

## Research Article

# SLEEP PROBLEMS AND THEIR RELATION TO COGNITIVE FACTORS, ANXIETY, AND DEPRESSIVE SYMPTOMS IN CHILDREN AND ADOLESCENTS

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**Background:** Existing research indicates sleep problems to be prevalent in youth with internalizing disorders. However, childhood sleep problems are common in the general population and few data are available examining unique relationships between sleep, specific types of anxiety and depressive symptoms among non-clinical samples of children and adolescents. **Methods:** The presence of sleep problems was examined among a community sample of children and adolescents (N=175) in association with anxiety and depressive symptoms, age, and gender. Based on emerging findings from the adult literature we also examined associations between cognitive biases and sleep problems. **Results:** Overall findings revealed significant associations between sleep problems and both anxiety and depressive symptoms, though results varied by age. Depressive symptoms showed a greater association with sleep problems among adolescents, while anxiety symptoms were generally associated with sleep problems in all youth. Cognitive factors (cognitive errors and control beliefs) linked with anxiety and depression also were associated with sleep problems among adolescents, though these correlations were no longer significant after controlling for internalizing symptoms. **Conclusions:** Results are discussed in terms of their implications for research and treatment of sleep and internalizing disorders in youth. *Depression and Anxiety* 26:503–512, 2009. Published 2008 Wiley-Liss, Inc.<sup>†</sup>

**Key words:** sleep problems; anxiety; depression; cognitive factors; youth

## INTRODUCTION

As many as 40% of all children experience sleep problems for at least brief periods<sup>[1,2]</sup> yet, compared to adults, sleep disturbance during childhood is poorly studied and described. Although the specific origins of these problems vary, a significant proportion of youth who experience sleep problems also meet criteria for a psychiatric disorder or have elevated levels of emotional and behavioral problems<sup>[3–5]</sup>. Thus, there is now compelling evidence for linkages between the regulation of sleep, emotion, and behavior. To date, published reports have tended to focus on sleep problems among youth with internalizing disorders, including depressive<sup>[6,7]</sup> and anxiety disorders<sup>[8,9]</sup>, sleep problems in relation to broad indices of internalizing symptoms<sup>[4,10]</sup>, and sleep and psychiatric symptoms in discrete age groups of children<sup>[5,11]</sup>. Although these studies provide an important basis for research in this area, data examining concurrent associations between

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sleep problems and unique symptoms of anxiety (e.g., generalized, separation, panic) and depression in community samples of children and adolescents are more limited.

From a clinical standpoint, a basis for examining early sleep and its relation with internalizing problems is well established. Risk of developing an anxiety or depressive disorder is significantly higher among adults with insomnia than the general population<sup>[12,13]</sup> and similar findings have been reported in children. For example, Gregory and O'Connor<sup>[14]</sup> examined associations between parent-reported sleep problems in young children and the development of emotional problems during mid-adolescence among a large community sample ( $N = 490$ ). The presence of sleep problems at age 4 years significantly predicted internalizing symptoms at ages 13–15 years [based on the anxious/depressed subscale of the Child Behavior Checklist (CBCL);<sup>[15]</sup>]. Johnson et al.<sup>[4]</sup> also reported parental report of sleep problems at age 6 years to predict elevated CBCL anxious/depressive scores at age 11. These data reveal important longitudinal links between children's sleep and the later development of internalizing problems, yet concurrent relationships also appear significant. One study examining both current and persistent sleep problems in a large community sample ( $N = 1290$ ) of children 8–12 years found current sleep problems to be associated with an increased risk for internalizing problems<sup>[16]</sup>. These data suggest that transient problems may be as harmful as persistent problems, although the specific mechanisms underlying these associations remain poorly understood.

An additional gap in this body of research relates to the role of development. Changes in the bioregulatory systems governing sleep, emotion, and behavior are considerable during early development and throughout adolescence<sup>[17]</sup>. Based in part on the average age of onset for anxiety versus depressive disorders in youth, it has been suggested that sleep disturbance may be more closely associated with anxiety during childhood and with depression during adolescence<sup>[18]</sup>. However, empirical data are somewhat conflicting. For example, Gregory et al.<sup>[19]</sup> examined associations between sleep problems and the development of internalizing disorders during adulthood and found that 46% of children with persistent sleep problems from ages 5 to 9 years developed an adult anxiety disorder. Childhood sleep problems did not, however, predict the development of adult depressive disorders, suggesting a greater association with anxiety. In contrast, a second study by Gregory and colleagues<sup>[20]</sup> examined concurrent associations among sleep problems, anxiety, and depression in 300 twin pairs at 8 years of age. Results revealed a more robust association between childhood sleep problems and depression compared to anxiety. Additional research investigating these unique relationships in both children and adolescents is therefore needed.

