

Sleepless in America: Inadequate Sleep and Relationships to Health and Well-being of Our Nation's Children

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ABSTRACT

OBJECTIVE. Our goal was to identify characteristics associated with inadequate sleep for a national random sample of elementary school-aged children (6–11 years) and adolescents (12–17 years).

METHODS. Data from 68 418 participants in the 2003 National Survey of Children's Health were analyzed by using weighted bivariate and multivariate regression models. The dependent variable was report of not getting enough sleep for a child of his or her age ≥ 1 night of the past week. Independent variables included demographic characteristics, child health, school and other activities, and family life.

RESULTS. Parents of elementary school-aged children with inadequate sleep were more likely to report that their child was having problems at school or had a father with fair or poor health. Parents of adolescents with inadequate sleep were more likely to report that their child had an atopic condition, frequent or severe headaches, a parent with less-than-excellent emotional health, or experienced frequent parental anger. Inadequate sleep in both age groups was associated with parental report that their child usually or always displayed depressive symptomatology, family disagreements involved heated arguing, or parental concern that the child was not always safe at home, at school, or in their neighborhood.

CONCLUSIONS. Approximately 15 million American children are affected by inadequate sleep. Primary care providers should routinely identify and address inadequate sleep and its associated health, school, and family factors.

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Key Words

sleep, child health, national estimates, school age, teens

Abbreviations

ADHD—attention-deficit/hyperactivity disorder
NSCH—National Survey of Children's Health
ADD—attention-deficit disorder
PL—poverty level
OR—odds ratio
CI—confidence interval

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INADEQUATE SLEEP DURING childhood is an invisible phenomenon that fails to receive attention from primary care providers until it interferes with the child's behavior, mood, or performance.¹⁻⁴ Community and multi-site studies have consistently reported that up to 20% to 25% of US children and adolescents experience a range of sleep problems.⁵⁻¹⁰ Inadequate sleep takes many forms: difficulty with sleep onset, length, or circadian rhythms with resulting daytime sleepiness experienced by otherwise healthy children; disturbed sleep associated with acute and chronic illness; and primary sleep disorders. The least attention has been paid to the first group, and there is little consensus about the second.

Normative requirements for adequate sleep based on epidemiologic and laboratory studies¹¹⁻¹³ reflect the need for progressively less sleep by developmental stage with averages of 10 hours for 5- to 13-year-olds (declining from 11.1 at 5 years to 9.0 hours at 13 years) and 8 to 9 hours for adolescents 14 to 18 years of age.¹¹ More recent reports suggest that adolescent needs may be underestimated,⁶ especially during midadolescence.¹⁴ Evidence is accumulating that US children and teens typically sleep less than the required hours recommended.^{8-10,15,16} Primary care providers inadequately assess, diagnose, or treat sleep problems even when parents and children offer complaints.¹ Strength of associations between sleep disturbances and cognition, behavior, or mood in otherwise healthy children range from robust to unknown.¹⁷

Relationships between sleep disturbance and chronic health conditions during childhood have been investigated. The association of sleep and attention-deficit/hyperactivity disorder (ADHD) is not well understood. The consequences of impaired sleep may resemble and/or exacerbate ADHD symptomatology. Conversely, ADHD symptoms and psychostimulant medication may exacerbate sleep impairment. Although as many as 50% of parents of children and adolescents with ADHD report sleep problems,¹⁸⁻²⁰ studies using more objective polysomnography have failed to demonstrate differences in sleep architecture between children with and without ADHD.²⁰

Similarly, both research and clinical experience supports the relationship between sleep problems and mood and anxiety disorders, although it is unclear whether the sleep problem or the psychiatric disorder is the primary problem.^{21,22} In some studies, primary psychopathology is associated with or worsened by sleep impairment.⁷ Consistently, sleep impairment and mood and anxiety disorders are comorbid conditions. Atopic disorders, such as asthma and allergic rhinitis, have also been associated with increased sleep impairment.^{2,23,24}

The purpose of this study was to describe the prevalence and characteristics of inadequate sleep as perceived by parents of a random national sample of school-aged and adolescent children and reported as part of the 2003

National Survey of Children's Health (NSCH). We use a multi-domain conceptual approach incorporating child, family, and environmental factors. The assumptions are made that children require regular patterns and specific hours of sleep according to developmental stage and that inadequate sleep is undesirable and potentially deleterious to health.

