Sleep Disturbances in School-age Children with Chronic Pain

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Objectives To examine associations between pain, functional outcomes, and sleep disturbances in children with chronic pain, specifically juvenile idiopathic arthritis (JIA), sickle cell disease (SCD), and headache (HA). Sleep disturbances were tested as a risk factor for increased functional disability and decreased health-related quality of life (HRQOL). **Methods** One hundred children (JIA $n = 30$, SCD $n = 26$, HA $n = 44$; 8–12 years; 56% female) and their caregivers participated. Children completed questionnaires regarding pain, depression, and functional disability. Caregivers completed questionnaires regarding sociodemographics, child sleep habits, functional disability, and HRQOL. **Results** Levels of overall sleep disturbances were above the clinical cutoff for 53% of children with chronic pain. Sleep disturbances predicted lower physical HRQOL and higher functional disability, according to parent report. **Conclusions** Sleep disturbances are common and associated with daytime functioning in school-age children with chronic pain, suggesting that assessment and treatment of sleep problems is clinically relevant.

Key words children; chronic pain; quality of life; sleep; sleep problems.

Introduction

Sleep is noted to be essential for children's physical and mental well-being (Baiardini, Braido, Cauglia, & Canonica, 2006). A number of sleep problems are relatively common in middle childhood. In a large sample of US children in grades 1–4, parents reported that 39% had a hard time getting out of bed, 35% had restless sleep, and 34% woke up in a bad mood (Liu, Liu, Owens, & Kaplan, 2005). Additional sleep problems such as getting too little sleep, teeth grinding in sleep, difficulty falling asleep, talking in sleep, taking a long time to be alert in the morning, awakening once or more during the night, and being tired during the day were observed in 20–25% of this sample (Liu et al., 2005). Sleep disturbances collectively refer to impairment of the ability to initiate or maintain sleep, and can be measured by parent or child self-report, and by objective measures (e.g., actigraphy, polysomnography). Sleep disturbances in healthy children have been associated with behavior problems, decreased cognitive performance, academic problems, and impairment in daily living (Sadeh, Gruber, & Raviv, 2002). Sleep disturbances have also been associated with children's quality of life, negatively impacting children's physical and emotional well-being (Smaldone, Honig, & Byrne, 2007).

Sleep disturbances are common among children with chronic or recurrent pain conditions (Roth-Isigkeit, Thyen, Stoven, Schwarzenberger, & Schmucker, 2005). Recent research findings have noted a high prevalence of sleep disturbances in children diagnosed with juvenile idiopathic arthritis (JIA) (Sawyer et al., 2004), headache (HA) (Miller, Palermo, Powers, Scher, & Hershey, 2003), and sickle cell disease (SCD). For instance, Miller and colleagues found that children with migraine HAs had more sleep disturbances in the areas of sleep onset delay, night wakings, parasomnias, sleep anxiety, and sleep-disordered breathing compared to a normative sample. Further, a bi-directional theory has been proposed between pain and sleep disturbances, with pain interfering with sleep, and sleep disturbances exacerbating pain symptoms and complicating its management (Lewin & Dahl, 1999). There is increasing support for this model among children with chronic pain. For instance, self-report of sleep problems has been shown to correlate with pain intensity ratings among children with JIA (Bloom et al., 2002). Among children with SCD, high daily pain has been shown to relate to poor sleep quality that night, which is in turn predictive of high pain levels the following day (Valrie, Gil, Redding-Lallinger, & Daeschner, 2007b). Negative mood

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also plays a role in this relationship, partially mediating the effects of pain and sleep on each other (Valrie, Gil, Redding-Lallinger, & Daeschner, 2007a).

Less is known about the relationship between sleep and daily functioning in children with chronic pain. Functional outcomes that have been examined in pediatric chronic pain include functional disability, which is defined as restriction in performing daily activities in school, home, recreation, and social interaction, and health-related quality of life (HRQOL), defined as how a person perceives their health to impact physical, psychological, and social well-being. In one sample of children and adolescents (6–18) with migraine, parent report of sleep disturbances was related to parent report of daily functioning, specifically child adaptability and activities of daily living (Heng & Wirrell, 2006). One previous study (Palermo & Kiska, 2005) has examined the relationship between sleep disturbances and daily functioning in adolescents with chronic pain conditions (HAs, JIA, and SCD), but less is known about these associations in younger children with chronic pain conditions. Palermo and Kiska (2005) found that functional disability and HRQOL were strongly correlated with sleep disturbances, such that more severe sleep disturbances were associated with greater functional disability and lower HRQOL. In particular, strong associations were found between functional disability and HRQOL and two sleep variables, daytime sleepiness and sleep/wake problems. This study also demonstrated a significant relationship between mood and sleep in adolescents with chronic pain.