Due in part to a general lack of research on childhood sleep, examination of specific factors under-

lying the overlap with internalizing problems is limited. Epidemiological studies estimate the influence of genetic and environmental factors to be similar<sup>[21,22]</sup>; yet unique mechanisms remain unknown. Among adults, cognitive factors have a well-established role in the development and maintenance of internalizing disorders, and mounting evidence reveals an important association with sleep disturbance as well<sup>[23,24]</sup>. Adult insomniacs are much more likely to attribute their sleep problems to cognitive rather than somatic factors<sup>[25]</sup> and, similar to individuals with internalizing disorders, experience more negative thoughts at bedtime as compared to good sleepers<sup>[26]</sup>. The presence of an external locus of control (a perceived lack of control over certain outcomes and events) has been specifically associated with persistent difficulties initiating and/or maintaining sleep<sup>[27,28]</sup>.

Evidence for dysfunctional cognitive processes among depressed and anxious youth also is considerable. In particular, interpretation biases (inaccurately perceiving neutral or ambiguous situations or events as threatening) and judgment biases (negative estimations of one's ability to cope with or control certain outcomes/events) are common<sup>[29–31]</sup> and hypothesized to contribute to the development of these disorders over time. Although investigation of cognitive factors in relation to sleep has primarily been limited to adults, preliminary evidence suggests the presence of similar relationships in children. Specifically, Gregory and Eley<sup>[32]</sup> found a moderate correlation ( $r = -.38$ ) between a negative attributional style (internal, stable and global attributions for the occurrence of negative outcomes/events) and sleep problems in a community sample of 79 children ages 8–11 years.

In summary, this study focused on three specific aims. First, we examined unique associations between sleep problems, specific types of anxiety, and depressive symptoms. On the basis of previous suggestion and conflicting data, we investigated whether these relationships differ among children (ages 6–11 years) and adolescents (ages 12–17 years). The role of gender also was examined. We additionally investigated associations between sleep problems and cognitive biases in relation to comorbid internalizing symptoms and age. In terms of interpretation biases, we focused on cognitive errors, which are consistently linked with anxiety and depression in both children and adolescents<sup>[29–31]</sup>. We also examined anxiety control beliefs which have an established link with anxiety disorders in youth<sup>[33]</sup>. Although research confirms a link between locus of control and sleep disturbance in adults<sup>[27,28]</sup>, the relation between control beliefs and sleep has not been examined in youth. We predicted significant correlations between sleep problems and anxiety and depression in all youth, but that the former association would be stronger for children while the latter would be more robust for adolescents. We also hypothesized that in addition to relations with anxiety and depression, sleep problems would be significantly associated

with interpretational biases (cognitive errors) and judgment biases (control beliefs).

## METHODS

### PARTICIPANTS

Data were collected from a socio-economically and ethnically diverse sample of 175 children and adolescents aged 6–17<sup>1</sup> years (mean age = 11.4 years,  $SD = 3.4$ ) and their primary caregiver (90% mothers, 5% fathers, and 5% grandparents). Participants' ethnic background and income level were characteristic of the urban area from which they were recruited. Demographic data for the full sample and separate age groups are presented in Table 1.

### RECRUITMENT AND PROCEDURES

Families were recruited through adult students enrolled in courses at the University of New Orleans in Louisiana, area schools, and media outreach. Participants received monetary compensation for participating in a research study on youth behavior, emotions, and anxiety. Informed consent/assent was obtained before participation. Completion of child and parent assessment measures took place in two separate, private rooms. Standardized instructions were given to both the parents and children. Research assistants read all questionnaire items aloud to younger children to ensure their understanding. Children were provided with further explanation and examples as needed. Youth were excluded if parents indicated that they had a history of one or more of the following diagnoses: pervasive developmental disorder, mental retardation, selective mutism, organic mental disorders, schizophrenia, or other psychotic disorders. Youth were also excluded if they posed a risk of harm to themselves or others. Only one child was excluded based on a diagnosis of pervasive developmental disorder—not otherwise specified. Potential families were told that they would be eligible to participate regardless of whether the child/adolescent had problems with anxiety or depression. Youth identified as having potentially, clinically significant symptoms were referred for appropriate assessment and intervention services after the completion of measures. A total of six families were referred for services. This recruitment process was designed to help normalize the distribution of anxiety and depression symptoms to facilitate the use of parametric statistics.

