In Sleep, What Pain May Come: A Correlative Examination of Sleep Disturbances and Pediatric Chronic Pain

Rebecca Cherry
Pacific University

Recommended Citation
In Sleep, What Pain May Come: A Correlative Examination of Sleep Disturbances and Pediatric Chronic Pain

Abstract
This dissertation study investigated the bidirectional relationship of sleep and chronic pain in 100 children, ages 8 – 12. Four hypotheses were analyzed: a) children with chronic pain exhibit increased sleep disturbance, b) higher levels of psychological symptoms relate to increased severity of sleep disturbance, c) higher levels of pain relate to total sleep disturbance, and d) increased sleep disturbance relates to a reduced quality of life and impaired daily functioning. The findings suggest that children with chronic pain experience challenges in sleeping, daily functioning, and psychological well-being. This dissertation illustrates the importance of studying sleep and chronic pain as interrelated in the resulting problems of children living with chronic pain.

Degree Type
Dissertation

Degree Name
Doctor of Psychology (PsyD)

Committee Chair
Catherine Miller

Second Advisor
Jay Thomas

Third Advisor
Michel Hersen

Subject Categories
Psychiatry and Psychology

Comments
Library Use: LIH

This dissertation is available at CommonKnowledge: https://commons.pacificu.edu/spp/237
IN SLEEP, WHAT PAIN MAY COME:
A CORRELATIVE EXAMINATION OF SLEEP DISTURBANCES AND
PEDIATRIC CHRONIC PAIN

A DISSERTATION STUDY
SUBMITTED TO THE FACULTY
OF
SCHOOL OF PROFESSIONAL PSYCHOLOGY
PACIFIC UNIVERSITY
HILLSBORO, OREGON

BY
REBECCA J. CHERRY
IN PARTIAL FULFILLMENT OF THE
REQUIREMENTS FOR THE DEGREE
OF
DOCTOR OF PSYCHOLOGY
JULY 23, 2010

APPROVED BY THE COMMITTEE:
Catherine Miller, PhD
Jay Thomas, PhD

PROFESSOR AND DEAN:
Michel Hersen, PhD, ABPP
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABSTRACT</td>
<td>iii</td>
</tr>
<tr>
<td>ACKNOWLEDGEMENTS</td>
<td>iv</td>
</tr>
<tr>
<td>INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>LITERATURE REVIEW</td>
<td>3</td>
</tr>
<tr>
<td>Sleep Disturbance</td>
<td>3</td>
</tr>
<tr>
<td>Pediatric Pain</td>
<td>5</td>
</tr>
<tr>
<td>Sleep-Pain Relationship</td>
<td>11</td>
</tr>
<tr>
<td>PURPOSE</td>
<td>17</td>
</tr>
<tr>
<td>Inclusion of Specific Pain Populations</td>
<td>17</td>
</tr>
<tr>
<td>Dissertation Purpose</td>
<td>17</td>
</tr>
<tr>
<td>Hypotheses</td>
<td>18</td>
</tr>
<tr>
<td>METHOD</td>
<td>20</td>
</tr>
<tr>
<td>Participants</td>
<td>20</td>
</tr>
<tr>
<td>Procedures</td>
<td>20</td>
</tr>
<tr>
<td>Measures</td>
<td>21</td>
</tr>
<tr>
<td>Statistical Analysis</td>
<td>27</td>
</tr>
<tr>
<td>RESULTS</td>
<td>29</td>
</tr>
<tr>
<td>Sleep Disturbance in a Chronic Pain Population</td>
<td>29</td>
</tr>
<tr>
<td>Correlations</td>
<td>30 - 33</td>
</tr>
<tr>
<td>DISCUSSION</td>
<td>34</td>
</tr>
<tr>
<td>Summary</td>
<td>34</td>
</tr>
<tr>
<td>Associations</td>
<td>35 - 40</td>
</tr>
<tr>
<td>Limitations</td>
<td>40</td>
</tr>
<tr>
<td>Future Direction</td>
<td>43</td>
</tr>
<tr>
<td>Conclusion</td>
<td>44</td>
</tr>
<tr>
<td>REFERENCES</td>
<td>45</td>
</tr>
</tbody>
</table>
ABSTRACT

This dissertation study investigated the bidirectional relationship of sleep and chronic pain in 100 children, ages 8 – 12. Four hypotheses were analyzed: a) children with chronic pain exhibit increased sleep disturbance, b) higher levels of psychological symptoms relate to increased severity of sleep disturbance, c) higher levels of pain relate to total sleep disturbance, and d) increased sleep disturbance relates to a reduced quality of life and impaired daily functioning. The findings suggest that children with chronic pain experience challenges in sleeping, daily functioning, and psychological well-being. This dissertation illustrates the importance of studying sleep and chronic pain as interrelated in the resulting problems of children living with chronic pain.

Key words: pediatric chronic pain, sleep disturbance, sleep-pain relationship
ACKNOWLEDGEMENTS

The building of a dissertation requires myriad effort from numerous sources. In recognition of the contributions made, I thank the following people and establishments, all of which had some role in creating this piece of work.

Catherine Miller, PhD
Jay Thomas, PhD
Tonya Palermo, PhD
Irina Fonareva
Marsha Green, PsyD and Charles Green, M.F.A.
Patience McGinnis, PsyD
Shari Nacson
Elizabeth Rapkoch, PsyD
Dyami Valentine
Carol & Richard Cherry
Insomnia Coffee Company (Hillsboro, OR)
Starbucks Coffee (Shaker Heights, OH)
Phoenix Coffee (Cleveland Heights, OH)
The Stone Oven (Cleveland Heights, OH)
Loop (Tremont, OH)
The Bidirectional Relationship of Sleep Disturbance and Chronic Pain

As difficult as it is to imagine a child kept from playing with friends or sleeping through the night by severe headache or joint pain, research shows chronic pain to be quite prevalent in young populations (Perquin et al., 2000). While chronic pain is commonly known to afflict adults, it receives less consideration for children and adolescents. In fact, chronic pain, defined as any prolonged pain that lasts a minimum of 3 months or recurs throughout a minimum period of 3 months, is a universally familiar condition (Perquin et al.). Perquin et al.’s study of over 5,400 Dutch children and adolescents collected parent and self-reports in which 25% of the sample reported having chronic pain. In addition, over one-third of the children reporting pain symptoms were between the ages of 12 and 15 years. A closely related study collected data from a school-aged and adolescent sample and determined that 68.2% reported pain that restricted daily functioning (Roth-Isigkeit, Thyen, Stöven, Schwarzenberger, & Schmucker, 2005).

Chronic pain in children and adolescents can have far-reaching consequences. For example, recurrent pain in childhood increases the risk of experiencing pain-related illness in adulthood as well as emotional disturbance, such as anxiety and depression (Roth-Isigkeit et al., 2005). In order to effectively improve the lives of children living with chronic pain, the study of pediatric chronic pain requires greater attention from researchers and health care workers in both the medical and mental health fields.

The prevalence of pediatric chronic pain in children has prompted researchers to focus on its impact on various areas of daily life. Sleep is one important function that bears considerable impact. Research has discovered a complex bidirectional relationship between sleep and pain. Palermo and Fonareva (2006) began a published commentary recognizing that the “links between the regulation of sleep and pediatric pain are complex and bi-directional: pain may disrupt sleep and, in turn, sleep loss may enhance pain sensitivity” (p. 11). Both together and separately, sleep disturbance and chronic pain
can interfere with the ability to function well during the day. For children, chronic pain interferes with sleep, school attendance and performance, pursuit of hobbies, maintenance of social contacts and activities, and appetite (Roth-Isigkeit et al., 2005). It is feasible that the overall quality of life for a child is further compromised when persisting sleep disturbance compounds the problems of chronic pain.

This dissertation study investigated sleep disturbance in children with chronic pain. The first section comprises the Literature Review, which outlines the current state of the literature and discusses pertinent research findings. Subsequent sections, entitled Purpose, Methods, and Results, explain the participating populations, state the research hypotheses and procedure, detail the measures and analyses used, and provide the findings. The Discussion section includes more detailed considerations of the correlations found, limitations of the study, potential future direction for topical research, and overall conclusions drawn from the study’s results.
LITERATURE REVIEW

Prevalence of Sleep Disturbance, Pediatric Pain, and Relationship of the Two

Sleep Disturbance

Only in the past 20 years has sleep research focused on children’s issues. In 1993, Mindell published a literature review in which she declared children to be subjects of the least amount of sleep research. She recorded only 10% of the literature on sleep to include toddlers and children between ages 5 and 12. Nonetheless, surveys done as early as 1975 indicate that approximately a quarter of the children between ages 1 and 5 experience sleep problems (Mindell, 1993). Salzarulo and Chevalier (1983) interviewed 218 families of children, ages 2-15, and found sleep-talking to be the most common sleep problem (32%). Other sleep problems reported in that study were nightmares, night-waking, delayed sleep onset, enuresis, bruxism (teeth grinding), and sleep rocking. In 1982, Dollinger (1982) conducted a similar type of survey for mothers of children ages 3 – 15, which also found sleep-talking to be the most common sleep problem (53%), closely followed by restless sleep and bedtime refusal (42%), and need of a nightlight to go to sleep (40%). Kahn et al. (1989) found that among 972 preadolescent children (8 - 10 years old), 43% experienced sleep problems lasting beyond 6 months. Despite the paucity noted by Mindell, the research published prior to 1993 indicates that many children experience some sort of sleep problem.