METHODS

Data Source

Data for this study come from the responses of parents or caregivers of 68 418 children between the ages of 6 and 17 years interviewed as part of the 2003 NSCH who responded to the question "During the past week, on how many nights did your child get enough sleep for a child his/her age?" "Enough sleep" was broadly interpreted as however the parent/caregiver defined it for a particular child. Parents of children <6 years of age were not asked this question as part of the survey. The survey design is described briefly in the article by Kogan and Newacheck²⁵ in this issue; more in-depth information can be found elsewhere.²⁶

Variables

We stratified children by age into 2 groups: school-aged children (6-11 years) and adolescents (12-17 years). Independent variables were organized by the following categories: demographic characteristics, child health (health status, comorbid conditions, and reported child behaviors); school and activities (problems in school, physical activity, and television viewing), and family/community life (family structure, parental health, and family stress). The dependent variable, inadequate sleep, was a response to the question on the survey indicating that the child did not sleep well on at least 1 night of the preceding week.

Some variables and/or response categories were merged into broader categories before inclusion in bivariate or multivariate models. Race and ethnicity variables were merged to encompass non-Hispanic white, non-Hispanic black, Hispanic, and other race. The category "other race" was inclusive of children identified as Asian or Native American. We dichotomized responses to questions about time spent watching television, watching videos, or playing video games at ≥ 2 hours and < 2 hours in accord with the guidelines established by the American Academy of Pediatrics.²⁷ We merged responses to 3 questions that asked parents whether a doctor or other health professional had told them that their child had asthma, hay fever or another respiratory allergy, or eczema or another skin allergy to create the variable "atopic condition."

A variable "depressive symptoms" was created from collective responses to 4 questions that asked about level of parental concern regarding the following child behav-

ioral characteristics: stubborn, sullen, or irritable; feeling worthless or inferior; unhappy, sad, or depressed; and withdrawn and does not get involved with others. We quantified level of concern for depressive symptoms as “never concerned,” indicating that the respondent did not express concern about any of the 4 component variables, and “sometimes” or “usually/always” concerned if the respondent expressed this level of concern for at least 1 of the 4 behaviors. We used a similar approach to create the variable “environmental safety” from 3 questions that asked parents how often they felt their child was safe in their community or neighborhood, school, and home. Human subjects review was not required for this study.

Analyses

The NSCH provides population weights to permit extrapolation of findings from this sample to national and state population estimates. Incorporating the appropriate weights, we used SUDAAN 9.0.0 (Research Triangle Institute, Research Triangle, NC)²⁸ to perform all of our analyses. Bivariate analyses were conducted to examine relationships between the outcome variable, inadequate sleep, and variables included in each of the categories specified above for children 6 to 11 years of age and 12 to 17 years of age who experienced inadequate sleep with those who did not. Multivariate logistic regression analyses were performed to assess the independent associations between inadequate sleep and covariates of interest for each group of children.

RESULTS

The 68 418 children identified for interviews were weighted to represent 47.4 million children nationwide. Overall, the parents of 31.9% of these children reported that their child’s sleep had been inadequate on ≥ 1 night during the week before participation in the survey. The percentage of children affected by inadequate sleep demonstrates a strong relationship with age throughout

childhood, with a more marked increase by age for children ≥ 12 years of age (Fig 1).

Characteristics of children with and without reported adequate sleep are presented by age group in Table 1. In both groups, children with reported inadequate sleep were more frequently non-Hispanic white, resided in families with education greater than high school and higher income levels, and were more frequently described as having less-than-excellent health compared with children with reported adequate sleep patterns. Disease comorbidities such as atopic conditions, attention-deficit disorder (ADD), or ADHD were more common in children with inadequate sleep. Parents of children with inadequate sleep reported less successful school experiences, with approximately one third having been contacted for a school-related problem and more reporting their child having been bullied by classmates.

Table 2 presents results of the multivariate logistic regression analyses. All models controlled for demographic, child health, school and activities, and family life variables. When covariates were examined independently for their relationship to inadequate sleep, the following variables were associated with greater sleep needs in both age groups: (a) presence of 1 or more depressive symptoms, (b) less frequent days of physical activity, and living in a home where (c) parents argue heatedly or shout, (d) on rare occasions respond by hitting or throwing things during family disagreements, or (e) perceive that the environment at home, school, or in the community is not always safe. Some variables were exclusively associated with inadequate sleep in the elementary school age group: (a) having problems at school and (b) fair or poor paternal general health, whereas others were associated with inadequate sleep in the adolescent group only (a) an atopic condition, (b) frequent or severe headaches, (c) less-than-excellent maternal or paternal emotional health, (d) parental perception that the child is sometimes harder to care for

