The Interrelationship of Chronic Pain and Sleep Disturbances

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Overview

- Summarize the evidence for the effects of disturbed sleep on pain and response to pain treatment
- Develop strategies to assess and treat sleep disturbances in children with ongoing pain
- Apply behavioral strategies to decrease sleep problems

Chronic and Recurrent Pain is a Significant Pediatric Health Problem

- 20-40% of children and adolescents in community samples experience persistent pain (Perquin et al., 2000; Stanford et al., 2008)
  - Pain accompanied by moderate to severe disability in 5 - 8% (Huguet & Miro, 2008)
- Most common locations: head, abdomen, limbs
- Multiple pains are common
- Girls > incidence than boys
- Significant functional impact of pain on children and families

"…I'm always tired and don't get enough sleep, that's something they [the doctors] can't do anything about."

Osborn & Rodham, 2010

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Impact of Sleep Disturbances

Daytime Sleepiness

Inattention
Poor Memory

Mood Disturbance

Behavior/Performance Problems

Family Disruption

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Case Example

- 15 year old female with chronic jaw and neck pain, and migraine headaches
- Constant pain, treatments are not providing relief
- Tries to go to sleep between 9-10 p.m., is unable to fall asleep until 2-3 a.m.
- Excessive sleepiness during the day (falling asleep in class)
- Excessive napping in the afternoons
- School absenteeism, reduced physical functioning (high level of disability)
- Limiting social activities that involve sleep (sleepovers, camp, etc.)

Sleep Problems are Commonly Reported in Youth with Chronic Pain

- At least 50% of individuals with chronic pain report sleep problems
  - 50-65% of population-based sample of youth with chronic pain has some difficulty with sleep (Roth-Isigkeit, et al., 2005)
- Many different clinical populations demonstrate similar sleep disturbances
  - juvenile arthritis (Bloom et al., 2002)
  - headache (Bruni et al., 1997, Miller et al., 2003)
  - complex regional pain syndrome (Meltzer et al., 2005)
  - sickle cell disease (Palermo & Kiska, 2005)

Adolescence is a Vulnerable Time for Sleep Problems

- Delayed sleep onset
  - Circadian: relative phase delay at puberty
  - Environmental factors
- Advanced wake times (sleep offset)
  - Earlier school start times
- Decreased sleep / wake regularity and decreased daytime alertness
  - Discrepancy weekday / weekend sleep cycle
- ↓ Parental protection of sleep time

Early Models of Pediatric Pain and Sleep

- **Pain sensations can directly disrupt sleep states:** prolongs sleep onset, interferes with depth and continuity of sleep states
- **Insufficient sleep** can cause daytime sequelae (behavioral and emotional changes) that interfere with the coping skills necessary for effective pain management
- **Pain is a perceived threat, fear and anxiety is incompatible with sleep:** pain-related fear, arousal associated with hypervigilance

- Lewin, DS, & Dahl, RD (1999). Importance of sleep in the management of pediatric pain. J Dev Behav Pediatr 20(4):244-52.

Possible Mechanisms

- Pain modulation and the regulation of the sleep-wake cycle share common neurobiological systems
  - ***Inflammatory***: Sleep deprivation related to increases in pro-inflammatory markers; potential role in central sensitization
  - ***Neurochemical***: Changes in molecules modulating stages of sleep and pain (e.g., ACh, GABA, monoamines); potential role in increasing nociception
  - ***Cognitive/affective***: Sleep deprivation and sustained high pain levels engage brain regions involved in cognition and emotion-processing networks; sleep may alter higher level perception of and reaction to pain

- Very little research on any mechanisms

Sleep Deprivation And Pain

- Deficient sleep (experimental total sleep deprivation/restriction/ fragmentation) increases sensitivity to thermal or mechanical nociceptive stimulation (animal and human experimental studies). Lautenbacher, et al (2006) *Sleep Med Rev* 10:357-69

- Experimental sleep fragmentation or insomnia disorder have been shown to alter central pain inhibitory and facilitatory pathways (i.e., altered conditioned pain modulation, temporal summation of pain). Finan, et al (2013) *J Pain* 14: 1539-52

Recent Evidence for the Direction of the Sleep-Pain Association

- Sleep impairments are a stronger, more reliable predictor of pain than pain is of sleep impairments
- Sleep disruption leads to subsequent increased pain in multiple samples across childhood and adulthood
  - Presurgery sleep duration $\longrightarrow$ Postop Pain (Rabbitts, et al., 2015)
- Sleep disturbance may impair key processes that contribute to the development and maintenance of chronic pain, including endogenous pain inhibition

Finan, Goodin, & Smith (2013). The association of sleep and pain: an update and a path forward. Journal of Pain, 14, 1539-1552.

What is the Temporal Daily Association Among Pain and Sleep?

- Examined the bidirectional and daily temporal association among sleep and pain

Hypotheses:

- Higher daily pain will be associated with poorer sleep
- Poorer sleep will be associated with higher next-day pain

Lewandowski, A.S., Palermo TM, et al (2010). Temporal daily associations between pain and sleep in adolescents with chronic pain versus healthy adolescents. *Pain*, 151:220-225.