It is unknown whether these same relationships are present in middle childhood. In this study, we examine associations between pain, sleep problems and HRQOL, functional disability, and mood in middle childhood, extending previous research that has been conducted with adolescents. Middle childhood is an important developmental period to examine, as both pain and sleep problems increase in adolescence (LeResche, Mancl, Drangsholt, Saunders, & Korff, 2005), and adolescents with chronic pain may be particularly sensitive to sleep disturbances (Meltzer, Logan, & Mindell, 2005). Knowledge of the relationship between pain, sleep disturbances, and functional outcomes in middle childhood may inform developmental models of chronic pain and sleep in children and adolescents. This knowledge may also help to develop preventative interventions within a developmental context.

In this cross-sectional study, we describe and compare sleep disturbances in children with three chronic or recurrent pain conditions: JIA, SCD, and chronic HA. JIA is a chronic condition that consists of three subtypes: systemic, polyarticular, and pauciarticular. Most children with JIA report mild to moderate levels of pain, however, in 25–30% of children with JIA pain is described as moderate to severe and can have a significant impact on children's participation in activities (Rapoff, McGrath, & Lindsley, 2003). SCD is a genetic blood disorder that primarily impacts individuals of African and Mediterranean descent. Pain is a common consequence of SCD and occurs with variable frequency and severity; on average children report between five and seven episodes per year with each episode lasting ~1–3 days (Graumlich et al., 2001). HA is the most prevalent type of chronic pain in the general pediatric population, being identified by as many as 18.9% of youth (Perquin et al., 2000). In the current study, HAs are categorized according to one of three subtypes: migraine, tension, or mixed.

The goal of the current study was to examine sleep patterns and problems in a sample of children with several different pain-related conditions, and to examine broad associations between sleep disturbances and functional disability and HRQOL outcomes. Based on previous research findings, we hypothesized that across pain conditions, more intense and frequent pain, as well as higher levels of depression symptoms would be associated with increased sleep disturbances. We also hypothesized that sleep disturbances would be broadly associated with functional limitations and HRQOL outcomes across pain conditions, such that increased sleep disturbances would be related to increased functional limitations and reduced HRQOL.

Method

Participants

Participants included 100 children between the ages of 8 and 12 ($M = 10.22$, $SD = 1.37$), 56% females and 44% males, and their caregivers. The ethnicity of the children in the sample was African American (40.4%), Caucasian (57.7%), and other ethnic background (1.9%). Children and their caregivers were recruited as part of a larger longitudinal study on chronic and recurrent pain at a Midwest tertiary care children's hospital, where they were established patients in the pediatric neurology, rheumatology, and hematology clinics. The study was approved by the Institutional Review Board of the study site. Children were diagnosed with either recurrent HAs ($n = 44$; 43% females), JIA ($n = 30$; 80% females), or SCD ($n = 26$; 50% females). A higher proportion of female children were in the JIA

Table I. Sociodemographic and Illness-related Characteristics

Characteristic	Total ($n = 100$) *n*
Gender (female)	56
Racial background (minority)	41
Family income:	
<$10,000	13
$10,000–29,000	23
$30,000–49,000	19
$50,000–69,000	18
>$70,000	24
Health condition	
Headache	44
Migraine	23
Tension-type	9
Mixed headache	12
JIA	30
Pauciarticular	21
Polyarticular	6
Systemic	3
SCD	26
HbSS disease	22
Sickle beta + thalassemia	3
HbSC disease	1

group, $\chi^2(2, N = 100) = 10.02$, $p = .002$), reflecting the gender distribution of this disease. Age was similar in the three pain groups. The ethnic distribution of the groups was significantly different, with 100% of the SCD group, 30% of the HA group, and 10% of the JIA group reporting African-American ethnicity, $\chi^2(2, N = 98) = 49.98$, $p < .001$. Family income was lower in the SCD group $\chi^2(4, N = 97) = 22.26$, $p = .002$). Demographic characteristics of children in the SCD group were similar to demographics of other published samples (Schatz, 2004). Table I presents demographic and illness-related information.