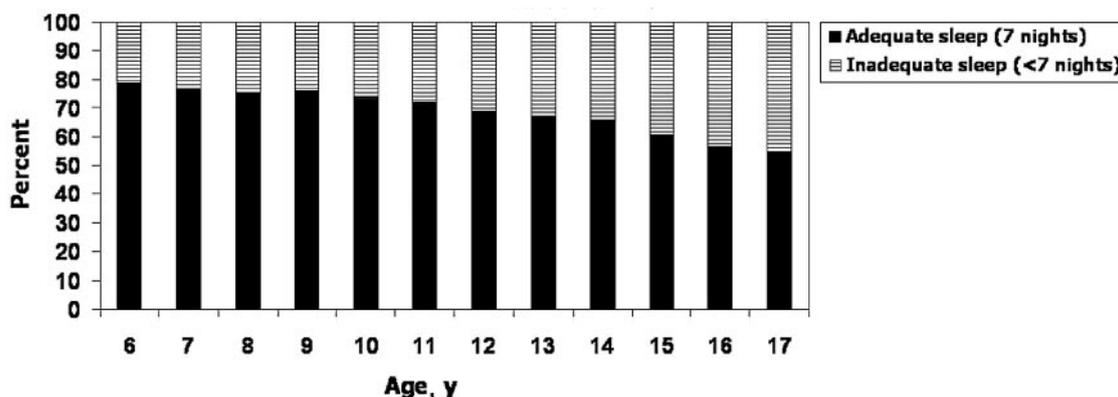


FIGURE 1 Percentage of children with reported inadequate sleep according to year of age ($P < .001$ for trend). Source: 2003 National Survey of Children’s Health.

TABLE 1 Characteristics of Children With and Without Reported Inadequate Sleep According to Age Group

Variable	Age 6 to 11 y (N = 23 764 177)		Age 12 to 17 y (N = 23 641 346)	
	Inadequate Sleep (N = 5 828 973 [24.5%])	Adequate Sleep (N = 17 935 204 [75.5%])	Inadequate Sleep (N = 9 302 085 [39.3%])	Adequate Sleep (N = 14 339 261 [60.7%])
Demographic characteristics				
Gender				
Male	51.3	51.1	50.1	51.2
Female (reference)	48.7	48.9	49.9	48.8
Race/ethnicity				
Non-Hispanic white (reference)	63.3	59.6	69.8	60.4
Non-Hispanic black	14.9	14.3	12.9 ^a	16.3
Hispanic	15.3 ^a	18.0	11.3 ^a	16.4
Other/mixed race	6.2 ^a	8.0	5.9 ^a	6.7
Family education level				
Less than high school	7.7	7.9	4.7 ^a	8.0
High school graduate	23.5 ^a	27.0	22.6 ^a	30.1
More than high school (reference)	68.8	65.1	72.7	61.8
Income as % PL				
<100% PL	14.3 ^a	16.1	10.9 ^a	16.1
100%–199% PL	19.7 ^a	21.2	18.0 ^a	20.9
200%–399% PL	31.3	30.3	32.3 ^a	29.3
≥400% PL (reference)	26.3	22.8	29.7	22.8
PL missing	8.4	9.6	9.0	11.0
Child health				
Health status				
Excellent (reference)	57.3	62.1	56.3	59.1
Very good, good	38.4 ^b	34.9	40.3 ^b	37.2
Fair, poor	4.3 ^b	3.0	3.4	3.6
Comorbid conditions				
Depression/anxiety	5.3 ^b	2.9	8.0 ^b	6.6
Behavioral/conduct problem	8.7 ^b	5.3	6.5	6.3
Developmental delay or physical impairment	3.7	3.8	3.2	3.4
Atopic condition ^c	32.4 ^b	29.1	33.6 ^b	27.4
Frequent or severe headache	5.9 ^b	4.4	10.4 ^b	7.9
Learning disability	11.2 ^b	9.3	12.2 ^a	13.8
ADD/ADHD	9.6 ^b	7.1	10.1	9.5
Reported child behaviors				
Depressive symptoms ^d				
Never (reference)	11.4	19.7	12.2	20.5
Sometimes	73.0 ^b	69.8	72.6 ^b	66.8
Usually, always	15.6 ^b	10.5	15.2 ^b	12.7
Overweight	27.5	28.3	11.5 ^a	13.4
School and activities				
Having problems at school				
Never (reference)	65.0	72.8	67.6	70.7
Parents contacted	35.0 ^b	27.2	32.4 ^b	29.3
Bullied by classmates				
Not at all (reference)	56.3	61.5	69.6	69.1
A little	28.7 ^b	23.4	19.6 ^b	17.4
A lot	15.0	15.2	10.8 ^a	13.5
Days of physical exercise (≥20 min/d) during past week				
None	7.0 ^b	6.9	15.5 ^b	
1–5 d	62.6 ^b	55.1	61.3 ^b	56.0
6–7 days (reference)	30.4	38.0	23.2	28.4
Television/video time per d				
≤2 h (reference)	55.2	57.6	56.3	52.4
>2 h	44.8 ^b	42.4	43.7 ^a	47.6
Family life				
Family structure				
2 parents, biological/adopted (reference)	63.5	61.7	57.3	53.8
2-parent stepfamily	9.1	10.2	12.2 ^a	13.8
Single mother	23.9	23.1	26.1	26.0
Other	3.5 ^a	5.0	4.4 ^a	6.4