### MEASURES

**The Revised Child Anxiety and Depression Scales**<sup>[34]</sup>. The Revised Child Anxiety and Depression Scales (RCADS) were used to assess child-reported anxiety and depression symptoms. The RCADS is a 47-item adaptation of the Spence Children's Anxiety Scale<sup>[35]</sup> that assesses symptoms of anxiety disorders (except posttraumatic stress disorder and specific phobias) and depression based on DSM-IV criteria. Items are scored on a 4-point Likert scale (1 = Never, 2 = Sometimes, 3 = Often, and 4 = Always) and yield a total anxiety score as well as subscales for depression, generalized anxiety (GAD), panic and agoraphobia (PDA), separation anxiety (SAD), social anxiety (SP), and obsessive compulsive (OCD) symptoms. Investigation of the psychometric properties of the RCADS demonstrated a factor

**TABLE 1. Frequencies and percentages for demographic variables for the full sample and child and adolescent groups**

Variable	Full sample	6–11 years	12–17 years
	<i>n</i> (%) ( <i>N</i> = 175)	<i>n</i> (%) ( <i>n</i> = 88)	<i>n</i> (%) ( <i>n</i> = 87)
Gender (female)	92 (53%)	47 (54%)	45 (52%)
Ethnicity			
Black	73 (42%)	43 (49%)	30 (34%)
White	78 (44%)	31 (35%)	47 (54%)
Hispanic	13 (7%)	8 (9%)	5 (6%)
Mixed/other	10 (6%)	5 (6%)	5 (6%)
Family income*			
\$0–11,999	44 (25%)	29 (33%)	15 (17%)
\$12K–30,999	45 (26%)	27 (31%)	18 (21%)
\$31K–50,999	42 (24%)	17 (19%)	25 (29%)
Over \$51,000	39 (22%)	13 (15%)	26 (30%)
Mother's education level			
Some high school	5 (3%)	2 (2%)	3 (3%)
High School degree	25 (14%)	11 (13%)	14 (16%)
Some college	56 (32%)	32 (26%)	24 (28%)
College degree	59 (34%)	30 (34%)	29 (33%)
Advanced degree	8 (5%)	5 (6%)	3 (3%)
Father's education level			
Some grade/high school	16 (9%)	9 (10%)	7 (8%)
High school degree	50 (29%)	30 (34%)	20 (23%)
Some college	38 (22%)	20 (23%)	18 (21%)
College degree	25 (14%)	11 (13%)	14 (16%)
Advanced degree	17 (10%)	7 (8%)	10 (11%)

Some data are missing for participants in both age groups.

\*Significant age group difference ( $p < .05$ ).

structure consistent with DSM-IV anxiety disorders and depression and convergent validity consistent with existing measures of childhood anxiety<sup>[34]</sup>. Internal consistency for the RCADS total anxiety score was computed for this study's sample. Coefficient  $\alpha$ 's were 0.94 for the full sample, 0.94 for children ages 6–11 years, and 0.95 for adolescents ages 12–17 years. Parents also completed a parent version of the RCADS (RCADS-P). Internal consistency (coefficient  $\alpha$ 's) was 0.93 in the full sample, 0.92 for children and 0.94 for adolescents.

**Child Depression Inventory [Kovacs, 1985]**. The Child Depression Inventory (CDI) includes 27 items assessing symptoms of depression in youth. Each item has a range of three choices and children are instructed to choose the one that best describes them during the past 2 weeks. Although the RCADS also contains a depression scale, a separate measure of depression was used to reduce measurement confounds when examining unique associations with sleep problems.<sup>2</sup>

Moreover, although the RCADS depression scale showed modest internal consistency (coefficient  $\alpha < 0.60$  for the full sample, children, and adolescents), internal consistency for the CDI was good (0.84 for the full sample, 0.81 for children, and 0.89 for adolescents). The CDI

<sup>1</sup>Because of the wide age range of participants, steps were taken to ensure the developmental appropriateness of assessment measures by establishing estimates of internal consistency and convergent validity for both older and younger participants. Analyses revealed adequate validity and reliability for this study.

<sup>2</sup>Although CDI scores were used to examine associations between sleep problems and depressive symptoms, we also examined associations between sleep problems and the child-report RCADS depression scale (without the sleep items). Correlations with sleep problem scores were highly similar.

is widely used and has been shown to have good reliability and validity estimates<sup>[36]</sup>.

**The Revised Children's Manifest Anxiety Scale<sup>[37]</sup>.** The Revised Children's Manifest Anxiety Scale (RCMAS) is a widely used and well-researched 37-item scale designed to assess general anxiety in children. Twenty-eight items (scored as yes or no) yield a total anxiety score, and nine items compose a lie subscale. The RCMAS has been found to have satisfactory reliability including a 9-month test-retest correlation of  $r = .69$  and internal consistency of 0.85 among a large community-based sample of children and adolescents<sup>[38]</sup>. The parent version of the RCMAS (RCMAS-P) was administered to parents. The RCMAS-P has similar validity estimates to the RCMAS<sup>[39]</sup>.

