacting upon the others: sleep disruption during critical developmental periods may increase the likelihood of later affective dysregulation and vice versa. For instance, disturbed sleep may disrupt processes occurring in the prefrontal cortex [27]. This area of the brain is known to be important in the executive functioning which is needed to control emotion and cognition [47]. Consequently, affected children might then be at risk of impaired emotional processing and potentially internalizing/externalizing disorders.

Indeed, studies have shown that a consequence of sleep disturbance is impaired affective regulation and coping skills. For example, otherwise healthy individuals demonstrate heightened negative affect following mild-to-moderate sleep deprivation [48]. Thus, anxious children may find their emotional difficulties heightened if they proceed to suffer from disrupted sleep.

Cognitive processes

The cognitive model of insomnia^[49] illustrates how particular dysfunctional cognitions concerning disturbed sleep may feed upon themselves and exacerbate the problem. These cognitions – and the presence of a particular cognitive style which may predispose towards emotional difficulties – have primarily been researched in adults but are now receiving greater attention in young people. For example, in adults, pre-sleep arousal has been investigated in adults in terms of somatic (i.e. physiological) and cognitive arousal, with both associated with disturbed sleep^[50]. Of the two, cognitive arousal has been found to demonstrate the stronger association with sleep disruption, and this has been shown in community and clinical samples of youth^[2, 11]. Adults experiencing GAD have been found to report greater levels of cognitive activity and worry at bedtime, relative to non-anxious insomniacs and controls^[51]. They also rated their pre-sleep worries as less controllable and more interfering. Other research has considered the potential importance of specific cognitions and cognitive styles. For example, Alfano et al.^[52] found that adolescents' sleep problems were correlated with 'negative cognitive errors' (e.g. internal attribution for negative outcomes, selective attendance to negative aspects of an event). Such beliefs are implicated in the development of anxiety and depression, e.g.^[53]. Similarly, the cognitive process of 'catastrophising' may also be of importance. This describes a particular cognitive style whereby individuals are prone to focus on the worst possible outcome of a situation, overestimate the chance that this will occur, and exaggerate the consequences of this occurrence^[54]. Catastrophising is known to be associated with anxiety, e.g.^[54] and has also been implicated in sleep disturbance^[55, 56]. Further exploration of the interplay between sleep, sleep-related cognitions and anxiety is necessary.

Conclusions

Anxiety and sleep difficulties are associated in youth. Indeed, the growing body of literature has shown that anxious children do not always sleep well and that in certain cases sleep disturbances in youth may serve as a red flag for the development of later anxiety. Whereas historically sleep disturbance has to some extent been dismissed as a symptom of other disorders, this view is becoming outdated. It is now acknowledged that sleep disturbances need to be considered in their own right. Indeed, in the DSM V, the concept of ‘primary insomnia’ and ‘insomnia related to another disorder’ has been replaced by ‘insomnia disorder’ – which may or may not be comorbid with other disorders. Indeed, further research aimed at understanding the mechanisms between sleep disturbance and anxiety is of paramount importance and holds the promise of improving the quality of life for both children and the families with whom they live.

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