Children were recruited from four clinical sites (three suburban, one inner-city) during specialty care visits for evaluation and treatment of their condition. Visits were routine, such that patients were not seen on an urgent care basis or due to an acute increase in pain or illness intensity. Ninety percent of the families who were approached about participating in the study agreed. Informed consent was obtained from caregivers and assent from children. Children and their caregivers then completed the questionnaires and interviews while in the clinic. Families were compensated for participating in the study with gift cards to local stores. Data from this sample have also been used in previously published work (e.g., Lewandowski, Palermo, & Peterson, 2006; Palermo, Witherspoon, Valenzuela, & Drotar, 2004).

Measures

Sociodemographics

Caregivers completed a questionnaire to provide demographic information including the child's age, gender, ethnicity, and family income level. Caregivers estimated annual family income in $10,000 brackets, which were coded from 1 = <$10,000 through 8 = >$70,000.

Pain Characteristics

Children and parents reported on pain frequency and intensity over the previous 4 weeks. For pain frequency, they reported on how often the child experienced pain on a six-point scale with response options ranging from ''less than once a month'' to ''daily.'' The Faces Pain Scale (FPS), which has well-established reliability and validity, was utilized to assess average pain intensity (Bieri, Reeve, Champion, Addicoat, & Ziegler, 1990). The FPS consists of a series of seven faces displaying various intensities of pain with anchors on each end of the scale, ''no pain'' to ''worst pain.'' At the time data collection began, the revised version of the Faces Pain Scale—Revised (FPS-R) was not yet published (Hicks, von Baeyer, Spafford, van Korlaar, & Goodenough, 2001). Previous research has used these measures in assessing characteristics of chronic pain in children (Peterson & Palermo, 2004).

Depression

Children also completed the Revised Children's Anxiety and Depression Scale (RCADS), a self-report measure of anxiety and depressive symptoms corresponding to several disorders in the Diagnostic and Statistical Manual of Mental Disorders, fourth edition (American Psychiatric Association, 2000). Children rated each item on a 4-point scale ranging from ''never'' to ''always,'' with higher scores indicating greater frequency. *T*-scores were calculated on the basis of the child's gender and grade in school. The Major Depressive Disorder (MDD) subscale was used in this study. The measure has good internal consistency ($\alpha = .76$ for the MDD subscale) and its test–retest reliability over 1 week was demonstrated to be adequate (Chorpita, Yim, Moffitt, Umemoto, & Francis, 2000). Validity has been demonstrated through relationships with other anxiety and depression measures.

Sleep Problems

Caregivers completed the Children's Sleep Habits Questionnaire (CSHQ; Owens, Spirito, & McGuinn, 2000), a 45-item questionnaire that assessed the sleep behaviors of school-aged children over a typical week. It yields a total score (''total sleep disturbance'') and eight subscale scores based on the primary presenting clinical

sleep problems in this age group—bedtime resistance, sleep onset delay, sleep duration, sleep anxiety, night wakings, daytime sleepiness, parasomnias, and sleep-disordered breathing. Caregivers rated the frequency of each sleep behavior on a 3-point scale ranging from ''usually'' (5–7 times per week) to ''rarely'' (0–1 time per week). Higher scores indicate greater sleep disturbance, and a score of 41 has been established as the clinical cutoff. The measure also assesses bed times and wake times, and has adequate internal consistency, test–retest reliability, and validity (Owens et al., 2000). The CSHQ has been used in previous studies with children with recurrent and chronic pain (Bloom et al., 2002; Heng & Wirrell, 2006). Reliability of the total sleep disturbance scale in the current sample was $\alpha = .86$.

Functional Disability

The Functional Disability Inventory (FDI) assesses a child's limitations in completing tasks associated with daily living in the domains of school, home, recreation, and social interaction. Sample items include attending school, walking up stairs, reading, and doing homework. Children and parents report the child's difficulty in completing each task on a 5-point scale ranging from 0—''no trouble'' to 5—''impossible.'' Sum scores range from 0 to 60, with higher scores indicating greater functional disability. The validity and reliability of this measure in assessing functional disability has been well-established (Claar & Walker, 2006; Walker & Greene, 1991).