**Child Behavior Checklist<sup>[15]</sup>.** The CBCL was completed by the parent to assess both internalizing and externalizing problems. The CBCL consist of 113 items rated on a scale ranging from 0 = not true to 2 = very/often true. The CBCL provides a total problems score as well as eight internalizing and externalizing subscales. Reliability and validity estimates are well established: mean coefficient  $\alpha$  ranging from 0.89 to 0.96 for the internalizing, externalizing, and total problems scales<sup>[15]</sup>.

**The Children's Negative Cognitive Error Questionnaire<sup>[40]</sup>.** The Children's Negative Cognitive Error Questionnaire (CNCEQ) was used to assess cognitive errors in children. This 24-item measure is designed to assess four types of errors via four theoretically derived subscales: catastrophizing, overgeneralization, personalizing, and selective abstraction errors. Each subscale contains six questions. Items include a hypothetical vignette and a negative interpretation of the event to which the child responds if he or she would interpret the situation in a similar fashion. For example, one of the items assessing selective abstraction has the hypothetical situation of playing basketball where it is indicated that during the game the child scored five baskets and missed two easy shots. After the game the child thought, "I played poorly." Children are asked to rate on a five-point scale how similar the thought is to their own thoughts in that situation (e.g., 1—"not at all like I would think" 5—"almost exactly like I would think"). The CNCEQ has demonstrated acceptable internal consistency, test-retest reliability, and construct validity estimates<sup>[30,40]</sup>.

**The Anxiety Control Questionnaire For Children<sup>[41]</sup>.** The Anxiety Control Questionnaire For Children (ACQ-C) was developed by adapting the method used in the study of<sup>[42]</sup>. Questions were designed to measure perceived lack of control over external threats (e.g., events, objects, or situations that are fear producing) and control over negative internal emotional and bodily reactions generally associated with anxiety (e.g., shaking/trembling, subjective experience of anxious tension). Children are asked to rate their agreement with each question along a rating scale as follows 0 (none), 1 (a little), 2 (some), 3 (a lot), or 4 (very, very much). A total control belief score is obtained by summing the items and higher scores indicate greater control beliefs (i.e., that one can control outcomes/event). Internal consistency estimates (i.e., coefficient  $\alpha$ ) for the total scale were 0.94 and 0.92 in two independent samples<sup>[41]</sup>. The ACQ-C has also produced good convergent validity estimates with the NSLOC<sup>[43]</sup> ( $r = -.22$ ) and RCMAS ( $r = -.47$ ).

## MEASUREMENT OF SLEEP PROBLEMS

A sleep scale was created from sleep-related items from both the parent and child measures. Specific sleep items included are consistent with items found on other commonly used and validated measures of childhood sleep [e.g., Children's Sleep Habits Ques-

tionnaire<sup>[44]</sup>]. Several of these items also have been used in creating sleep scales for previous research<sup>[11,14]</sup>. Analysis, which included examination of items for content overlap, intercorrelations, and factor analysis to identify a single set of sleep items, was conducted using the following: seven items from the parent version of the CBCL (nightmares, overtired, sleeps less than most children, sleeps more than most children, trouble sleeping, wets the bed, and talk/walks during sleep), four sleep items from RCADS-child and parent versions (trouble sleeping, no energy for things, tired a lot, and worries when going to bed at night) and two items from RCMAS-child and parent versions (hard to get to bed at night and bad dreams). Results of this analysis produced a single sleep problems factor consisting of seven items: four CBCL items (overtired, sleeps less than most children, sleeps more than most children, and trouble sleeping), two RCADS-child items (trouble sleeping, tired a lot), and one RCMAS-p item (worries when going to bed at night). Item ratings were standardized then added together for a total sleep problems score. The resulting sleep problems scale demonstrated acceptable internal reliability (cronbach's  $\alpha = .75$ ), skew, and kurtosis.

## DATA ANALYTIC STRATEGY

Data were analyzed with SPSS 13.0 statistical software. Examination of demographic variables between the child and adolescent age groups did not reveal any significant differences with the exception of family income (Table 1). Family income was therefore controlled for in all subsequent analyses. Partial correlation coefficients were used to examine overall associations among sleep problems, specific types of anxiety, and depressive symptoms according to age. Analyses of covariance (ANCOVAs) and hierarchical linear regression models were used to examine unique associations between sleep problems, anxiety, depression, and cognitive biases (cognitive errors and control beliefs). Sleep items were removed from all RCADS scales and the CDI scores before calculating anxiety and depression scores to remove overlapping items from analyses. Specific age groups for children (6–11 years;  $n = 88$ ) and adolescents (12–17 years;  $n = 87$ ) were chosen on the basis of previous research examining internalizing symptoms and sleep in youth<sup>[9,45]</sup>. Specifically, because cognitive, social, and hormonal changes that occur with the onset of adolescence are significant and have important implications for understanding anxiety and depression as well as sleep, adolescents 12 years and over were examined separately.