TABLE 1 Continued

Variable	Age 6 to 11 y (N = 23 764 177)		Age 12 to 17 y (N = 23 641 346)	
	Inadequate Sleep (N = 5 828 973 [24.5%])	Adequate Sleep (N = 17 935 204 [75.5%])	Inadequate Sleep (N = 9 302 085 [39.3%])	Adequate Sleep (N = 14 339 261 [60.7%])
Total children in household				
1 (reference)	14.8	14.2	28.6	25.6
2	39.4	40.7	37.3 ^a	36.9
≥3	45.9	45.2	34.1 ^a	37.5
Parental health				
Mother's general health				
Excellent (reference)	29.2	35.0	27.8	31.5
Very good, good	59.0 ^b	55.7	59.8 ^b	55.9
Fair, poor	11.8 ^b	9.3	12.4	12.6
Mother's emotional health				
Excellent (reference)	28.3	38.5	29.2	37.1
Very good, good	63.1 ^b	56.0	62.1 ^b	55.7
Fair, poor	8.6 ^b	5.5	8.7 ^b	7.2
Father's general health				
Excellent (reference)	30.7	37.9	28.6	32.7
Very good, good	62.2 ^b	56.4	63.0 ^b	58.7
Fair, poor	7.1 ^b	5.7	8.4	8.6
Father's emotional health				
Excellent (reference)	34.1	45.2	34.0	41.9
Very good, good	62.0 ^b	51.5	61.2 ^b	53.8
Fair, poor	3.9 ^b	3.3	4.8 ^b	4.3
Family stress				
Child harder to care for				
Never (reference)	64.4	73.1	64.5	69.9
Sometimes	28.7 ^b	21.5	28.2 ^b	23.5
Usually, always	6.9 ^b	5.4	7.3 ^b	6.7
Argue heatedly or shout				
Never (reference)	17.6	27.0	16.6	23.8
Rarely	34.6 ^b	33.9	33.5 ^b	34.0
Sometimes, usually, always	47.8 ^b	39.2	49.9 ^b	42.3
Hitting/throwing things during family disagreements				
Never (reference)	84.5	90.2	86.5	90.2
Rarely	11.5 ^b	6.8	10.1 ^b	6.9
Sometimes, usually, always	4.0	3.0	3.4	2.9
Parental anger with child				
Never (reference)	15.9	23.9	17.4	25.1
Sometimes	80.7 ^b	73.8	77.5 ^b	71.7
Usually, always	3.4 ^b	2.3	5.1 ^b	3.2
Environmental safety ^e				
Always (reference)	33.3	41.9	26.5	35.1
Usually	52.3 ^b	43.7	59.6 ^b	47.8
Sometimes, never	14.4 ^b	14.4	13.9	17.1

^a Significantly associated with lesser impaired sleep, relative to reference category, in bivariate analysis.

^b Significantly associated with greater impaired sleep, relative to reference category, in bivariate analysis.

^c Respondent report of ≥1 of the following conditions: asthma, hay fever or respiratory allergy, eczema or skin allergy.

^d Respondent report of ≥1 of the following during the past month: child feels worthless or inferior, unhappy, sad or depressed, stubborn, sullen or irritable, or withdrawn.

^e Respondent report of ≥1 of the following areas of concern for child's safety: at school, neighborhood, or home.

than other children, and (e) parental anger with the child. Living in a family with reported income <400% of the federal poverty level (PL) was associated with significantly lower odds of inadequate sleep, even after controlling for potentially confounding variables. In addition, >2 hours of television viewing per day, diagnosis of learning disability, and being victimized by classmate bullying behavior were associated with significantly lower odds of inadequate sleep in the adolescent group.

DISCUSSION

The neuroscientist Robert Stickgold warns that because critical reparative and integrative processes “. . . occur exclusively during sleep and can't be reproduced when we are awake, the consequences of losing them look more and more terrifying. . . .”²⁹ The independent non-profit National Sleep Foundation concluded from its 2004 *Sleep in America* poll that a remarkable number of children age 10 and younger have some kind of sleep

TABLE 2 Adjusted ORs for Inadequate Sleep for Children Aged 6 to 11 and 12 to 17 Years