Health-related Quality of Life

To assess the children's HRQOL, caregivers were administered the Child Health Questionnaire parent form (CHQ-PF50). This measure assesses a child's physical, emotional, and social functioning and well-being and provides summary scores along two dimensions—physical health and psychosocial health. Each dimension is measured with multiple items, with higher scores indicating better HRQOL. The Physical and Psychosocial summary scores have adequate reliability and validity (Landgraf et al., 1998) and have been used previously in children with chronic and recurrent pain conditions (Houlihan, O'Donnell, Conaway, & Stevenson, 2004; Oliveira et al., 2007).

Analyses

Descriptive statistics, frequencies and means, of socio-demographic characteristics and key study variables were calculated. Mean differences by health condition (HA, JIA, and SCD) were computed using a one-way analysis of variance (ANOVA) for the pain, sleep, depression, functional disability, and HRQOL variables. Scheffe's test was used for post hoc comparisons to control for multiple comparisons, and effect sizes were examined using partial eta-squared. The proportion of children in this sample exceeding the clinical cut-off score (raw score ≥ 41) for total sleep disturbances on the CSHQ (Owens et al., 2000) was compared to published norms using a chi-squared test. This normative community sample consisted of 469, 4 to 10-year-old elementary school enrolled in a suburban school district in New England (Owens et al., 2000).

Pearson product moment correlations were conducted to examine the bivariate associations between study variables. Finally, hierarchical multiple regressions were conducted to determine whether sleep disturbances would be independently associated with functional disability and HRQOL outcomes after controlling for demographics, pain characteristics, and depression. Health condition group membership was also accounted for by entering two dummy-coded variables—whether or not the child was in the HA group and whether or not the child was in the JIA group.

Results

Pain Characteristics, Depression and Functional Outcomes

Descriptive statistics for pain characteristics, depression, and functional outcomes are presented in Table II. Significant group differences by diagnostic group were found for pain frequency and pain intensity. Post hoc comparisons indicated that children in the HA group reported significantly higher pain frequency than children with SCD, and children with SCD and HA reported significantly higher pain intensity than children with JIA. These effect sizes were medium. There were no significant group differences on the children's report of depression or functional disability. Children reported somewhat higher levels of functional disability than their parents reported, $t(80) = 1.71$, $p = .09$. No group differences were observed in caregiver report of functional disability or HRQOL outcomes (Table II).

Sleep Patterns and Problems

According to caregiver responses on the CSHQ, the children's mean bedtime was 9:13 PM and their mean wake time was 7:03 AM on school days. The average sleep time was 9.41 hr, which is within the range of typical sleep requirements in this age group (Mindell & Owens, 2003). Bedtime, wake times, and sleep time were similar across the groups of children with JIA, SCD, and HA (Table III).

Table II. Group Comparisons on Pain, Mood, and Daily Functioning

	JIA $n = 30$ *M* (*SD*)	SCD $n = 26$ *M* (*SD*)	Headache $n = 44$ *M* (*SD*)	Total sample $n = 100$ *M* (*SD*)	Omnibus partial eta-squared
Child-report pain					
Pain frequency	3.30 (2.09)	2.45 (1.87)[b]	4.04 (1.51)[b]	3.45 (1.88)	.11
Pain intensity	3.33 (1.73)[b,c]	4.52 (1.89)[b]	4.70 (1.32)[c]	4.23 (1.69)	.13
Parent-report of child pain					
Pain frequency	3.13 (1.74)	2.17 (1.66)[b]	4.02 (1.55)[b]	3.29 (1.78)	.18
Pain intensity	3.67 (1.35)[b,c]	4.67 (1.93)[b]	5.21 (1.26)[c]	4.60 (1.20)	.17
Child-report mood					
Depression (RCADS)[a]	48.59 (12.04)	47.61 (12.49)	50.54 (11.12)	49.20 (11.71)	.01
Child-report functioning					
Functional Disability (FDI)	12.62 (10.38)	10.79 (10.36)	16.80 (11.70)	13.85 (11.10)	.05
Parent-report functioning					
Functional Disability (FDI)	10.72 (12.98)	10.80 (11.21)	12.04 (11.68)	11.30 (11.87)	.00
Physical HRQOL[a]	39.48 (14.95)	39.48 (12.80)	41.36 (13.68)	40.25 (13.74)	.01
Psychosocial HRQOL[a]	48.66 (12.08)	49.49 (10.01)	46.84 (9.20)	48.13 (10.34)	.01

[a]*T*-scores.

Matching superscripts b and c indicate significant post hoc comparisons using Scheffe's test.