Most often, sleep disturbances will be transient and have no long lasting consequences (Mindell, 1993). However, for some children, sleep disturbance will significantly impact general well-being and functioning. As early as 1976, research by Bixler, Kales, Scharf, Kales, and Leo (1976) linked sleep-waking disorders within the first year of life to sleep problems in older children. Bixler et al. (as cited by Mindell, 1993) gained support from Kahn et al.’s study (1989), which found that parents of 14% of 972
preadolescent children (ages 8 – 10) reported poor sleep for their child, which began in infancy. Interestingly, the onset of sleep problems during toddler and preschool years seems less likely to continue into school-aged and adolescent years. Klackenberg (as cited in Mindell, 1993) conducted a longitudinal study of children ages 4 – 16 that showed only 5-10% of sleep disturbances in later childhood and adolescence could be predicted from behaviors at 4 years old. The greater consequences of infancy sleep difficulty may be an important age distinction when considering prevention of long-term sleep problems.

Sleep problems have also been associated with difficulty concentrating and academic achievement. Children suffering from lack of sleep may easily be considered to have behavior problems or to be misdiagnosed as hyperactive (Mindell, 1993). In healthy school-aged children, excessive daytime sleepiness has been associated with failure of one or more years of school (Mindell). Additionally, Kahn et al. (1989) found that 21% of those children identified as poor sleepers failed 1 or more years of school. Also, social functioning can be compromised by specific sleep problems, such as a child with enuresis avoiding sleepovers. Lowered academic performance, limited social life, and behavioral problems underscore the potentially pervasive consequences of sleep disturbance.

Children with medical or mental health diagnoses are among the clinical populations that suffer sleep disturbances. More specifically, Mindell, Spirito, and Carskadon (1990) administered questionnaires to the parents of 107 children, 38 of which had chronic medical illnesses and 68 with minor health problems. While no significant differences in major sleep problems were found, the chronically ill children were found to get less sleep throughout the day and night, have later bedtimes, earlier wake times, and take fewer naps. Mindell et al. (1990) wrote of their surprising results, “One reason for these unexpected findings may have been the result of these parents
focusing on the past few days of their child’s behaviors rather than the past few months. Future research is necessary to explore these differences in a more direct manner” (p. 337). Furthermore, Mindell’s (1993) review of the research cites several studies indicating that significant numbers of hospitalized and chronically ill children frequently develop sleep problems or experience exacerbation of preexisting sleep problems. Mindell’s and Mindell et al.’s research as well as much of the research to be discussed below elucidates an unfortunate irony for clinically diagnosed, chronically ill, and hospitalized children. Sleep problems appear common in populations of children that may have a great need for sleep’s healing and growth-promoting properties. Judging from the prevalence of sleep disturbance throughout child populations, there appears to be a counterproductive cycle that makes it difficult for children with chronic pain to obtain necessary sleep for healthy development and healing. Continued research of the prevalence of pain, patterns of pain symptoms, and sleep patterns of pediatric and adolescent clinical populations could provide greater understanding of the etiology, causes, and treatment of sleep disturbance, which could, in turn help minimize the effects of the poor sleep - chronic pain paradox.

**Pediatric Pain**

Historically, pain research focused on particular pain conditions, narrow age ranges, and measured pain as, simply, present or absent (Perquin et al., 2000). Perquin and her colleagues conducted a comprehensive analysis of pain problems in children. The study’s design considered multiple pain conditions, included all ages of children (0-18 years), and measured the presence of pain by the parameters of intensity, duration, and frequency. Perquin et al. found that over half of 5424 children reported experiencing pain in the last 3 months. The more alarming statistic was the prevalence of chronic pain reported by 25% of the sample. One-third of those suffering chronic pain reported experiencing very frequent and more intense pain. The leading types of chronic pain
were limb and abdominal, respectively. The highest prevalence rates occurred in the 8- to 11-year-old group and among 12- to 15-year-old girls. Perquin et al. suggested that research design could explain the results in the former group because the study used self-report (rather than parent-report) data collection methods with children age 8 and above. However, they noted that previous research has found a positive correlation between prevalence rates and age. Perquin et al. proposed that the onset of menstruation might explain the increase of reported incidence of chronic pain for 12- to 14-year-old girls; however, they did not provide their reasoning.

In the same month of the publishing of Perquin et al’s study, another journal published a literature review by Tonya Palermo that evaluated research on the impact of recurrent and chronic pain on daily function. Palermo (2000) found chronic pain prevalence rates in the general population of children that ranged from 7.5% - 32%. Musculoskeletal pain (32.1%) and general types of headaches (30.5%), both occurring at least once a week, ranked as the two leading prevalence rates. Fibromyalgia with widespread musculoskeletal pain at least once a week ranked as the smallest prevalence rate (7.5%). The research done by Perquin’s team as well as by Palermo show at the very least, that chronic pain is not a condition exclusive to adults. While rates do increase with age, prevalence is significant enough across pediatric populations to warrant “follow-up investigation focusing on the course of pain over the years, on the quality of life, and other bio-psycho-social factors related to the experience and extent of this pain in children, which may be potential starting points for intervention” (Perquin et al, 2000, p. 57).

Research indicates that chronic pain can result in frequent school absence, decreased general school performance and social functioning, and correlates to rates of psychological distress. Among the research of chronic pain’s influence on school related behaviors, Shapiro et al. (1995) conducted a study linking absenteeism to pediatric sickle
The team collected a total of 4756 daily diary entries from eighteen adolescents with SCD. The sample reported pain on an average of 30% of those days. Incidentally, 43% of the days with pain reports were also days with poor sleep reports. Pain was managed at home nine-tenths of the time, resulting in absence from school 21% of 3186 school days with an average number of 2.7 consecutively missed school days. Only half of those school absences resulted directly from SCD-related pain. When pain was managed at home, children missed school 65% of days in comparison to when it was managed in hospital (35%). Shapiro and her colleagues hypothesized that minor infection, clinic visits, and other SCD-related medical problems might be cause for the additional absences. The researchers also suggested that the impact of pain and illness on psychosocial function might play a role in missing school. That is, children perceived as vulnerable by parents may be kept out of school for reasons that most other children would not be. Furthermore, absence often results in falling behind in schoolwork and, thus, may perpetuate a pattern of school avoidance.

Flato, Aasland, Vinje, and Forre (1998) provided further support for the impact of pain on school performance from a long-term follow-up study of 72 Norwegian children with chronic arthritis. Over half (52%) of the children reported that the disease affected their school performance. Physical education was reportedly the most influenced subject (n =32). Flato and his colleagues noted, “Our findings support the need for greater efforts to maximize school performance in children with chronic arthritis” (p. 373). The two studies cited above illustrate the prevalence of compromised school performance as a result of pediatric chronic pain, which occurs both internationally and across medical diagnoses.

Decreased quality of life has been linked to pediatric chronic pain in several significant studies. Langeveld, Koot, and Passchier (1997) were among the first to publish an investigation of the relationship between the changes in headache activity
(i.e., frequency and intensity) and the experienced changes in quality of life (QoL). Over a week long period they requested 60 adolescents (ages 12 – 18) to record journal entries of headache activity in addition to completing a questionnaire, which addressed six QoL subdomains: Functional Status, Psychological Functioning, Physical Functioning, Social functioning, Satisfaction with Life in General, and Satisfaction with Health. When the journal entries and the questionnaire were correlated for Week 1, significant associations were revealed for Harmony Fatigue, Cheerful Mood/Good Humour, Social Interaction with Brothers and Sisters, Headache Impact on Daily Activities, Headache Impact on Leisure Activities, Satisfaction with Life in General, and Satisfaction with Health. Only the subscale Headache Impact on Daily Activities with actual headache index continued to be significant in the following weeks. A pattern of decreasing significance occurred for most of the correlations and by Week 4, there were no significant correlations. The researchers attributed the finding to declining compliance in diary completion. The format, which was paper and pencil format, may have been “too demanding for subjects to guarantee a high compliance continuously for four weeks” (p. 41).

While Langeveld et al.’s (1997) study might have had faulty design it did yield some significant results. A medium association was found between headache activity and Headache Impact on Daily Activities and actual headache. Positive sensitivity for actual headache was found within the QoL subdomains of Psychological Functioning, Satisfaction with Life in General, Satisfaction with Health, and the QLH-Y subscales of Harmony, Fatigue, and Cheerful Mood/Good Humour. High headache activity coincided with low scores on Harmony, Cheerful Mood/Good Humour, Satisfaction with Life in General, Satisfaction with Health as well as with high scores on Fatigue. All correlation was in the expected direction.