	Age 6–11 y			Age 12–17 y		
	OR	95% CI	<i>P</i>	OR	95% CI	<i>P</i>
Demographic characteristics						
Race/ethnicity			<.01			<.001
Non-Hispanic white (reference)	1.00			1.00		
Non-Hispanic black	1.02	0.83–1.25		0.73	0.60–0.89	
Hispanic	0.80	0.66–0.97		0.71	0.59–0.86	
Other/mixed race	0.69	0.53–0.90		0.77	0.60–0.99	
Family education level			.02			<.001
Less than high school	1.01	0.71–1.43		0.74	0.49–1.11	
High school graduate	0.81	0.70–0.94		0.68	0.60–0.77	
More than high school (reference)	1.00			1.00		
Income as % PL			.01			<.001
<100% PL	0.68	0.52–0.88		0.49	0.38–0.64	
100%–199% PL	0.77	0.64–0.91		0.79	0.67–0.93	
200%–399% PL	0.91	0.80–1.03		0.89	0.80–0.99	
≥400% PL (reference)	1.00			1.00		
Child health						
Atopic condition ^a			NS			.002
Yes				1.17	1.06–1.29	
No (reference)				1.00		
Frequent or severe headache			NS			.01
Yes				1.27	1.05–1.53	
No (reference)				1.00		
Learning disability			NS			<.001
Yes				0.68	0.58–0.78	
No (reference)				1.00		
Depressive symptoms ^b			<.001			<.001
Never (reference)	1.00			1.00		
Sometimes	1.38	1.17–1.63		1.56	1.36–1.79	
Usually, always	1.67	1.32–2.12		1.43	1.17–1.75	
School and activities						
Having problems at school			.03			NS
Never (reference)	1.00					
Parents contacted	1.16	1.02–1.32				
Bullied by classmates			NS			.01
Not at all (reference)				1.00		
A little				0.91	0.81–1.02	
A lot				0.79	0.66–0.93	
Days physical education during past week			<.001			<.001
None	1.10	0.85–1.42		1.16	1.00–1.35	
1–5	1.43	1.28–1.60		1.33	1.19–1.49	
6–7 (reference)	1.00			1.00		
Television/video time per d			NS			<.001
≤2 h (reference)				1.00		
>2 h				0.84	0.76–0.92	
Family life						
Mother's emotional health			NS			.04
Excellent (reference)				1.00		
Very good, good				1.20	1.03–1.39	
Fair, poor				1.32	0.98–1.77	
Father's general health			.04			NS
Excellent (reference)	1.00					
Very good, good	1.14	0.99–1.32				
Fair, poor	1.41	1.06–1.88				
Father's emotional health			NS			.03
Excellent (reference)				1.00		
Very good, good				1.18	1.02–1.36	
Fair, poor				1.41	1.04–1.92	
Family stress						
Child harder to care for			NS			.001
Never (reference)				1.00		
Sometimes				1.24	1.10–1.39	
Usually, always				1.26	0.96–1.66	

TABLE 2 Continued

	Age 6–11 y			Age 12–17 y		
	OR	95% CI	P	OR	95% CI	P
Argue heatedly or shout			.007			.005
Never (reference)	1.00			1.00		
Rarely	1.17	1.01–1.35		1.10	0.96–1.25	
Sometimes, usually, always	1.28	1.10–1.49		1.24	1.08–1.42	
Hitting, throwing things			.002			<.001
Never (reference)	1.00			1.00		
Rarely	1.40	1.16–1.70		1.41	1.17–1.70	
Sometimes, usually, always	1.19	0.81–1.75		1.19	0.87–1.63	
Parental anger with child			NS			.006
Never (reference)				1.00		
Sometimes				1.15	1.02–1.30	
Usually, always				1.61	1.16–2.23	
Environmental safety ^c			.002			<.001
Always safe (reference)	1.00			1.00		
Usually safe	1.23	1.09–1.38		1.35	1.22–1.49	
Sometimes, never safe	1.06	0.86–1.32		1.05	0.87–1.25	

NS indicates not significant. Each model controls for demographic characteristics, child health, school and activities, and family life variables.

^a Respondent report of 1 of the following conditions: asthma, hay fever or respiratory allergy, eczema or skin allergy.

^b Respondent report of ≥ 1 of the following during the past month: child feels worthless or inferior, unhappy, sad or depressed, stubborn, sullen or irritable, or withdrawn.

^c Respondent report of ≥ 1 of the following areas of concern for child's safety: at school, neighborhood, or home.

problem,⁹ three quarters of parents are dissatisfied about children's sleep, and few pediatric providers inquire about or follow-up on sleep complaints; their more recently released adolescent data contain similar concerns.¹⁰ Carskadon³⁰ refers to sleep as "the forgotten country" and calls for attention to the "sleeping half of children's lives."

Is such alarm warranted? In our analysis, parents in a national random sample reported that 31.9% of their children experienced ≥ 1 night of inadequate sleep during the previous week. These children experienced health-related deficits associated with selected demographic, child, family, and environmental factors. This is consistent with growing evidence for deleterious effects of even occasional lapses in recommended amounts of sleep.