Table III shows the average sleep pattern and sleep problem scores for children with each health condition and for the combined group of children with chronic pain. Few significant differences in sleep problems were observed between the different health condition groups. One significant group difference was observed on the sleep-disordered breathing scale; children with SCD obtained higher scores than children with HAs or JIA, and this effect size was large. The mean total sleep problems score for participants in this study ($M = 44.46$) was above the clinical cutoff score of 41 determined in development of the CSHQ (Owens et al., 2000). The proportion of children with scores above 41 was not significantly different between the three pain groups, with 58% of children with HA, 48% of children with JIA, and 60% of children with SCD being above the clinical cutoff, $\chi^2(2, N = 100) = 3.72$, $p = .19$). Overall, a significantly higher proportion of children in this sample (53%) were above the clinical cutoff compared to 23% in the community sample used in CSHQ development, $\chi^2(2, N = 100) = 50.82$, $p < .001$. Children with chronic pain had a mean daytime sleepiness score of 12.80 ($SD = 3.23$), which is similar to the mean score of the clinical sleep sample of 11.99 ($SD = 3.39$) (reported in Owens et al., 2000), suggesting that children with chronic pain demonstrate clinical levels of daytime sleepiness.

Associations Among Study Variables

Bivariate correlations are presented in Table IV. As hypothesized, total sleep disturbances were associated with HRQOL, such that more sleep problems correlated moderately with lower HRQOL outcomes. Sleep disturbances were positively correlated with parent, but not child report of functional disability. Contrary to our hypotheses, sleep disturbances were not significantly correlated with child-report or parent-report pain intensity or pain frequency. Additionally, higher levels of sleep disturbances were not correlated with higher levels of depressive symptoms in this child sample, in contrast to findings of this relationship in adolescents (Palermo & Kiska, 2005). Higher levels of sleep problems were also related to lower family income.

As hypothesized, there were significant moderate associations between pain and HRQOL domains such that higher child-report pain frequency and intensity were associated with lower Physical and Psychosocial HRQOL. Higher child-report pain frequency and intensity were also associated with higher levels of child-reported functional disability, while pain frequency but not intensity was related to parent-report functional disability. While depression was not correlated with sleep disturbances, higher depression scores were strongly associated with higher levels of child but not parent report of functional disability, and lower levels of parent-report Psychosocial HRQOL.

Sleep Disturbance as a Predictor of HRQOL and Functional Disability

Hierarchical multiple regressions were conducted to determine whether variance in HRQOL and functional disability outcomes was predicted by sociodemographic variables, pain variables, depression, and sleep

Table III. Sleep Times and Sleep Problems Across Groups

CSHQ sleep times	JIA $n=30$ *M* (*SD*)	SCD $n=26$ *M* (*SD*)	Headache $n=44$ *M* (*SD*)	Total chronic pain sample $n=100$ *M* (*SD*)	Omnibus partial eta-squared
Weekday bedtime	9:04 (0:26)	9:10 (0:32)	9:21 (0:40)	9:13 (0:35)	
Weekday wake time	6:58 (0:32)	7:01 (0:31)	7:06 (0:56)	7:03 (0:44)	
Total sleep time in hours	9.38 (1.06)	9.72 (1.53)	9.25 (1.02)	9.41 (1.18)	.02
CSHQ subscales					
Bedtime resistance	7.20 (2.04)	7.50 (1.94)	7.77 (2.38)	7.53 (2.17)	.01
Sleep duration	3.70 (1.23)	3.88 (1.21)	4.18 (1.51)	3.96 (1.36)	.02
Parasomnias	8.57 (1.77)	8.46 (1.07)	8.48 (1.69)	8.50 (1.57)	.00
Sleep-disordered breathing	3.38 (0.73)[a]	4.42 (1.65)[a,b]	3.27 (0.50)[b]	3.61 (1.09)	.20
Night wakings	3.72 (1.31)	3.77 (1.45)	3.75 (1.20)	3.75 (1.29)	.00
Daytime sleepiness	13.46 (3.70)	13.19 (3.61)	12.14 (2.57)	12.80 (3.23)	.04
Sleep anxiety	5.10 (1.88)	4.96 (1.71)	5.25 (1.75)	5.13 (1.77)	.00
Sleep onset delay	1.53 (0.78)	1.46 (0.65)	1.59 (0.73)	1.54 (0.72)	.00
Total sleep disturbance	44.36 (8.75)	45.61 (8.02)	43.88 (7.96)	44.46 (8.14)	.01

Matching superscripts a and b indicate significant post hoc comparisons using Scheffe's test, both $p < .001$.