## RESULTS

### ASSOCIATIONS BETWEEN SLEEP PROBLEMS AND TYPES OF ANXIETY AND DEPRESSIVE SYMPTOMS

Initial examination of ranges and skewness for sleep problems, anxiety and depression scores indicated acceptable levels for planned analyses. Total scores for child and parent measures are presented in Table 2. A significant difference emerged between the age groups for child-reported RCADS anxiety ( $t(173) = 3.21, P < .05$ ), with children reporting greater overall levels of anxiety than adolescents.

Partial correlations coefficients were used to examine associations among sleep problems, types of child-reported anxiety (GAD, PDA, SAD, SP, and OCD) and depressive symptoms among the child and adolescent groups. For children, moderate correlations between sleep problems and all five RCADS anxiety subscales

**TABLE 2. Means and standard deviations for self and parent report measures for the full sample and child and adolescent groups**

Measure	Full sample	6–11 years	12–17 years
	<i>M</i> ( <i>SD</i> ) ( <i>N</i> = 175)	<i>M</i> ( <i>SD</i> ) ( <i>n</i> = 88)	<i>M</i> ( <i>SD</i> ) ( <i>n</i> = 87)
Child RCADS anx*	71.4 (18.6)	75.8 (19.9)	67.0 (16.1)
Parent RCADS anx	61.7 (12.2)	62.8 (12.4)	60.6 (11.8)
Child RCADS dep	11.2 (3.3)	11.6 (3.5)	10.8 (3.1)
Parent RCADS dep	9.3 (2.3)	9.3 (2.4)	9.3 (2.3)
CDI	8.1 (6.9)	8.4 (6.6)	7.9 (7.2)
CNCEQ	50.5 (17.5)	51.9 (18.4)	49.1 (16.7)
ACQ-C	70.7 (22.2)	70.4 (20.7)	70.8 (23.9)

RCADS anx, the Revised Child Anxiety scale; RCADS dep, the Revised Child Depression scale; CDI, Children's Depression Inventory; CNCEQ, Children's Negative Cognitive Error Questionnaire; ACQ-C, Anxiety Control Questionnaire for Children.

\*Significant age group difference ( $P < .05$ ).

were found (all  $P < .05$ ). Child sleep problems also were significantly associated with total CDI scores. For adolescents, results revealed moderate correlations between sleep problems and three anxiety subscales including GAD, PDA, and SP. Adolescent sleep problems were significantly associated with depression scores as well. Correlations are presented in Table 3.

### DEVELOPMENTAL DIFFERENCES IN SLEEP PROBLEMS ASSOCIATED WITH ANXIETY AND DEPRESSION

To more directly compare developmental differences in sleep problems and anxiety, we conducted a 2 (age group)  $\times$  2 (high versus low levels of anxiety) ANCOVA with sleep problems as the dependent variable. A median split of RCADS total anxiety scores was used to create high and low anxiety groups (median = 57,  $SD = 15.9$ ). A main effect emerged for anxiety symptoms ( $F(1, 173) = 13.00, P < .001$ ). The main effect for age group and age group  $\times$  anxiety interaction was nonsignificant indicating that higher levels of anxiety were associated with greater sleep problems in all youth. A similar 2  $\times$  2 ANCOVA was conducted to compare developmental differences in sleep problems and depression using a median split for CDI scores (median = 6,  $SD = 6.2$ ). A main effect emerged for depressive symptoms ( $F(1, 159) = 23.20, P < .001$ ) but not for age group. However, the interaction term for age group  $\times$  depression was significant ( $F(168) = 13.20, P < .001$ ). To determine if adolescents with elevated depressive symptoms were most likely to report sleep problems, a follow-up single degree of freedom contrast [see <sup>[46]</sup>] was conducted and revealed a significant difference between adolescents with high depression scores and the rest of the sample [mean difference = 6.03,  $SE = 1.61, t(173) = 3.74, P = .001$ ].

We additionally examined the role of gender in comparing developmental differences in sleep problems, anxiety, and depression by conducting separate 2 (age group)  $\times$  2 (median split of anxiety/depression scores)  $\times$  2 (gender) ANCOVAs with sleep problem scores as the dependent variable. None of the main effects or interaction terms for gender were significant. Gender was therefore not examined further.