Acute sleep deprivation and chronic sleep disorders result in behavioral and performance deficits in school-aged children.^{2,31–34} Adolescents' erratic sleep patterns are fostered by pubertal changes in hormone secretion making it difficult to fall asleep before 11 PM⁷; yet early school start times compel them to be in class before 8 AM.⁵ Weekday and weekend variations result in prolonged delayed sleep onset, insomnia, and daytime sleepiness throughout the week³⁵ along with impaired mood, behavioral control, and academic performance.^{7,36}

Ethnocultural and Socioeconomic Differences

Impact of sleep problems on children and families transcends all cultures.³⁷ Contrary to earlier studies^{8,16,38} identifying minority and poorer children at greater risk, our data suggest that parents of non-Hispanic white children and those who have higher income and greater than high school education more frequently report the

perception of inadequate sleep in their children. Roberts³⁹ examined differences in sleep complaints among 5423 American adolescents of African, Chinese, Mexican, Central American, and Anglo descent and concluded minority status may affect risk for sleep problems. Primary school children in China averaged 9.3 vs 10.2 hours of sleep compared with US children and reported daytime sleepiness.⁴⁰ Cross-sectional analysis of child journals and caregiver questionnaires for 755 children aged 8 to 11 years showed that at all ages minority boys slept significantly less compared with minority girls and all nonminority children.⁸ A parent-report survey of 472 children in 1 US city showed an inverse association between socioeconomic status and both parasomnias and noisy sleep.² Exploration of sleep by ethnicity and socioeconomics remains in its infancy. Comparisons across studies are hampered by differences in definitions and data sources.

Sleep and Comorbidity

In our analysis, the relationship between inadequate sleep and mood disorders was present in both younger and older children. Children with depression subjectively reported poor and inadequate sleep when compared with controls; however, 1 study using objective electroencephalogram data failed to validate this relationship.⁴¹ When sleep architecture was studied in depressed, unmedicated children compared with healthy controls, only depressed older boys had significant sleep disturbance.⁴²

Consistent with the literature, in this study adolescents with atopic conditions and headache were more likely to have inadequate sleep compared with children without these conditions. However, this finding did not

hold true for younger children. Children in remission phase of atopic dermatitis evaluated by polysomnography demonstrate significantly disturbed sleep symptoms.⁴³ As many as 64% of asthmatic children report 3 nocturnal awakenings per week.⁴⁴ Individuals with allergic rhinitis sleep poorly and have sleep-disordered breathing and subsequent daytime sleepiness.^{45,46} Although children with migraine headaches subjectively experienced more sleep problems than did healthy control children,^{47,48} more objective actigraphy did not show differences in sleep parameters.⁴⁹

Our data failed to demonstrate an association between inadequate sleep and ADHD in either age group in multivariate models. Studies relying on parental report of sleep behavior^{18,38,50} support an association between a diagnosis of ADHD and sleep problems in children. Parents of children with ADHD report sleep problems in 25% to 50% of these children,²⁰ but these findings are not supported when more objective measurements such as polysomnography are used.⁵¹

Family Health and Social Factors

In both age groups, inadequate sleep was associated with family conflict; in teens it was further associated with parental emotional health, being perceived as a difficult child, and parental anger. Sleep issues are known to exist with child abuse and family violence.^{52,53} Our study makes the connection with inadequate sleep much earlier in the violence spectrum. It may be that perceived inadequate sleep is an alert for suboptimal family functioning and should trigger assessment, referral, and early intervention. Inadequate sleep was also associated with not feeling safe in school or neighborhood. The National Institute of Mental Health reports a significant increase in US children as witnesses to or victims of community violence⁵⁴ with resulting physical and psychological effects.⁵⁵ Regular use of brief sleep assessment tools⁷ can lead to addressing sleep issues and their underlying causes.

Limitations

These NSCH cross-sectional data limit interpretation to association. All bivariate and multivariate associations described in the text and displayed in the tables are bidirectional and reflect simultaneous relationships between independent variables and the dependent variable. Therefore, neither cause nor causal direction can be determined. In addition, sleep information is derived from parental response to 1 question concerning adequacy of a child's sleep during the past week. The survey does not provide information about perceived or diagnosed causes of inadequate sleep, whether it was a usual or unusual occurrence, or the norms by which each parent judged sleep. Nevertheless, prevalence of inadequate sleep and its effects in this large national sample are consistent with reports of epidemiologic sleep stud-

ies.^{9,10} Because evidence is accumulating concerning the health risks of inadequate sleep at all ages, future surveys should explore sleep in greater detail.

CONCLUSIONS

Sleep health is an important but underrecognized component of wellness in children. Sleep impairment may provide a critical alert for primary care providers to search for undiagnosed physical or psychological comorbidity, suboptimal coping, family dysfunction, or threats in school or community. Conversely, when any of these conditions and/or situations is known to be present, sleep impairment may be a comorbid symptom that needs to be addressed. Sleep health and its assessment should be a fundamental aspect of clinical prevention.