Table IV. Bivariate Correlations Among Key Study Variables

	Age	Income[b]	Pain int.[b]	Pain freq.[b]	Dep.	Sleep prob.	Phys. HRQOL	Psych. HRQOL	FDI parent	FDI child
1. Gender[a]	−.05	.05	−.15	−.08	−.15	.01	−.11	.03	−.09	−.15
2. Age		.04	.07	−.07	−.03	−.17	−.02	.25*	−.18	−.16
3. Income[b]			−.08	.01	−.12	−.37**	.39**	.18	−.24**	.09
4. Pain intensity: child[b]				.31**	.19	.17	−.31**	−.31**	.13	.49**
5. Pain freq.: child[b]					.27**	.15	−.35**	−.25*	.22*	.39**
6. Depression RCADS						.06	−.20	−.49**	.11	.61**
7. Total sleep problems							−.51**	−.27*	.38**	.08
8. Physical HRQOL								.42**	−.46**	−.33**
9. Psychosocial HRQOL									−.49**	−.46**
10. FDI: Parent-report										.27*

[a]Coded 0 = male, 1 = female.
[b]Spearman's rho.
*$p < .05$; **$p < .01$.

disturbance. Child and family demographic and disease information was entered into the first step. Child-report pain intensity and frequency was entered into the second step and depressive symptoms in the third. Total sleep disturbance was entered in the last step to test the hypothesis that sleep disturbance is independently associated with HRQOL and functional disability after controlling for the effects of demographic variables, disease information, pain variables, and depression. Parallel analyses were conducted using parent report of pain intensity and frequency.

As shown in Table V, this multivariate model accounted for 48% of the variance in Physical HRQOL ($F_{8,58} = 5.75$, $p < .000$), and 45% of the variance in Psychosocial HRQOL ($F_{8,58} = 5.13$, $p < .000$). Total sleep disturbance was a significant predictor of Physical HRQOL ($\beta = -.36$, $p = .003$), accounting for 10% of the variance, but not Psychosocial HRQOL ($\beta = -.20$, $p = .10$). Other variables that were significant predictors of Physical HRQOL include family income ($\beta = .29$, $p = .02$) and child report of pain frequency ($\beta = -.25$, $p = .03$). For Psychosocial HRQOL, depression was the primary predictor ($\beta = -.44$, $p < .01$), though age was also a strong predictor ($\beta = .28$, $p = .02$). Overall, higher Physical HRQOL was associated with higher family income, lower pain frequency, and fewer sleep disturbances; and higher Psychosocial HRQOL was associated with older age and fewer depressive symptoms.

As shown in Table VI, the multivariate model predicted 26% of the variance in parent report of functional disability ($F_{8,58} = 2.20$, $p = .04$), and 55% of the variance in child report of functional disability ($F_{8,58} = 7.72$, $p < .000$). Total sleep disturbance was a strong predictor of parent report of functional disability ($\beta = .34$, $p = .02$), accounting for 9% of the variance, but not child report of functional disability

Table V. Sleep Disturbances as a Predictor of Parent-report HRQOL

	HRQOL: Physical			HRQOL: Psychosocial		
	ΔR^2	*F*-value	β at final step	ΔR^2	*F*-value	β at final step
Step 1	.24**	4.37**		.21**	3.69**	
Headache group			.08			−.13
JIA group			−.13			.02
Child age			−.06			.28*
Family income			.29*			.10
Step 2	.13**	5.44**		.06	2.00	
Pain intensity			−.13			−.11
Pain frequency			−.28*			.00
Step 3	.00	.02		.15***	13.07***	
Depression			−.07			−.44***
Step 4	.10**	9.93**		.03	2.83	
Total sleep disturbances			−.36**			−.20
	Total R^2:.48***			Total R^2:.45***		

*$p < .05$; **$p < .01$; ***$p < .05$.

Table VI. Sleep Disturbances as a Predictor of Parent and Child Report Functional Disability

	FDI: Parent Report			FDI: Child Report		
	ΔR^2	*F*-value	β at final step	ΔR^2	*F*-value	β at final step
Step 1	.14	2.20		.13	2.10	
Headache group			.01			.16
JIA group			−.04			.14
Child age			−.10			−.27*
Family income			−.15			−.13
Step 2	.03	.85		.17**	6.11**	
Pain intensity			−.04			.32**
Pain frequency			.16			−.03
Step 3	.00	.01		.24***	27.44***	
Depression			.04			.51***
Step 4	.09*	6.24*		.01	.95	
Total sleep disturbances			.34*			−.10
	Total R^2:.26*			Total R^2:.55***		

*$p < .05$; **$p < .01$; ***$p < .05$.