Fuggle, Shand, Gill, and Davies (1996) examined quality of life in 25 children (ages 6 – 16) with sickle cell disease and found significant differences between them and
the healthy controls. Specifically, in all nine of the everyday activities recorded in the diaries, the impact of pain events was much greater than for the controls. Children with SCD had three times more (15.7 vs. 4.5) circumstances in which pain prohibited participation (e.g., missed school/schoolwork, missed sport, missed favorite activity). Involvement in sports and seeing their friends was significantly limited by sickle related pain. The children reported a much greater impact of the pain event (proportion of days with pain) when they perceived the event as sickle cell pain related. Based on their findings, Fuggle et al. (1996) concluded, “Despite the resilience of children with sickle cell disease, this chronic disorder has a significant impact on the physical, psychological, educational, recreational, and social life of these children” (p. 203).

A study of children with SCD examined how chronic pain impacts a child’s social functioning. Lemanek, Horowitz, and Ohene-Frempong (1994) found a curious difference between the social competence ratings by clinic staff and by parents of children, ages 4 – 8, diagnosed with SCD. No significant differences in social functioning between children with SCD and comparison groups appeared; however, a significant difference was found between parent ratings and staff ratings. The children with SCD were perceived as more socially competent by their parents than by clinic staff members. The researchers recognized that it is difficult to discern reasons for this result, as it is possible that the clinic staff had limited opportunity to observe the children’s full range of social skills. The researchers suggested the possibility that children may, in fact, exhibit less prosocial behaviors in a clinical setting. They posed an important research question in conjunction with their finding, “To what extent can we generalize the ratings from others from one setting to another and whose ratings should be given greater weight regarding the decision to treat identified deficits in social behaviors?” (p. 453). The pertinence of this question resurfaces in the discussion section of this dissertation study.
Psychological distress has proved to be a predictive factor for the degree of functional difficulty experienced by children with chronic pain. A study of 236 children (ages 8 – 18) with Recurrent Abdominal Pain (RAP) revealed that children with chronic pain report being less cheerful and more depressed than pain-free children (Walker, Garber, & Greene, 1993). Ultimately, patients with RAP had higher levels of emotional distress and internalizing behaviors than well children but lower levels than children with mood or anxiety disorders. The same differences between RAP and psychiatric patients held true for externalizing behaviors. Walker et al. (1993) asserted that while RAP patients “experience more emotional distress than well children, their symptoms are both less severe than those of psychiatric patients and are of the sort that are less likely to create management problems for parents and teachers” (p. 254). Research by Thompson et al. (1994) lends further support with a study that found significant levels of anxiety and phobias in 50 children, ages 7-12, diagnosed with sickle cell disease. These children showed poor psychological adjustment over a 10-month period. Interestingly, these children self-reported lower stability of their adjustment than did their mothers. The researchers believe that the reliability of the measure used cannot be responsible for this lack of stability and suggest “longitudinal studies are now needed to trace the variability in child-reported distress over time in relation to changes in disease status” (p. 858). Lastly, a noteworthy study by Varni et al. (1996) offered contributions to the research on the impact of pain on emotional functional. The study surveyed 160 school-aged children with rheumatic diseases and their parents and found that higher patient-perceived pain intensity correlated to higher rates of depression, anxiety, and lower self-esteem than among healthy peers. A similar, but lower, association was found between parent-perceived patient pain and the above listed aspects of emotional distress. The researchers found this result consistent with studies on adult chronic pain patients, but recognized the significant relationship between greater pain and lower general self-
esteem as a new contribution to the study of the impact of chronic pain on adaptational outcome.

The majority of studies show a positive correlation between emotional distress and pain; however, fewer studies have explored the relationship between emotional distress and functional status. Among that research, Flato et al. (1998) found depression and anxiety in addition to pain were strong predictors of physical disability in children with juvenile rheumatoid arthritis. Walker et al. (1993) found that children with chronic pain reported restriction in their general amount of activity. The correlation between chronic pain and daily function lends support to the need to explore specific areas of function in which chronic pain may significantly impact a child’s life. Given the prevalence of pediatric chronic pain, a greater understanding of its etiology and impact on the quality of life seems imperative for effective treatment. An increase in the investigation into pediatric pain and its effects will certainly generate improved interventions and effective treatment in both the medical and psychological domains.

Sleep-pain Relationship

Compromised sleep, potentially, can create greater difficulty with management of physical conditions. Most adults remember a lost night’s sleep due to pain/physical discomfort and then experiencing seemingly exacerbated symptoms the following day. Conversely, many adults have experienced a good night’s sleep that eased the next day’s symptoms. In this way, sleep disturbance and chronic pain seem connected. While empirical support has been found for adult pain experience, the relationship between sleep disturbance and chronic pain in pediatric populations has not received as much research attention. Palermo (2000) asserted that sleep disturbance is a “potentially important but neglected outcome...Recent research has suggested that disruptions in sleep have far-reaching consequences” (p. 60). She cited only five studies supporting the effect of chronic pain on sleep disturbance (Bloom, Alario, Nobile, & Owens as cited by
Palermo, 2000; Bruni et al., 1997; Dinges et al., 1990; Shapiro et al., 1995; Fuggle, Shand, Gill, & Davies, 1996). The research addressed impact of pain on the amount and quality of children’s sleep in specific pediatric pain populations: migraine, sickle cell disease, and juvenile rheumatoid arthritis. For example, Bruni et al. found that children and adolescents with migraines and headaches frequently experience some form of sleep disturbance, such as compromised sleep quality, delayed sleep onset, night and early morning awakening, and daytime sleepiness. Elucidation of far-reaching consequences came from Dinges et al.’s finding that disturbed sleep associated with sickle cell pain lead to risk of sleep deprivation that potentially exacerbated problems with daytime functioning and school attendance. Palermo recognized the need for further clarity of the direct relationship between amount and patterns of pain and degrees of sleep disturbance.

A brief follow-up search for studies addressing the impact of pain on children’s sleep detected myriad additional studies published in this last decade, indicating a response to the research demand. Among these was the previously mentioned research by Roth-Isigkeit et al. (2005) that studied 749 German children and adolescents and found that 41% of respondents reported sleep disturbance, which they attributed to their pain. In that same study, 16.2% reported sleep problems as a trigger for their pain, making sleep problems the fifth most frequently reported trigger for pain. Another study, conducted by Miller, Palermo, Powers, Scher, and Hershey (2003), researched sleep disturbance in children with migraines headaches and found that these children experienced more sleep disturbances than their healthy counterparts. In their sample of 118 children, ages 2-12 and previously diagnosed with migraine headache conditions, 42% were reported by their parents to get too little sleep. Other sleep disturbance behaviors that were reported at greater than 20% included bruxism, sleeping with parents, and snoring. Valrie, Gil, Redding-Lallinger, and Daeschner (2007) examined
sleep-pain relationship in children with SCD. Valrie et al. (2007) hypothesized that pain levels over the course of the day would correlate to the quality of sleep had that night and the alternate relationship would exist as well. Results proved this bi-directional correlation to hold true. That is, high pain severity ($\beta = -3.72$, $p<.01$) was inversely related to sleep quality at night. Multilevel model analysis revealed that the relationship between pain severity and sleep quality was influenced by analgesic use. As might be expected, analgesic use attenuated the relationship between pain severity and sleep quality; and, without use, high pain was related to poorer sleep quality. Additionally, pain severity of the following day was inversely related to sleep quality ($\beta = -6.54$, $p<.01$) of the previous night. The researchers noted that their findings are consistent with previous studies and posited reasons why pain interferes with sleep. They suggested that the discomfort from pain may interfere with sleep at night and that pain might disrupt underlying sleep mechanisms. They posited similar reasons for sleep quality affecting pain levels of the following day: poor sleep may lower the threshold for pain and/or poor sleep may be an indicator of the biological factors related to the onset of a pain episode (i.e., blood oxygen levels). Most important was the researchers’ recognition that “these results support the hypothesis that there is a cyclic relationship between pain and sleep” (p. 860).

As noted earlier, studies have typically recorded only the presence or absence of pain in a given sample. To address the paucity of research on the relationship between pain patterns (duration, location, frequency, and intensity) and severity of sleep disturbance, Palermo and Kiska (2005) conducted a study investigating the relationship between reported sleep disturbances, pain symptoms, daytime functioning, and health related quality of life for adolescents living with sickle cell disease, juvenile arthritis, or headaches. Results suggested that a significant relationship exists between the experience of chronic pain and sleep disturbances such that sleep disturbance is linked
to mood disturbance, restricted daily functioning, and decreased quality of life. Few other studies have taken such a comprehensive approach to the study of sleep in chronic pain populations. Palermo and Kiska's findings elucidated the bidirectional nature of sleep and chronic pain, thereby emphasizing the importance of studying each as it relates to, and with, the other in children living with idiopathic or disease related pain. Sleep is critical for both development and healing of any child. Disturbed sleep may become particularly problematic for children with chronic pain in that it may exacerbate pre-existing symptoms, difficulty with daily functioning, and impair a child’s psychological well-being. Although research supports a correlation between sleep disturbance and pain symptoms, the relationship between the amount and pattern of pain and the frequency and severity of sleep disturbance still remains uncertain.