### ANXIETY, DEPRESSION, AND COGNITIVE FACTORS AS UNIQUE PREDICTORS OF SLEEP PROBLEMS

Partial correlations coefficients for sleep problems, anxiety, depression, and cognitive biases based on age are presented in Table 3.<sup>3</sup> As is shown, there was a significant association between sleep problems and cognitive errors (CNCEQ scores) among adolescents but not children. Also, the negative association between sleep problems and control beliefs (ACQ-C scores) was marginally significant in the adolescent group only ( $r = -.20, P = .07$ ) suggesting sleep problems to be related to a decreased sense of control.

To better understand the unique contribution of variables in predicting sleep problems among children and adolescents, a series of hierarchical linear regression analyses were conducted. First for children, we examined whether anxiety predicted sleep problems while controlling for depression. Sleep problem scores were used as the criterion variable, and family income, parents' education levels, and gender were entered into the model in the first step. CDI scores were entered in the second step and RCADS anxiety scores were entered as the predictor variable. Anxiety scores were significant predictors of sleep problem scores after controlling for demographic variables and depression ( $R^2 = .33, \beta = .47, P < .001$ ), accounting for 14% of the variance in children's sleep problems. A similar regression model was used to examine whether depression predicted sleep problems while controlling for anxiety. Again, sleep problem scores were the criterion variable, and demographic variables were entered into the model in the first step. After controlling for anxiety, depression was not a significant predictor of sleep problems among children.

Hierarchical regression models also were used to examine unique predictors of sleep problems in adolescents. For the first model, anxiety scores did not predict sleep problems after controlling for demographic variables and depression. However, when entering RCADS anxiety scores in the second step,

<sup>3</sup>In addition to depression and anxiety, sleep problems also are common in youth with externalizing problems. Thus, we also examined unique associations with CBCL externalizing scores. Although a significant correlation between sleep problems and CBCL externalizing scores was found, results of hierarchical regression analyses indicated both anxiety and depression to be significant predictors of sleep problems after controlling for externalizing symptoms.

**TABLE 3. Partial correlations among sleep problems, types of anxiety, depression, and cognitive biases for child and adolescent groups**

Children (6–11)	1	2	3	4	5	6	7	8	9	10
1. Sleep problems										
2. RCADS anx	.46**									
3. RCADS-GAD	.46**	.81**								
4. RCADS-PDA	.33**	.86**	.61**							
5. RCADS-SAD	.38**	.76**	.44**	.64**						
6. RCADS-SP	.33**	.83**	.63**	.58**	.49**					
7. RCADS-OCD	.40**	.73**	.51**	.61**	.55**	.44**				
8. CDI	.26*	.56**	.52**	.49**	.32**	.54**	.32**			
9. CNCEQ	.12	.42**	.27**	.38**	.31**	.34**	.37**	.43**		
10. ACQ-C	-.12	-.36**	-.35**	-.33**	-.22**	-.30**	-.22**	-.34**	-.25**	
Adolescents (12–17)	1	2	3	4	5	6	7	8	9	10
1. Sleep problems										
2. RCADS anx	.41**									
3. RCADS-GAD	.34**	.83**								
4. RCADS-PDA	.27*	.83**	.57**							
5. RCADS-SAD	.20	.76**	.47**	.71**						
6. RCADS-SP	.49**	.88**	.71**	.57**	.53**					
7. RCADS-OCD	.21	.70**	.46**	.58**	.57**	.45**				
8. CDI	.58**	.66**	.56**	.58**	.48**	.59**	.39**			
9. CNCEQ	.29*	.48**	.31**	.44**	.43**	.38**	.41**	.58**		
10. ACQ-C	-.20	-.36**	-.33**	-.38**	-.27*	-.26*	-.18	-.47**	-.30**	

RCADS anx, Revised Child Anxiety Scale; RCADS-GAD, generalized anxiety subscale; RCADS-PDA, panic and agoraphobia subscale; RCADS-SAD, separation anxiety subscale; RCADS-SP, social anxiety subscale; RCADS-OCD, obsessive compulsive subscale; CDI, Children’s Depression Inventory; ACQ-C, Anxiety Control Questionnaire for Children; CNCEQ, Children’s Negative Cognitive Errors Questionnaire.  
 \*\* $P < .01$ ; \* $P < .05$ .

depressive symptoms remained significant predictors of sleep problem scores ( $R^2 = .31$ ,  $\beta = .50$ ,  $P < .001$ ), accounting for 15% of the variance in sleep problems among adolescents. See Table 4 for regression models.