(β = −.10, $p = .33$). Additional predictors of child report of functional disability included age (β = −.27, $p = .01$), child report of pain intensity (β = .32, $p = .01$), and depression (β = .51, $p < .000$). Analyses conducted with parent-report pain intensity and frequency yielded the same pattern of significant results.

Discussion

Findings from the present study extend previous research on sleep, mood, and HRQOL with adolescents to children in middle childhood. Similar to previous research (Bloom et al., 2002; Miller et al., 2003), this study demonstrates that the majority of children with chronic pain conditions, in particular HAs, JIA, and SCD, are above the clinical cutoff for total sleep disturbances, a rate higher than normative community populations (Owens et al., 2000). It should be noted that the Owens et al. (2000) sample is significantly younger ($M = 7.6$ years) than the current sample [$M = 10.2$ years; $t(567) = 16.09$, $p < .001$], thus interpretation of comparisons should be made cautiously. On the majority of the sleep variables measured by the CSHQ, there were similar sleep patterns and behaviors observed between children with JIA, SCD, and HA. One notable exception was the

finding of significant group difference on sleep-disordered breathing; similar to previous studies, children with SCD were found to have the highest rate of symptoms of sleep-disordered breathing (Bandla & Splaingard, 2004). Higher rates of sleep-disordered breathing among children with SCD are likely due to disease characteristics, including lower levels of blood oxygen and nocturnal hypoxia (Setty, Stuart, Dampier, Brodecki, & Allen, 2003). In addition, independent of disease, urban African-American children with lower family income have been found to be at higher risk for sleep apnea (Spilsbury et al., 2006).

Clinical levels of daytime sleepiness were observed in this sample, which is deserving of future investigation. Similar levels of daytime sleepiness have been reported in a sample of 6 to 18-year-old children with migraine, which were significantly higher levels than case control siblings without migraine (Heng & Wirrell, 2006). There is some overlap between sleepiness and fatigue in adults with chronic pain (Merkelbach & Schulz, 2006), but less is known about the intersection of these constructs in childhood. It is possible that daytime sleepiness scores may be reflecting higher daytime fatigue levels in the children with chronic pain in this study. Fatigue is a multidimensional construct that has been described in several pediatric clinical populations and has a profound effect on daily functioning and HRQOL (Meeske, Patel, Palmer, Nelson, & Parow, 2006) but the relationship among fatigue, pain, sleep, and daily functioning in children is unknown. Future research might investigate daytime sleepiness and fatigue in the context of sleep duration in order to investigate whether children with chronic pain experience sleepiness when they achieve adequate sleep duration. Ecological momentary assessment might also be a useful approach for researchers to investigate fatigue and daytime sleepiness in children's natural environments. This methodology could capture sleepiness and fatigue without retrospective reporter bias, and may help answer questions such as whether children with chronic pain show different patterns of daytime sleepiness or fatigue.

Family income emerged as a significant correlate of sleep problems and predictive of Physical HRQOL in this sample, suggesting that family resources and related factors are important to consider in future research. Previous studies investigating sleep habits have demonstrated that minority children living in urban settings frequently sleep <9 hr (Spilsbury et al., 2004), suggesting that a number of sociodemographic and contextual factors contribute to sleep habits. The immediate home and neighborhood environment is affected by family resources, and also has the potential to interfere with sleep. For instance, passive television exposure in the home predicts sleep disturbances in young children (Paavonen, Pennonen, Roine, Valkonen, & Lahikainen, 2006). Neighborhood disadvantage has been shown to predict sleep apnea in school-age children above the effects of individual family SES, ethnicity, premature birth, asthma, and obesity (Spilsbury et al., 2006). As these authors point out, higher levels of environmental contaminants in disadvantaged neighborhoods may contribute to airway-related sleep problems, and high environmental noise and stress may lead to sleep fragmentation and disruption. Previous studies have shown that family wealth is related to school-age children's physical HRQOL, and is related to all dimensions of HRQOL in adolescents, including physical, psychological, and social functioning (von Rueden, Gosch, Rajmil, Bisegger, & Ravens-Sieberer, 2006). Future research that investigates the complex relations between family resources, home and neighborhood environments, sleep disturbances, and related functioning in children and adolescents may help create targeted sleep interventions.