Two years ago, the Journal of Pediatric Psychology devoted an entire issue to the current research on sleep in pediatric medical populations. In the issue’s final article, Chambers, Corkum, and Rusak (2008) provided worthwhile commentary on the state of the literature. They cited six recent publications that have “drawn our attention to the importance of sleep as a variable that can have significant influence, and be influenced by, pediatric chronic pain” (p. 1333) Prior to this research, sleep disturbances were seen as secondary to the problems associated with pediatric pain management.

Three publications discussed in this dissertation are among those referenced in their commentary (e.g., Long, Krishnamurthy, & Palermo, 2008; Miller et al., 2003; Palermo & Kiska, 2005). The commentary attributed Long et al.’s (2008) work along with research by Valrie et al. (2007) as research that “serve(s) to reinforce and extend our current knowledge of the importance of sleep in pediatric chronic pain” (p. 333). The authors acknowledged the diverse methodologies used to assess sleep across varied pain populations. They noted that despite these differences every study confirms the same point: sleep problems are common in pediatric pain populations and relate to many
other aspects of life and functioning, including mood disturbance and daily function. Aside from the consensus of findings, the creation of an issue devoted to sleep disturbance in the pediatric chronic pain population this topic attests to an increase in research attention, which was greatly needed.

Chambers et al. (2008) discussed areas in which further understanding is necessary. First, research shows a surge in pain prevalence as well as an increase in sleep difficulties (Carkasdon as cited by Chambers et al., 2008; Perquin et al., 2000) during adolescence. Given this understanding, it is safe to assume that the role of sleep disturbance becomes more salient in the later years of development; however, what remains unknown is the developmental trajectory of the sleep-pain relationship across childhood and adolescence. Second, the effect that pain medications may have on sleep quality and/or duration remains uncertain. The authors noted the “significant gap” (p. 333) in the knowledge base that exists due to the unknown kinds and quantities of medication used by children with chronic pain and how these medications relate to changes on sleep. They urged that this gap be addressed with “rigorous statistical analyses, in parallel to previous analyses of other factors such as mood” (p. 333). A third area to be explored is the impact of napping on nighttime sleep. The finding of increased daytime sleepiness in children with chronic pain suggests that naps are likely. If this is so, total sleep and sleep quality may likely be significantly impacted. Thus, the authors suggested that future research consider examination of a 24-hour cycle in order to determine the extent to which naps contribute and/or compensate. The commentary article concluded with acknowledgement of the strong descriptive base to date and the need to build upon it in order to examine whether sleep-improving interventions also ameliorate pain and its related symptoms. Such research would take a pioneering approach to understanding the bi-directionality of the sleep-pain relationship.
Pain management must address all aspects of a child’s life; research over the past 20 years has proven sleep to be among the significantly affected aspects. Therefore, in order to facilitate effective management of pediatric pain, the nature, impact, and patterns of the sleep-pain relationship must be understood. From a practical standpoint, psychologists and pediatricians working with children experiencing chronic pain should be aware of the implications of sleep disturbance and take steps toward integrating the assessment and treatment of sleep difficulties into their pain management practices. Preventing long-term health problems, poor academic achievement and performance, compromised emotional well-being begins by understanding the etiology of the bidirectional relationship of sleep and pain and will help alleviate the associated burden of chronic pain for these children and their families (Perquin et al., 2000).
PURPOSE

Inclusion of Specific Pediatric Pain Populations

The chronic pain populations examined in this dissertation have been identified in previous research to incur sleep disturbances in conjunction with chronic pain. The three clinical populations used are children with headache, juvenile rheumatoid arthritis (JRA), or sickle cell disease (SCD). Headaches are the most frequently reported type of pain experienced by children; JRA and SCD are common illnesses known to involve significant pain. Perquin et al. (2000) summarized the findings of many studies done from 1970 through 1996, noting that the prevalence of headache pain increases with age and is greater in girls than boys. JRA is the most prevalent form of connective tissue disease in children and is diagnosed in almost 300,000 children (Labyak, Bourguignon, & Docherty, 2003). Furthermore, children with JRA report pain symptoms and sleep disturbances in conjunction with this diagnosis (Palermo & Kiska, 2005). While SCD has not been as widely investigated as headaches or JRA, it is known to involve acute pain episodes; one type of pain episode is nocturnal hypoxemia, estimated to occur for 40% of children diagnosed with SCD (Bandia & Splaingard, 2004).

Dissertation Purpose

The data analyzed for this dissertation were taken, with permission, from a larger dataset compiled for wider research uses. Palermo and Kiska’s (2005) study of subjective sleep disturbances and chronic pain analyzed data from that dataset, which pertained to its adolescent population. In an attempt to replicate Palermo and Kiska’s examination of
the relationship between sleep disturbance and the experience of chronic pain, this dissertation analyzes data from the same dataset but collected from children, ages 8 to 12 years old. This dissertation’s design reproduces Palermo and Kiska’s study in its formulation of similar hypotheses and use of similar statistical analyses.

Hypotheses

The four hypotheses applied to the dataset reflect the findings of the literature on the relationship between pediatric chronic pain and sleep disturbance. The primary hypothesis stated that children with chronic pain exhibit increased sleep disturbance in comparison to otherwise healthy children (i.e., children without chronic pain). The second hypothesis posited that higher levels of psychological symptoms, such as depression and anxiety, are associated with increased severity of sleep disturbance. In other words, among children experiencing chronic pain, those with higher rates of anxiety/depression are predicted to experience greater sleep disturbance. The third hypothesis expected that higher levels of pain intensity, duration, and frequency relate to more problems with bedtime settling and more frequent night waking. This hypothesis was adjusted to accommodate the absence of necessary data. Thus, the working hypothesis examined total sleep disturbance data in place of bedtime settling and night waking. The fourth hypothesis predicted that increased sleep disturbance relates to a reduced quality of life and more impairment in daily functioning. That is, the hypothesis expected children with greater degrees of sleep disturbance to report a lower quality of life and greater difficulty performing everyday tasks. The four hypotheses proposed in this dissertation were tested through statistical analysis of data collected with sleep, pain, daily function, and quality of life assessment measures.

In the original dataset, Dr. Palermo provided both conglomerate data for a chronic pain group and differentiated scores among the specific pain groups. Pre-analyses revealed a significant difference in pain severity among the groups. Children
with JRA reported higher scores on the Faces Pain Scale. For this dissertation’s purposes, post-hoc analysis corrected for the difference, which, then, allowed the use of the conglomerate data. Heretofore, the three aforementioned pain conditions will collectively represent one chronic pain sample population.
METHOD

Participants

Children ages 8 – 12 years old and their caregivers were recruited from outpatient clinics of Case Western Reserve University School of Medicine, Rainbow Babies & Children’s Hospital. The recruitment period lasted 1 year and 9 months (Jan. 2001 – Aug. 2002). All children had a previous diagnosis of sickle cell disease (n= 26), rheumatoid arthritis (n = 30), or headache (n = 44). A total of 100 subjects between the ages of 8.0 and 12.85 years old participated. The mean age of the children was 10.22. Fifty-six children were female and 44 were male. Among the given choices of race identification, the break down was as follows: 56 children identified as Caucasian, 46 as Afro-American, and 2 as Hispanic. Parents’ ages ranged from 24.19 to 73.35 with the mean age being 49.16. Family income was reported in $10,000 increments; median income was $30,000 – $39,000.

Procedures

Researchers asked parents and children to complete questionnaires on sleep habits, pain, depression, functional disability, and quality of life. Caregivers also completed sociodemographic information (i.e., participant’s age, gender, racial background, parental marital status, occupation, and income). The data collection and research procedures for the original study received approval by the affiliated Institutional Review Board (IRB). In May 2008, Pacific University’s IRB approved the research and statistical analysis procedures for this dissertation study.
Measures

The Children’s Sleep Habits Questionnaire (CSHQ). Creators, Owens, Spirito, and McGuinn (2000), designed this measure as a parent report sleep-screening instrument that examines the sleep behaviors of school-aged children over a typical week. It is comprised of 45 items in a 3-point Likert scale format with eight subscales encompassing the major medical and behavioral sleep disorders in this age group. The eight subscales are conceptually grouped: bedtime resistance, sleep onset delay, sleep duration, sleep anxiety, parasomnias, sleep disordered breathing, daytime sleepiness, and night waking. A parent rates the child’s sleep behaviors on the following 3-point scale: usually (5-7 times per week), sometimes (2-4 times per week), and rarely (0 – 1 times per week). The total of all 45 items yields a total sleep disturbance score, with a higher total score indicating greater sleep disturbance. In both original samples collected from three New England elementary schools (community = 469 children) and a pediatric sleep disorders clinic in a children’s teaching hospital (clinical = 154 children), the measure demonstrated adequate internal consistency scores: 0.68 for the community sample, 0.78 for the clinical sample. Test-retest reliability was conducted at a 2-week interval. Correlations for three subscales as well as for each of the items were determined in the acceptable range (0.62 to 0.79). The CSHQ demonstrated validity (p<0.001) based on the individual items’, the subscales’, and total score’s ability to consistently distinguish between the community and clinical samples (Owens et al.).