On the basis of the significant association found between sleep problems and cognitive errors in adolescents, we also examined the unique contribution of CNCEQ scores in predicting sleep problems. For both regression models, sleep problem scores were again used as the criterion variable, and family income, parents’ education levels, and gender were entered into the model in the first step. For the first model, where CDI scores were entered in the second step, cognitive errors were not significant predictors of sleep problems. Similarly, in the second model controlling for RCADS anxiety scores, cognitive errors were not significant predictors of sleep problems among adolescents.

## DISCUSSION

On the basis of the common co-occurrence of sleep and internalizing symptoms, this study examined associations among these problems in a community sample of youth. Consistent with both community-based and clinical research, results suggest that sleep problems are associated with increased levels of anxiety and depressive symptoms in both children and adolescents. In clinic samples, sleep disturbance is most closely associated with GAD and SAD<sup>[8,9]</sup>. Results from this study suggest links between sleep and anxiety

**TABLE 4. Hierarchical linear regression analyses**

Step	$R^2$	$\Delta R^2$	$t$	$\beta$	$P$
Summary of model 1: predictors of child sleep problems					
1. Demographics	.07	.07			.254
Gender			.67	.08	.507
Mother’s education			-.52	-.06	.606
Father’s education			2.1	.26	.039
Family income			-.84	-.10	.406
2. RCADS anx	.32	.25			.000
2. CDI	.19	.12			.002
3. RCADS anx	.33	.14			.000
3. CDI	.33	.01			.408
Summary of model 2: predictors of adolescent sleep problems					
1. Demographics	.07	.07			.254
Gender			.67	.08	.507
Mother’s education			-.52	-.06	.606
Father’s education			2.1	.26	.039
Family income			-.84	-.10	.406
2. RCADS anx	.15	.11			.006
2. CDI	.31	.26			.000
3. RCADS anx	.31	.00			.669
3. CDI	.31	.15			.001

RCADS anx, the Revised Child Anxiety scale; CDI, Children’s Depression Inventory.

to be less specific in non-clinical samples of children, though this association may become more explicit by the teenage years (i.e., related to panic, generalized, or social anxiety). In addition, our findings are consistent with the suggestion that early childhood

sleep disturbance is more closely associated with anxiety, whereas adolescent sleep problems is closely linked to depression<sup>[18]</sup>. Adolescents with increased depressive symptoms were more likely to experience sleep problems, and depression accounted for 15% of the variance in sleep problems after controlling for anxiety. Conversely, anxiety was a stronger predictor of sleep disturbance in children under the age of 12 years.

There are several possibilities to explain developmental findings. First, although anxiety and fears are common in young children, in general, the frequency and intensity of many fears (including nighttime fears) decline with age<sup>[47,48]</sup>. By comparison, depression has a more common onset during adolescence<sup>[49]</sup>, suggesting that early sleep problems may be more likely to correspond with increases in anxiety. In addition, anxiety-related sleep problems, which commonly include excessive nighttime fears and bedtime avoidance, are generally evident to parents of young children, whereas sleep disturbance associated with depressive feelings may be both less apparent and less disruptive for caregivers. Beyond basic prevalence rates and specific sleep-related behaviors, emerging data also suggest differences in the underlying neurophysiological mechanisms associated with affective disorders during early development. For example, elevations in pre-sleep cortisol among both children with anxiety disorders and adolescents with major depressive disorder provide evidence of differential hypothalamic-pituitary-adrenal axis dysfunction<sup>[45]</sup>. Because increases in nocturnal secretion of cortisol also has been found among adults with insomnia<sup>[50]</sup>, alterations in the hypothalamic-pituitary-adrenal axis seem to have implication both for the development of psychopathology as well as the sleep-wake cycle.

Early environmental and familial factors also appear to be particularly salient to the association between childhood sleep problems and anxiety<sup>[51,52]</sup>. Warren et al.<sup>[52]</sup> reported that parents of infants and young children at risk for the development of anxiety (based on having an anxiety-disordered parent) were overly involved in bedtime routines (e.g., co-sleeping, putting children to bed asleep rather than awake) compared to non-anxious parents. These parenting behaviors were associated with significantly higher rates of sleep problems in at risk children. Such parenting strategies may interfere with the early development of self-regulatory skills required for regulating both sleep and emotion and lead to the later development of problems in both domains<sup>[17]</sup>. In a separate study, both parental psychopathology and family disorganization (i.e., lack of structure/routine within the home) were highly correlated with sleep disturbance and anxiety in children<sup>[21]</sup>.