The present study also further delineated the relationship between sleep disturbances and functional disability and HRQOL in school-age children with chronic pain conditions. Similar to findings in an adolescent sample (Palermo & Kiska, 2005), sleep disturbances were strongly related to parent report of Physical HRQOL and functional disability. Sleep disturbances were, however, not predictive of parent report of Psychosocial HRQOL or child report of functional disability. It should be noted that while this pattern of findings was observed in this combined sample of children with three different chronic pain conditions, results cannot be generalized to each pain condition. In fact, the relations between sleep disturbances and HRQOL and functional disability outcomes may differ or be of differing magnitudes among children experiencing different chronic pain conditions. Future research is needed to further specify the role of sleep disturbance in predicting outcomes within a variety of chronic pain conditions. In this study, children reported higher levels of functional disability than was reported by their parents. Similar levels were reported by adolescents (Palermo & Kiska, 2005). Additionally, child and adolescent reports of functional disability are strongly associated with their reports of pain and depression, suggesting that child-report of functional disability may be more useful for assessing perceptions of disability in pediatric chronic pain. In the previous study of

adolescents (Palermo & Kiska, 2005), self-report depression symptoms were strongly correlated with self-report daytime sleepiness and sleep/wake problems, and independently contributed to sleep/wake problems above the contributions of pain characteristics and functional disability. In this sample of 8- to 12-year-olds, self-report of depression symptoms was not significantly correlated with parent-report of sleep disturbances, suggesting that the association between sleep problems and depression symptoms may be stronger during adolescence. This finding may also be due to a lack of children's self-report of sleep problems, which is a limitation of the study. Future work should include child-report of sleep problems.

There are a number of limitations to this study that should be considered when interpreting the findings. First, the children were all recruited from a clinic-based setting, as such, these results may not be generalizable to other populations including children with chronic pain conditions who do not seek treatment for their pain problem. Detailed information about children's medication usage was not available, and many medications are known to influence sleep. Additionally, it is possible that variations in pain and health status at the time of the routine specialty care visit may have influenced child and parent report of sleep disturbances or functional outcomes. It is also possible that unreported or undiagnosed psychiatric problems may contribute to sleep problems in this sample. Another limitation is that assessment of sleep disturbances was made through caregiver report questionnaires only. The results may change if child report or objective measures of sleep disturbance, such as actigraphy or polysomnography, were used instead.

Additionally, our study was limited by using caregiver report measures to assess the majority of outcome variables, though some instances of child report was used. As these measures share method variance, it might have increased the likelihood of finding significant relationships. The lack of observed association between parent-report sleep disturbances and child-report functional disability is difficult to interpret, as this association was observed within reporter. Last, the cross-sectional design of this study prevents any conclusions being drawn concerning direction of effects. Future research is needed to determine the direction of the relationship between chronic pain, sleep disturbances, and functional outcomes such as HRQOL and disability in a variety of pediatric populations with chronic pain. Longitudinal studies examining changes in sleep, mood, and functional outcomes over time might further delineate the relationship among them. Future research might also include an age- and sex-matched healthy comparison group, in order to more clearly establish the nature of sleep disturbances in children with chronic pain. The addition of objective measurement tools, more thorough examination of possible comorbid psychiatric diagnoses, and the examination of the role of medications are also important future directions.

Overall, these findings offer some additional support for the importance of assessing sleep disturbances in children with chronic pain, both in research and in clinical settings. Parents are more likely to be involved in establishing and monitoring sleep habits for school-age children than they are for adolescents, thus assessment and intervention with parents is likely to lead to positive changes in sleep habits for school-age children. Assessment of sleep disturbances in school-age children can be accomplished via clinical interviews or sleep logs with parents and children or by using screening tools such as the CSHQ (Owens et al., 2000). These tools can provide valuable information about sleep duration and sleep habits. Additionally, interventions targeting sleep problems in children with chronic pain may lead to improvements in functioning and HRQOL. In school-age children, these interventions might include psychoeducation about the need for adequate sleep and sleep habit recommendations. Sleep interventions might help improve daytime functioning for children who are experiencing chronic pain. Finally, implementing sleep interventions in middle childhood may help avert the development of sleep problems in adolescence, which may have increased negative functional consequences in adolescents with chronic pain.

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