Revised Children’s Anxiety and Depression Scale (RCADS). Chorpita, Yim, Moffit, Umemoto, and Francis (2000) designed this measure as a self-report questionnaire based on the Diagnostic and Statistical Manual of Mental Disorders – IV (American Psychiatric Association, 1994) criteria for major depressive disorder (MDD) and five anxiety disorders (generalized anxiety disorder [GAD], social phobia, separation anxiety, obsessive-compulsive disorder [OCD], and panic disorder). RCADS is a 47-item
adaptation of the Spence Children’s Anxiety scale intended to assess children’s reports of anxious and depressive symptoms (Chorpita et al., 2000). RCADS demonstrated high internal consistency for the MDD subscale (0.76) and the GAD subscale (0.77). A subset of 125 children from the 246 initially administered the questionnaire was re-administered the test 1 week later; results determined high test-retest reliability (GAD = 0.79; MDD = 0.77) (Chorpita et al.). The dataset available for this dissertation used information collected from the GAD and MDD subscales of the RCADS. Although other subscales of the RCADS also measure psychological states, the GAD and MDD scales best depict the symptoms of anxiety and depression.

**Faces Pain Scale.** Bieri, Reeve, Champion, Addicoat, and Ziegler (1990) designed this measure to be used with children (preschool – elementary) as a simple self-report of pain intensity. The scale is comprised of 7 hand-drawn faces with the anchors of “no pain” and “worst pain”. A child selects the face that best expresses his/her current level of pain. Bieri et al. (1990) chose children from 26 local schools (1 Jewish school and 25 randomly selected Catholic parish schools), on which to test the scale’s psychometric properties. They designed a 5-phase study using separate groups of children for each phase. Phases I – III included 1st and 3rd graders; phase IV tested only 3rd graders; and, phase V tested only 1st graders. All children were individually tested. Content analysis of the faces drawn by the children during Phase I yielded no significant difference resulting from age; however, drawings by the 8-year-olds showed greater consistency of change than faces drawn by the 6 –year-olds ($\chi^2 = 9.04, df = 2, P < 0.02$). In phase II, agreement among the children regarding the ordering of face drawings showed no systematic deficiency and ranged from 71% (face #3) to 96% (face #0) in the 1st grader group and from 86% (face #3) to 100% (faces 0,1,5,6,) in the 3rd grade group. Overall, 62% of the 1st graders and 75% of the 3rd grader correctly placed all 7 faces. The scale’s equality of interval properties was tested in phase III. No significant differences occurred
between the results for two age groups. Overall, the children displayed a “good”
approximation to the expected positioning of the faces. Phase IV examined construct
validity by asking children the meaning of the faces. Clear statements of pain, hurt, ache
being sick, and emotional pain were made by 57.9% of the children. The additional
portion (35.9%) offered other interpretations; anger, boredom, or not knowing what the
faces showed. The remaining portion was not asked due to time constraints. In the final
phase, test-retest reliability yielded excellent results (.79) in a subgroup of 6-year-old
children tested 2 weeks later and by an alternate interviewer (Bieri et al.).

*Pain duration and pain frequency rating.* Parents and children included in the
original data collection completed parallel questionnaires to assess the child’s pain
symptoms over the previous 4-week period. Two separate Likert scales measured pain
duration and pain frequency by 4-point and 6-point scales, respectively. The response
options offered four increasing time periods from “less than once a month” to “daily”
(duration) and “an hour or less” to “all day” (frequency). Both scales demonstrated good
validity (frequency, \( r_s = .74, p < .001 \); duration, \( r_s = .53, p < .001 \)) by cross-informant
relationships between child and parent report (Palermo, Witherspoon, Valenzuela, &
Drotar, 2004).

*Functional Disability Inventory (FDI)* Walker and Greene (1991) designed the
FDI as a global measure for use in research of “the impact of illness on children’s
physical and psychosocial functioning in everyday social roles” (p. 40). The
questionnaire is intended for use with varying levels of severity of dysfunction associated
with myriad illnesses. Additionally, it can be used to study individual differences among
pediatric patients, examine the relationship between disability and psychosocial
functioning, or as an outcome measure in regards to patient functioning after
intervention.
The instrument has 15 questions rated on a 5-point Likert scale ranging from 0 (“No trouble”) to 4 (“Impossible”) and yielding a total score from 0 to 60 with ascending scores toward greater disability. The questionnaire addresses behavioral domains such as sleep/rest, mobility, and social interaction and recreation at school, home, and in the community. It uses questions targeting tasks essential to daily living (e.g., walking to the bathroom, riding in a school bus or car). To avoid the problem of confounding disability with developmental level, the FDI uses content and wording expected to be appropriate for children across a broad age range. Both a parent and self-report format are available.

Functional disability is defined, for this measure, as “difficulty in age-appropriate physical and psychosocial functioning due to physical health status” (Walker & Greene, 1991, p. 40). As there are many decent measures of emotional functioning available, the FDI focuses on only physical and psychosocial domains relevant to children’s settings. The stem of the questionnaire was adapted from the Physical Function subscale of the Duke-UNC Health Profile as were the ambulation questions. Questions pertaining areas other than ambulation were adapted from the Sickness Impact Profile (as cited by Walker & Greene) a measure used for similar purposes with adults.

Walker and Greene (1991) conducted two studies to test the psychometric properties of the FDI. The first study examined internal consistency in a small (N = 47) sample primarily comprised of adolescent girls (M = 14) and their mothers. The measure demonstrated high reliability for both the child’s report (alpha = .90) and mother’s report (alpha = .94). To test validity factors, the measure was correlated with several other measures, which yielded Pearson correlations ranging from .36 to .71 for child report and .20 to .55 for mother report. A moderate correlation between child and mother FDI scores was found (r = .30, p < .05). The second study yielded similar results.

At initial administration, the child version yielded a Cronbach’s alpha of .92 and, at the 3-month follow-up, of .85. For the mother’s version, Cronbach’s alpha was .95 at
both interview points. Concurrent validity was demonstrated by the high correlations between the child and parent forms of the FDI ($r = .71, p < .001$) and by the significant correlation yielded between the FDI and number of days of school absence for the prior 3 months ($r = .52, p < .001$). Construct validity was found by correlation of the FDI to several other health measures. Significant Pearson’s correlation ranged from -.13 to .65 for child’s report and -.18 to .53 for mother’s. Predictive validity tests yielded significant positive correlations between the FDI and two indices of subsequent disability: school absence - child report ($r = .44, p < .001$), school absence - mother report ($r = .35, p < .01$); bed days - child report ($r = .46, p < .001$), bed days - mother report ($r = .45, p < .001$). The FDI also significantly correlated with two aspects of illness behavior: number of medications used in three months post clinic visit (child report: $r = .26, p < .05$, mother report: $r = .22, p < .05$) and level of somatic complaints at 3-month follow-up (child report: $r = .45, p < .001$, mother report: $r = .21, p < .05$). Discriminant validity factors were assessed for utility in three diagnostic groups: Well (patients who attended the clinic for routine examination), Organic (patients with abdominal pain of organic etiology), and Recurrent Abdominal Pain or RAP (patients without identifiable organic etiology experiencing recurrent abdominal pain). Age group and child gender were included as factors in the ANOVA. The RAP ($Ms = 17.12$ and 17.41 for child and mother reports, respectively) and Organic groups ($Ms = 15.00$ and 17.04 for child and mother reports) showed significantly higher scores than the Well group ($Ms = 3.50$ and 2.26 for child and mother reports). At the 3-month follow up the RAP group showed significantly higher scores ($Ms = 6.86$ and 7.42 for child and mother reports) than both other groups (Organic, $Ms = 2.65$ and 3.16; Well, $Ms = 2.64$ and 1.03 for child and mother report). Significant age gender interaction existed in the mother report follow-up data: $F (1, 85) = 4.26, p < .05$; mothers of daughters reported higher disability for the child than did mothers of sons (daughters: $M = 8.29$, sons: $M = 2.58$). FDI sensitivity to changes in
patient status was examined by changes in FDI scores reported at follow-up by Organic and RAP groups. The Organic group and their mothers reported significant decreases in child functional disability between the initial and 2-week interviews and between the 2-week and 6-week interviews. The RAP group reported significant decline only between the initial and 2-week interviews. FDI sensitivity was also explored with test-retest reliability. Pearson correlations were high for the RAP group at 2 week, 6 week, and 6 month follow-up, but, ultimately, not significant for the Organic group. The FDI proved to be a better predictor of bed days \((T_s = 3.87 \text{ and } 3.67, p < .001)\) than school absences \((T = 1.81, p < .08)\); nonetheless, both yielded significant regression coefficients, explaining 20% and 18% of the variance, respectively. The greater utility of the FDI in predicting bed days may be due to its assessment of disability across several settings (Walker & Greene, 1991).