REFERENCES

1. Chervin RD, Archbold KH, Panahi P, Pituch KJ. Sleep problems seldom addressed at two general pediatric clinics. *Pediatrics*. 2001;107:1375-1380
2. Stein MA, Mendelsohn J, Obermeyer WH, Amromin J, Benca R. Sleep and behavior problems in school-aged children. *Pediatrics*. 2001;107(4). Available at: www.pediatrics.org/cgi/content/full/107/4/e60
3. Wilkoff W. Sleep need in children. *Pediatrics*. 2003;112:1463-1464
4. Blunden S, Lushington K, Lorenzen B, Ooi T, Fung F, Kennedy D. Are sleep problems under-recognised in general practice? *Arch Dis Child*. 2004;89:708-712
5. Lamberg L. Pediatric sleep medicine comes of age. *JAMA*. 2005;293:2327-2329
6. Hoban TF. Sleep and its disorders in children. *Semin Neurol*. 2004;24:327-340
7. Owens JA, Witmans M. Sleep problems. *Curr Probl Pediatr Adolesc Health Care*. 2004;34:154-179
8. Spilbury JC, Storfer-Isser A, Drotar D, et al. Sleep behavior in an urban US sample of school-aged children. *Arch Pediatr Adolesc Med*. 2004;158:988-994
9. National Sleep Foundation. 2004 Sleep in America poll. Available at: www.sleepfoundation.org/_content//hottopics/2004SleepPollFinalReport.pdf. Accessed April 17, 2006
10. National Sleep Foundation. Adolescent sleep needs and patterns: research report and resource guide. Available at: www.sleepfoundation.org/_content/hottopics/sleep_and_teens_report1.pdf. Accessed April 17, 2006
11. Heussler HS. 9. Common causes of sleep disruption and daytime sleepiness: childhood sleep disorders II. *Med J Aust*. 2005;182:484-489
12. Howard BJ, Wong J. Sleep disorders. *Pediatr Rev*. 2001;22:327-342
13. Anders T, Sadeh A, Appareddy V. Normal sleep in neonates and children. In: Ferber R, Kryger M, eds. *Principles and Practice of Sleep Medicine in the Child*. Philadelphia, PA: WB Saunders; 1995:7-18
14. Yarcheski A, Mahon NE. A study of sleep during adolescence. *J Pediatr Nurs*. 1994;9:357-367
15. Iglowstein I, Jenni OG, Molinari L, Largo RH. Sleep duration from infancy to adolescence: reference values and generational trends. *Pediatrics*. 2003;111:302-307
16. Roberts RE, Roberts CR, Chen IG. Ethnocultural differences in sleep complaints among adolescents. *J Nerv Ment Dis*. 2000;188:222-229
17. Fallone G, Seifer R, Acebo C, Carskadon MA. How well do