Findings linking cognitive biases and sleep in adolescents add to a limited body of research investigating potential mechanisms of early sleep and internalizing symptoms. The two cognitive constructs examined in this study—interpretation biases and

control beliefs—are commonly implicated in the development of anxiety and depression<sup>[29,31]</sup> and an external locus of control has been identified among adults with chronic sleep difficulties<sup>[28,53]</sup>. In this study, adolescent sleep problems were significantly associated with cognitive errors, whereas the association with an external locus of control was only marginally significant. In clinic settings, youth with sleep problems often worry about the meaning and implications of these problems including whether they will persist over long periods of time (i.e., interpret them in a threatening manner). Even though this study did not examine pre-sleep thought activity, a relation between negative interpretation biases, and sleep suggests that some amount of rumination and worry may take place at night and interfere with sleep onset and maintenance in youth with elevated internalizing symptoms.

By comparison, an association between an external locus of control and sleep may develop over time as a result of persistent sleep difficulty and serve to further exacerbate an inability to regulate sleep. It also should be noted, however, that because this study included children as young as age 6 who may not yet possess the metacognitive skill required to experience elaborative thought processes<sup>[54]</sup>, associations between cognitive factors and sleep may in fact develop before adolescence. This issue requires further exploration in future research. Of course it also is important to note that the association between cognitive errors and sleep problems was mediated by the presence of both anxiety and depressive symptoms. Thus, cognitive biases seem to be one of several potential mechanisms involved in the co-occurrence of these problems. Other important factors for consideration in future research include neurophysiological and autonomic mechanisms, environmentally conditioned nocturnal arousal, and familial factors. For example, unlike adults, children's sleep habits are impacted (at least in part) by caregiver-dictated bedtime schedules and sleep practices<sup>[55]</sup>. The interplay between cognitive and environmental factors therefore requires further study.

Although the nature of these data does not allow for conclusions regarding directionality, relationships between sleep and affective functioning seem to be bidirectional<sup>[17]</sup>. Internalizing problems may give rise to and exacerbate sleep difficulties, while the effects of insufficient sleep include decreased affective regulation and coping skills. For example, rates of sleep disturbance are highest among psychiatric populations<sup>[5,13]</sup> and increases in negative affective responses (i.e., anger, sadness, and fear) following mild-to-moderate amounts of sleep restriction have been reported in otherwise healthy children and adolescents<sup>[56,57]</sup>. Thus, persistent sleep disturbance may contribute to the development of internalizing disorders vis-à-vis an overall reduction in regulatory skills. However, because data are generally limited, experimental and longitudinal research is needed to better understand these complex relationships.

## LIMITATIONS

Despite its contributions, this study is not without limitations. Our evaluation of sleep problems was not based on a validated measure of sleep, but rather relied on factor analysis of sleep-related items from several parent and child questionnaires. Thus, we were unable to adequately examine the persistence and specific type of sleep problems reported by children and parents. Other data suggest this to be an important area of investigation<sup>[58,59]</sup>. Despite findings of adequate psychometric properties for use in this study and the use of similar sleep scales in previous research<sup>[11,14]</sup>, the reliability of our sleep scale with other samples of children and adolescents is unknown. Alternatively, use of both parent and child reports in constructing a sleep scale may have provided a more accurate assessment of sleep problems compared to relying solely on parent report<sup>[11]</sup>.

Another important consideration in interpreting the current findings includes the fact that despite common reports of sleep disturbance among depressed youth, studies have often failed to find objective evidence of sleep disruption in this population<sup>[60,61]</sup>. Data based on objective measures of sleep among anxious youth are lacking. Thus, correspondence between subjective and objective measures is unclear and replication based on polysomnography and/or actigraphy is ultimately needed. Finally, based on our specific recruitment methods and the sole use of parent and self-report measures these findings may not generalize to other populations of youth. Examination of specific sleep problems in larger samples of children and adolescents is therefore required.

## CLINICAL IMPLICATIONS

Data indicating adult sleep disorders to commonly originate and persist from childhood suggest that early intervention may be critical<sup>[62]</sup>. Factors associated with the development of sleep problems during childhood are varied, but the fact that a considerable number of children also meet criteria for an internalizing disorder and/or exhibit other emotional and behavioral problems<sup>[3,4]</sup> highlights an important association between these bioregulatory systems. Together with data from this study, findings underscore the need for clinicians to assess for internalizing problems in youth presenting with sleep complaints and to make appropriate referrals for treatment. Based on a reciprocal model of dysregulation<sup>[17]</sup>, persistent sleep problems may exacerbate internalizing symptoms and contribute to the ultimate development of affective disorders<sup>[19]</sup>. Furthermore, based on a link between sleep and cognitive biases, consideration of these factors may be important for understanding and treating sleep problems in youth, particularly adolescents. Correcting misperceptions about the effects of sleep loss, the meaning and implications of persistent sleep problems, and the controllability of sleep has been shown to be efficacious in reducing sleep problems in adults.<sup>[53]</sup>

By comparison, treatment outcome data among children are extremely limited and specific mechanisms of change remain to be explored.

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