*Children’s Health Questionnaire (CHQ).* Landgraf, Abetz, and Ware (as cited in Landgraf et al., 1998) designed the Children’s Health Questionnaire as a tool for measuring two fundamental components of a child’s or adolescent’s physical and psychosocial functioning and well-being. The CHQ was originally constructed as a 98-item questionnaire. A more practical length instrument is the 50-item, parent-completed, short form known as the CHQ–PF50. The 50 items capture 14 concepts: physical functioning, role/social – physical, general health perception, bodily pain, parental time impact, parental emotional impact, role/social emotional, role/social behavioral, self-esteem, mental health, general behavior, family activities, family cohesion, change in health (Landgraf et al.). The concepts are reflected in 11 scales: physical functioning, bodily pain, role/social-physical, general health perception, role/social-emotional/behavioral, mental health, general behavior, self-esteem, parental emotional impact, parental time impact, family impact. Item internal consistency was .60 and item discriminate validity, measured by percentage, showed ≥ 96% for all but 3
concepts (mental health = 90%, parental emotional impact = 83%, family activities = 83%). Internal consistency for all 11 scales was estimated with Cronbach’s α coefficient. Reliability of at least .50 but preferably .70 or greater is considered sufficient for group comparisons (Landgraff et al.). Nine of the scales exceeded the minimum for group level comparisons (median = .80). General health perceptions (α = .66) and family impact (α = .59) were the two scales that did not meet criteria.

**Statistical Analysis**

Statistical analysis was conducted using The Statistical Package for Social Sciences, version 14.0 (SPSS). Descriptive statistics were summarized by frequencies and means. Mean age for the collective chronic pain group was 10.22 years old with a range from 7.90 – 12.85. The frequencies of disease categories were as follows: Headache (f = 44), Arthritis (f = 30), and Sickle Cell Disease (f = 26). Because N = 100, the frequencies translated directly into percentages (44%, 30%, and 26%), respectively. The same translation held true for sex (female: f = 56 (56%), males: f = 44 (44%) and race (Caucasian: f = 56 (56%), African American: f = 42 (42%), and Other: f = 2 (2%).

Pre-analysis of the data was required in order to ensure its usability, thus an ANOVA was run to determine whether each of the three clinical chronic pain populations have similarly reported their levels of pain. The one-way between-groups ANOVA was conducted on children’s reported levels of pain severity, as measured by the Faces Pain Scale (FPS). Subjects were divided by their medical diagnosis (group 1: headache; group 2: juvenile rheumatoid arthritis; group 3: sickle cell disease). There was a statistically significant difference in FPS scores for the JRA group when compared to both the headache and SCD group. $[F (2) = 7.074, df = 96, p = .001]$. The actual difference in mean scores between groups was large. The effect size, calculated using eta squared, was .13. Post-hoc comparisons using the Tukey HSD test indicated that the mean score for Group 2 ($M = 3.33, SD = 1.73$) was significantly different from Group 1 ($M = 4.7, SD = 1.32$) and
Group 3 (M = 4.5, SD = 1.89). Although significant difference was found for pain severity, use of the dataset proved reasonable because the group means were relatively equal.

To determine whether sleep disturbance in children with chronic pain is significantly greater than sleep disturbance in healthy children (Hypothesis #1) a one-sample t-test was run on scores obtained from the CSHQ (M = 44.46, sd = 8.14). Hypotheses #2 – 4 were examined by running Pearson product correlations. In order to examine bivariate relationship between psychological symptoms and the severity of sleep disturbance (Hypothesis #2), Pearson correlations were run on data collected from RCADS, Faces Pain Scale, and the Likert scales rating pain duration and frequency. The relationship between children’s pain level and specific sleep behaviors (Hypothesis #3) was examined by a Pearson correlation run with data collected from the Faces Pain Scale, the Likert scales for pain frequency and duration, and the CSHQ. Finally, the total sleep disturbance score (obtained from the CSHQ) and the FDI, and CHQ were used to examine sleep disturbance’s correlation to health related quality of life and functional disability, as represented by FDI and CHQ scores (Hypothesis #4).
RESULTS

Sleep Disturbance in a Chronic Pain Population

A one-sample t-test (M= 44.46, sd = 8.14) was performed to examine the hypothesis that children with chronic pain will exhibit increased sleep disturbance in comparison to otherwise healthy children. There was a significant difference $t (88) = -13.61, p < .05$ with the magnitude of the difference in the means being large ($\eta$ squared = 1.44), indicating that this sample of children with chronic pain experiences less sleep disturbance than otherwise pain-free children. However, the analysis yielded misleading results. Given the design of the questionnaire, children with chronic pain might report less frequency for each item but higher incidence of disturbed sleep behaviors such that the pediatric pain population will have a lower mean score than the community sample. Mean scores, in this case, misrepresent the sample’s difficulty. Thus, the analysis was determined insufficient for the purpose of this dissertation.

A test of proportions replaced the one sample t-test analysis. For the CSHQ, Owens et al. (2000) suggest use of a cut-off score of 41 to determine clinical significance. The mean total sleep disturbance score for this chronic pain population (M=44.46), which was above the suggested cutoff score and indicated greater total sleep disturbance. A significantly higher proportion of this sample’s children (53%) were above the clinical cutoff score than were the scores of the community sample (23%) used in the development of the CSHQ. Based on the results of this test of proportions ($p < .0001$), children with chronic pain demonstrate more total sleep disturbance than do children without chronic pain.
Correlation of Sleep Disturbance and Psychological Symptoms

The relationship between sleep and psychological symptoms (i.e., anxiety and depression) was investigated using Pearson product moment correlation coefficient. The results showed no significant relationship between CSHQ and RCADS scores (MDD: $r = .055, n = 99, p < .05$; GAD: $r = .046, n = 100, p < .05$), indicating that children with chronic pain do not experience greater total sleep disturbance in association with increased levels of anxiety/depression.

Correlation of Pain and Psychological Symptoms

The relationship between pain and psychological symptoms (anxiety and depression) was investigated using Pearson product moment correlation coefficient. Bonferroni correction determined a significance level for 6 correlations ($p = .008$).

Pain frequency *slightly* correlated to RCADS-MDD scores ($r = .27, n = 95, p < .008$) and RCADS-GAD ($r = .22, n = 94, p < .008$), indicating that higher levels of both depression and anxiety *are* associated with greater pain frequency.

Pain severity correlated with RCADS-GAD at a significance level equal to $p = .008$; thus, the association was determined not significant ($r = .27, n=100$), indicating that higher anxiety levels are *not* associated with increased pain severity. No significant correlation was determined between pain severity and RCADS-MDD, indicating that higher levels of depression are *not* associated with increased pain severity.

Pain duration showed a *small* correlation with RCADS-MDD ($r = .034, n = 94, p < .008$) and a *moderate* correlation to RCADS-GAD ($r = .06, n=95, p <.008$), indicating that higher levels of psychological symptoms *are* associated with greater pain duration.

Overall, increasing psychological symptoms (i.e., anxiety and depression) relate to greater pain frequency and duration, indicating that children with chronic pain experience higher levels of anxiety/depression when they experience greater levels of pain frequency and duration.
Correlation of Pain Intensity, Duration, and Frequency to General Sleep Disturbance

The relationship between pain and sleep disturbance was investigated using Pearson product moment correlation coefficient. Results showed no significant relationship between CSHQ scores and any of the pain measures (frequency: \( r = .1, n = 95, p < .05 \); severity: \( r = .2, n = 94, p < .05 \); duration: \( r = .2, n = 95, p < .05 \)), indicating that children with increasing degrees of chronic pain do not report greater sleep disturbance.

Correlation of Sleep Disturbance with Quality of Life and Daily Functioning

The relationship among sleep disturbance, quality of life, and daily functioning was investigated using Pearson product moment correlation coefficient. A Bonferroni correction determined the significance level (\( p = .025 \)) for the correlation between CSHQ and FDI scores, FDI and CHQ, and CSHQ and CHQ scores. Where indicated, analyses were performed, separately, on parent report and self-report scores.

The parent’s FDI score was moderately correlated to CSHQ scores (\( r = .382, n = 84, p < .025 \)), indicating that when parents report greater sleep disturbance for their children, they report greater levels of functional disability in their children. In sum, according to parent report, children with greater total sleep disturbance experience greater functional disability.

Children’s FDI scores did not have a significant correlation to CSHQ scores, indicating that children’s report of their own functional disability has little to no relationship to the parent’s report of the child’s sleep disturbance. Greater levels of functional disability, as self-reported, are not associated with increased total sleep disturbance, as reported by parents.

The parent report CHQ scores were largely and negatively correlated to the parent report CSHQ scores (\( r = -.512, n = 72, p < .025 \)), indicating that when parents report decreased total sleep disturbance for their children they also report greater
physical functioning and well-being (aka health related quality of life) for their children. In other words, according to parent report, children experiencing less sleep disturbance have increased physical health related quality of life.