- school-aged children comply with imposed sleep schedules at home? *Sleep*. 2002;25:739–745
18. Owens JA, Maxim R, Nobile C, McGuinn M, Msall M. Parental and self-report of sleep in children with attention-deficit/hyperactivity disorder. *Arch Pediatr Adolesc Med*. 2000;154:549–555
 19. Marcotte AC, Thacher PV, Butters M, Bortz J, Acebo C, Carskadon MA. Parental report of sleep problems in children with attentional and learning disorders. *J Dev Behav Pediatr*. 1998;19:178–186
 20. Corkum P, Tannock R, Moldofsky H. Sleep disturbances in children with attention-deficit/hyperactivity disorder. *J Am Acad Child Adolesc Psychiatry*. 1998;37:637–646
 21. Fallone G, Owens JA, Deane J. Sleepiness in children and adolescents: clinical implications. *Sleep Med Rev*. 2002;6:287–306
 22. Dahl RE, Ryan ND, Matty MK, et al. Sleep onset abnormalities in depressed adolescents. *Biol Psychiatry*. 1996;39:400–410
 23. Dahl RE, Bernhisel-Broadbent J, Scanlon-Holdford S, Sampson HA, Lupo M. Sleep disturbances in children with atopic dermatitis. *Arch Pediatr Adolesc Med*. 1995;149:856–860
 24. Sadeh A, Horowitz I, Wolach-Benodis L, Wolach B. Sleep and pulmonary function in children with well-controlled, stable asthma. *Sleep*. 1998;21:379–384
 25. Kogan MD, Newacheck PW. Introduction to the volume on articles from the National Survey of Children's Health. *Pediatrics*. 2007;119(suppl 1):S1–S3
 26. Blumberg SJ, Olson L, Frankel M, Osborn L, Srinath KP, Giambro P. Design and operation of the National Survey of Children's Health, 2003. *Vital Health Stat 1*. 2005;(43):1–124
 27. American Academy of Pediatrics, Committee on Public Education. Children, adolescents, and television. *Pediatrics*. 2001;107:423–426
 28. SUDAAN Language Manual, Release 9.0. Research Triangle Park, NC: Research Triangle Institute; 2004
 29. Lambert C. Deep into sleep. *Harvard Magazine*. 2005;107:25–33
 30. Carskadon MA. The sleep of America's children. National Sleep Foundation. Available at: www.sleepfoundation.org/hottopics/index.php?secid=11&id=82. Accessed December 20, 2005
 31. Dahl RE. The impact of inadequate sleep on children's daytime cognitive function. *Semin Pediatr Neurol*. 1996;3:44–50
 32. Smedje H, Broman JE, Hetta J. Short-term prospective study of sleep disturbances in 5–8-year-old children. *Acta Paediatr*. 2001;90:1456–1463
 33. Fallone G, Acebo C, Arnedt JT, Seifer R, Carskadon MA. Effects of acute sleep restriction on behavior, sustained attention, and response inhibition in children. *Percept Mot Skills*. 2001;93:213–229
 34. Smedje H, Broman JE, Hetta J. Associations between disturbed sleep and behavioural difficulties in 635 children aged six to eight years: a study based on parents' perceptions. *Eur Child Adolesc Psychiatry*. 2001;10:1–9
 35. Hoban TF, Chervin RD. Assessment of sleepiness in children. *Semin Pediatr Neurol*. 2001;8:216–228
 36. Dahl RE. Pathways to adolescent health sleep regulation and behavior. *J Adolesc Health*. 2002;6:175–184
 37. Owens JA. Introduction: culture and sleep in children. *Pediatrics*. 2005;115:201–203
 38. Stein MA. Unravelling sleep problems in treated and untreated children with ADHD. *J Child Adolesc Psychopharmacol*. 1999;9:157–168
 39. Roberts RE, Roberts CR, Chen IG. Ethnocultural differences in sleep complaints among adolescents. *J Nerv Mental Dis*. 2000;188:222–229
 40. Liu X, Liu L, Owens JA, Kaplan DL. Sleep patterns and sleep problems among schoolchildren in the United States and China. *Pediatrics*. 2005;115:241–249
 41. Bertocci MA, Dahl RE, Williamson DE, et al. Subjective sleep complaints in pediatric depression: a controlled study and comparison with EEG measures of sleep and waking. *J Am Acad Child Adolesc Psychiatry*. 2005;44:1158–1166
 42. Robert JJ, Hoffmann RF, Emslie GJ, et al. Sex and age differences in sleep macroarchitecture in childhood and adolescent depression. *Sleep*. 2006;29:351–358
 43. Reuveni H, Chapnick G, Tal A, Tarasiuk A. Sleep fragmentation in children with atopic dermatitis. *Arch Pediatr Adolesc Med*. 1999;153:249–253
 44. Turner-Warwick M. Epidemiology of nocturnal asthma. *Am J Med*. 1988;85(1B):6–8
 45. Craig TJ, McCann JL, Gurevich F, Davies MJ. The correlation between allergic rhinitis and sleep disturbance. *J Allergy Clin Immunol*. 2004;114(5 suppl):S139–S145
 46. Desager KN, Nelen V, Weyler JJ, De Backer WA. Sleep disturbance and daytime symptoms in wheezing school-aged children. *J Sleep Res*. 2005;14:77–82
 47. Miller VA, Palermo TM, Powers SW, Scher MS, Hershey AD. Migraine headaches and sleep disturbances in children. *Headache*. 2003;43:362–368
 48. Carotenuto M, Guidetti V, Ruju F, Galli F, Tagliente FR, Pasotto A. Headache disorders as risk factors for sleep disturbances in school aged children. *J Headache Pain*. 2005;6:268–270
 49. Bruni O, Russo PM, Violani C, Guidetti V. Sleep and migraine: an actigraphic study. *Cephalalgia*. 2004;24:134–139
 50. Ring A, Stein D, Barak Y, et al. Sleep disturbances in children with attention-deficit/hyperactivity disorder: a comparative study with healthy siblings. *J Learn Disabil*. 1998;31:572–578
 51. Sangal RB, Owens JA, Sangal J. Patients with attention-deficit/hyperactivity disorder without observed apneic episodes in sleep or daytime sleepiness have normal sleep on polysomnography. *Sleep*. 2005;28:1143–1148
 52. McFarlane JM, Groff JY, O'Brien JA, Watson K. Behaviors of children who are exposed and not exposed to intimate partner violence: an analysis of 330 black, white, and Hispanic children. *Pediatrics*. 2003;112(3). Available at: www.pediatrics.org/cgi/content/full/112/3/e202
 53. Wells RD, McCann J, Adams J, Voris J, Ensign J. Emotional, behavioral, and physical symptoms reported by parents of sexually abused, nonabused, and allegedly abused prepubescent females. *Child Abuse Negl*. 1995;19:155–163
 54. Richters JE, Martinez P. The NIMH community violence project: I. Children as victims of and witnesses to violence. *Psychiatry*. 1993;56:7–21
 55. Martinez P, Richters JE. The NIMH community violence project: II. Children's distress symptoms associated with violence exposure. *Psychiatry*. 1993;56:22–35

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