The parent report CHQ scores were slightly and negatively correlated ($r = -.271$, $n = 72$, $p < .025$) to CSHQ scores, indicating that when parents report decreased total sleep disturbance in their children, they also report greater psychosocial functioning and well-being (health related quality of life) for their children. According to parent report, children experiencing decreased sleep disturbance have greater psychosocial health related quality of life.

A moderate negative correlation was found between the parent report FDI and CHQ scores of their children’s physical HRQOL ($r = -.458$, $n = 77$, $p < .025$), indicating that when parents report greater physical functioning and well-being for their children, they also report less functional disability for their children. According to parent report, children experiencing increased physical health show better daily functioning.

A moderate negative correlation was found between self report FDI scores and parent report CHQ scores of their children’s physical HRQOL ($r = -.332$, $n = 69$, $p < .025$), indicating that when a child reports greater functional disability, the parent reports decreased physical functioning and well-being in their child. In sum, children with greater functional disability, as self-reported, experience poorer physical health related quality of life, as parent reported.

Parent FDI scores showed a moderate negative correlation to the CHQ scores for their children’s psychosocial HRQOL ($r = -.491$, $n = 77$, $p < .025$), indicating that when parents report greater functional disability in their children, they also report decreased psychosocial functioning and well-being for their children. According to parent report, children with greater functional disability experience poorer psychosocial health related quality of life.
A moderate negative correlation was found between self-report FDI scores and parent report CHQ scores of their children’s psychosocial HRQOL \( r = .462, n = 69, p < .025 \), indicating that when a child reports greater functional disability, the parent reports decreased psychosocial functioning and well-being for their child. Children with greater functional disability, as self-reported, experience poorer psychosocial health related quality of life, as parent reported.
DISCUSSION

Consideration of the Four Hypotheses

Summary

Overall, the majority of this study’s analyses provide evidence in support of a
sleep-pain relationship. Three of the four major hypotheses proposed were supported,
indicating that children with chronic pain experience greater general sleep disturbance,
elevated psychological symptoms, and poorer health-related well-being, in comparison
to non-clinical populations. Correlations of individual measures within each of the three
hypotheses yield a majority of significant associations. Yet, the most interesting finding
of this study involves a single, unsupported hypothesis. While this pediatric sample
reports greater sleep disturbance than do children without chronic pain, it does not
report that those sleep disturbances directly relate to pain experiences. More precisely
put, children with chronic pain sleep more poorly than children without pain, but do not
report that their poor sleep has anything to do with their pain.

Initially, the two findings seemed contradictory; however, further investigation
suggested that children with chronic pain might experience greater sleep disturbance
due to other contributing variables. Notably, children who have not experienced a pain-
free life might have difficulty finding a causal connection without a comparative state of
health. Close examination of all the study’s findings elucidated the complexity with
which sleep and pain relate to each other in this pediatric chronic pain population.
Association of Chronic Pain and Sleep Disturbance

The majority of children with chronic pain in this study obtained scores on the CSHQ above the clinical cut-off, indicating greater total sleep disturbance. As noted in a similar study (Long et al., 2008), the mean age (M=7.6 years) of Owens and colleagues’ sample was significantly younger than the sample used in this study (M=10.2). Thus, the interpretation of findings involving the CSHQ should be done cautiously. Nonetheless, previous research (Palermo, 2000; Roth-Isigkeit et al., 2005) supports the existence of greater sleep disturbance in pediatric chronic pain populations, lending more evidence to the association of sleep disturbances and chronic pain.

In contrast, there was not a significant correlation in this sample of children between pain, as measured by the Faces Pain Scale and the Likert scales, and sleep disturbance, as measured by the CSHQ. There are three possible reasons for this contrasting finding. First, the difference in mean age in this sample and the sample used for the development of the CSHQ necessitates cautious interpretation of the scores. Second, the report sources differ. That is, the CSHQ is parent report only, but the pain measures were administered to both parents and children. The dataset provided only one score for each pain measure, which showed no distinction between child and parent pain measure scores. Thus, the comparison of parent report scores to combined parent and child report scores might misrepresent the child’s sleep-pain experience. Third, developmental stage could, also, be considered a factor, given that Palermo and Kiska (2005) found a slight correlation between pain and two specific sleep problems in an adolescent population. During middle childhood (ages 6 – 12), children use concrete thinking to guide their thought processes. Cognitive processing centers on logic and reasoning; abstract and hypothetical thinking have yet to fully develop (Davies, 1999). For this age population, sleep and pain may seem unrelated because there exists no obvious cause and effect relationship. Where an adolescent may focus on the
implications and concerns of having a pain condition, a school-age child lacks in such future based thinking. Additionally, school-age children continue to seek confirmation of parental attachment. While most children at this age are capable of going to bed without assistance, most still desire parent involvement to affirm attachment (Davies, 1999). Children desire greater parental attachment during times of stress and illness; thus, pain and sleep may not correlate in pediatric pain groups because parent comforting acts as a satisfactory control of nighttime pain.

*Associations of Psychological Symptoms, Pain, and Sleep*

Two of the three pain measures - pain frequency and pain duration – showed a significant relationship to both anxiety and depression. In other words, for children with chronic pain, the more often and/or the longer the pain episode occurs, the greater the psychological distress. Interestingly, pain intensity seems to have no association to a child’s depression or anxiety. The nature of this construct contributes to a potential explanation for its lack of correlation. Pain intensity represents an isolated occurrence whereas frequency and duration of pain extend over a period of time. Being that the RCADS measures mood disorders, for which symptoms must accumulate over time, the correlation may reflect an overall feeling state that results from enduring pain on a regular basis. In contrast, pain intensity is a short-lived experience; thus it may not as readily influence a child’s psychological state. Put into more practical terms, a child has time to make full emotional recovery from a one-time occurrence of intense pain. The same cannot be said when a child experiences pain, no matter its intensity, on a frequent and extended basis because the pain episodes become integrated into daily living.

In contrast to the correlations of psychological symptoms and pain, this study found that children with chronic pain do not experience higher levels of anxiety/depression in association with sleep disturbance. Long et al. (2008) also found no association between psychological symptoms and sleep disturbance in this pediatric
One possible explanation for the finding may be the difference in report sources for children versus adolescents. The RCADS (psychological symptoms) is a self-report measure whereas the CSHQ (sleep disturbance) is a parent-report measure. In concurrence with Long et al.'s published remarks, sole reliance on parent report sleep measures limits the reliability of this finding. A second possible explanation is that sleep medications may aid sleep quality in this population. The significant levels of sleep disturbance and reports of psychological symptoms relating to pain versus sleep, when taken together, present the possibility that sleep medications assist a pediatric chronic pain patient’s ability to sleep. Unfortunately, this hypothesized explanation could not be investigated due to insufficient information on subjects’ use of sleep medications. A third possible explanation considers that parental involvement impacts the sleep behaviors of children. Unlike adolescents, children more often seek and respond to parental comfort at bedtime hours. A parent’s comfort increases the alleviation of any psychological symptoms potentially interfering with sleep. Lastly, Long et al. suggested that the association between sleep disturbance and depression might be stronger during adolescence. This idea, again, draws from child development theories. As mentioned previously, at this cognitive stage, children are more oriented in the present and exercise less future focus. Therefore, sleep may come more easily simply because they may not readily perseverate on the concerns of the next day. In other words, children may not, as often as adolescents, lie awake or sleep restlessly due to depressive or anxious thinking.

**Association of Sleep Disturbance and Daily Functioning**

Results suggest that sleep disturbance impacts a child’s ability to function during the day, when measured by parent report. This association may illustrate how functional disability contributes to the sleep-pain relationship. Given that sleep disturbance and pain did not correlate, it is possible that functional disability links sleep and pain by affecting the strength and/or direction of the relationship between the variables. In other
words, children with chronic pain may experience greater sleep disturbance because of the interaction among functional disability, sleep, and pain. Greater levels of functional disability make sleeping problematic and that relationship may, in turn, influence a child’s pain experience. Further investigation of this hypothesis requires examination of functional disability’s relationship to pain.

Contrary to the results above, no correlation was found between self-report FDI scores and parent report CSHQ scores. This finding suggests that children have a different experience than that perceived by their parents. Interestingly, children reported higher FDI scores than their parents did, which lends further support to a difference between the child and parent perception of sleep-daily function experience. One explanation may be that 8 - 12 year olds, once in bed, are not checked on, as regularly by parents than are younger children. Therefore, parents may not be accurate reporters of nighttime behaviors for this age group. As no self-report sleep measure was used, there are no data to suggest that children’s FDI scores would correlate with their report of sleep disturbance. Long et al. (2008) also found no association between self-report FDI scores and CSHQ (parent report). Additionally, they used multiple regressions to test for sleep’s independent association with HRQOL and functional disability. Their results found total sleep disturbance to be a strong predictor of parent-report but not of self-report functional disability. Long et al. surmised their results on the sleep-functional disability association to be inconclusive; they noted, “This finding may also be due to the lack of children’s self-report of sleep problems, which is a limitation of this study. Future work should include child-report of sleep problems” (p. 266).

The argument stated above can be applied to this dissertation’s findings, as well. Because parents report sleep disturbance, the relationship may have more to do with parents’ perception of their children’s experience versus the actual degree of either sleep or functional disability. Palermo and Kiska (2005) found an association between sleep
and daily function in their study of an adolescent pain population that may be due to the comparison of self-report measures. If so, their finding provides further argument for the need of self-report measures for younger populations. Furthermore, the role of functional disability in the sleep-pain relationship remains in question due to the absence of self-report measures and the unexamined relationship between functional disability and pain.

**Association of Sleep Disturbance and Quality of Life**

A significant correlation between sleep and health-related quality of life (HRQOL) supports the hypothesis that children with sleep disturbance also experience poorer health-related quality of life. The correlations used parent reports of the physical and psychosocial subscales of the CHQ and parent report CSHQ. Results suggest that children with greater sleep disturbance also experience decreased HRQOL. Where Long et al. (2008) also found significant relationships in this age group, Palermo & Kiska, (2005) yielded a moderate correlation between sleep and psychosocial HRQOL yet, found no relationship between sleep and physical HRQOL. Both studies lend further support to the existence of a sleep/HRQOL correlation. The adolescent study used self-report (Palermo & Kiska, 2005) whereas Long et al. and this dissertation study generated results from parent report. While a small correlation exists in the 8 to 12-year-old population, Palermo and Kiska’s findings suggest a stronger relationship between specific sleep disturbances (daytime sleepiness and sleep/wake problems) and the quality of an adolescent’s psychosocial life. The strength difference may be explained by the use a different sleep measure and self-report CHQ scores, or by the adolescent’s developmentally appropriate emphasis on social interactions.

**Association of Daily Function and Quality of Life**

The final set of Pearson correlations was conducted in excess of the proposed hypotheses in order to lend further explanation to the matter of sleep-pain associations.
This dissertation study may be among the first to isolate the relationship between functional disability and HRQOL. A significant correlation was found between functional disability and health related quality of life. The correlation compared parent report scores for both CHQ subscales to parent report FDI scores. Results suggest that children experiencing greater functional disability also experience decreased health related quality of life. No self-report of HRQOL was administered, thus the association between self-report functional disability and HRQOL could not be determined. It would be interesting to clarify the existence of a sleep-HRQOL relationship through the analysis of self-report measures in the younger population.

Interestingly, self-report FDI scores demonstrated significant correlation with parent report HRQOL scores, indicating that children and parents have a shared perspective of the association between functional disability and HRQOL. One explanation for the relationship may be that functional disability limits both a child’s interest in physical activities and negatively impacts social exposure and acceptance. Previous studies (Long et al., 2008; Palermo & Kiska, 2005) have explored the association of sleep and/or pain with HRQOL, functional limitation, and depressive symptoms. Further investigation is necessary in order to distinguish direct association from third variable facilitation. Exploration of HRQOL in a non-pain or non-sleep disturbed population exhibiting functional disability might yield telling results.

Limitations

This dissertation study analyzed a previously existing dataset; no original data were collected. Therefore, limitations recognized in the original study remain true for this study. Specifically, the following limitations from the original study should be considered when interpreting the findings: a) at the time of data collection, information on the children’s use of sleep medication was not collected; b) the sleep measures administered were subjective and retrospective reports of the parents; c) the possibility
that health/sleep status at the time of reporting influenced parents’ and children’s answers; d) the potential for under or over-reporting; and e) the recruitment of children from a clinic-based setting.

The lack of information regarding the use of sleep medications limits the interpretation of findings for correlations involving sleep disturbance measures. If a child’s sleep has been aided by the use of medication that will influence the CSHQ scores as well as pertinent questions on other measures. Although sleep shows associations with a majority of the other examined variables there could be reason to consider sleep medication use, particularly due to the odd findings that children do not report sleep disturbances as related to pain. In regard to use of subjective and retrospective parent reports, the design of the CSHQ, FDI, and CHQ relies on the memory and perspective of the caretaker, thus increasing the possibility of imprecise reporting. As pointed out by Long et al. (2008), results may be different if self-report and/or objective measures are utilized. Haim et al. (as cited in Palermo & Kiska, 2005) compared objective and subjective sleep measures in children with abdominal pain and found objective sleep measures yielded results similar to those of healthy controls whereas subjective sleep measures did not. Ultimately, the use of both types of measure within one study would provide the most accurate picture. Incorporating “real-time” measures such as daily questionnaires or polysomnography could assist in gathering a more accurate assessment of sleep and other functional behaviors.

The third limitation may be due to the timing of data collection. All questionnaires were filled out when the children visited the clinic for treatment, which potentially allowed the child’s present health/sleep status to influence the answers of both the parents and the child. In other words, the child’s state of health at the time of the clinic visit might have taken precedence, causing both parent and child difficulty with recalling past health related episodes.
Lastly, limitation of this study results from the recruitment of children solely from a clinic-based setting. While research into the sleep-pain relationship must include clinical samples, exclusive use narrows the result’s generalizability. That is, results derived from this data set cannot appropriately be applied to subjects outside of clinical pediatric populations, such as children without, or not seeking treatment for, chronic pain.

The potential for under- or over-reporting exists whenever questionnaires are utilized. In this circumstance, answers to questions may reflect either undiagnosed psychiatric problems and/or exaggeration of symptoms that are contributing to sleep problems. If a child has underlying psychiatric problems, scores on the CSHQ, RCADS, and FDI will be affected most. The psychiatric status of each subject was determined only by the information reported on the questionnaires administered at the clinic visit; no pre-screening or review of records was done.

An overarching limitation specific to this study is the narrow scope of data analysis. This study’s analysis did not include examination of any mediator/moderator relationships. As mentioned in the discussion, the possibility exists that sleep disturbance in this pediatric chronic pain population extends beyond a simple sleep-pain association due to the interaction with other variables. Additionally, the correlation of functional disability and health-related quality of life could be affected by either pain or sleep disturbance. It is possible that the sleep – pain relationship is moderated by another variable (i.e., functional disability) whereby the relationship’s strength, direction, or both are affected by the presence of this independent variable. It also possible that a mediated relationship exists between sleep and pain, such that without the intervention of a third variable (i.e., quality of life), there would be a significantly different or no significant relationship at all between sleep and pain. Based on the
limited analyses in this study, possibilities exist for myriad and complex interactions among sleep-pain, quality of life, and daily functioning.

Of the limitations discussed above, the greatest limiting factor, by far, was the predominant use of parent-report measures. Parent reporting may have increased or decreased the likelihood of finding significant correlations. It is also possible that the comparison of different report sources (parent to self-report) reflects a decreased likelihood of associations among variables, given that those comparisons often did not yield significant relationships. As a consequence of this limitation, a majority of the significant correlations generated in this study, particularly those comparing different report sources, should be interpreted cautiously.

Future Directions

Overall, this study supported the hypothesis that children with chronic pain experience more sleep disturbance than do children without chronic pain. Furthermore, the frequency and severity of the pain seems to influence levels of depression and anxiety; however, neither pain nor mood symptoms are directly associated with sleep disturbances. More often, and depending on the report sources used, sleep disturbance relates to functional disability and health-related quality of life. Findings were both supportive and contradictory of the four proposed hypotheses. Such mixed findings indicate a complexity to the sleep-pain relationship and warrant further investigation. Future study could examine the mediation and/or moderation of the sleep-pain relationship and include comparison of same report sources (preferably self-report and objective measures).

The analyses of this study generated some significant correlations that suggest need for clarification as to the direction of these relationships. Because this study only employed correlations, no conclusions can be made as to the direction of, or contributors to, the sleep-pain relationship. Clearly, more comprehensive investigation must be done
toward understanding causality and complexity of interactions in the sleep-pain relationship. Examining pediatric populations with non-painful medical conditions, abnormalities, or both may help determine potential causes for sleep disturbance. Such research could assist the medical and mental health fields in creating effective treatment and intervention strategies for sleep disturbances in pediatric chronic pain populations.

**Conclusion**

In sum, the findings suggested that children with chronic pain experience problems in several areas of daily life. Sleeping, daily functioning, and psychological well-being presented this population with challenges. Interestingly, three out of four correlations that yielded results contradictory to the stated hypotheses involved sleep disturbance. All of the analyses compared parent-report measure to self-report measure. As pointed out throughout the discussion, the differing report sources added significant limitation to this study. On the other hand, the findings supported that measures such as functional disability and/or psychological symptoms are more useful than sleep measures for assessing pediatric chronic pain. This study strictly examined correlations; thus, the findings cannot offer conclusive evidence as to the direction or cause of these relationships. Nonetheless, this study’s results substantiate the need for further investigation and attest to pain’s impact on daily lives of children living with chronic pain.
References


Home management of sickle cell-related pain in children and adolescents: Natural history and impact on school attendance. *Pain, 61*, 139-144.