Methods: Daily Measurements over 10 days

Actigraphy Data

- Sleep Duration: total sleep time
- WASO: time awake after sleep onset
- Sleep Efficiency: time in bed/time asleep (%)

Electronic Pain and Sleep Diary

- Reported on sleep, pain, and mood
- Custom PDA software
- Eliminates “hoarding” of answers; real time data capture
- Increases validity of responses and compliance (Palermo, Valenzuela & Stork, 2004)

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Temporal Associations Among Pain and Sleep

- **Daily pain did not predict nighttime sleep**
- **Nighttime sleep predicts next-day pain**
  - Total sleep time predicted next-day pain (p<.001)
  - Greater number of minutes awake after sleep onset (WASO) predict higher next-day pain (p<.05)
  - Sleep efficiency X group interaction (p<.05)

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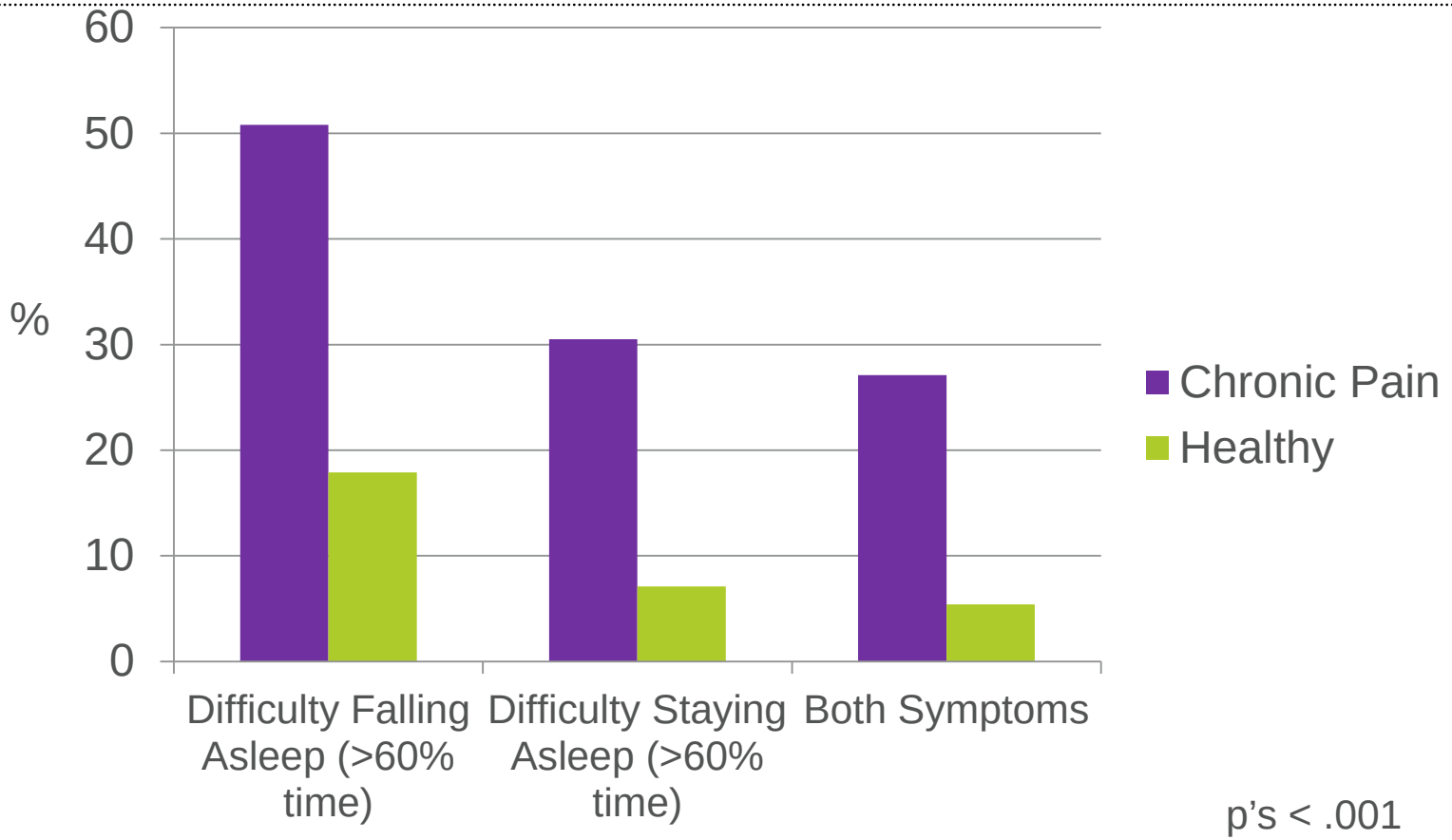
Common Sleep Problems

- Difficulty initiating sleep (delayed sleep onset)
- Difficulty maintaining sleep (prolonged nighttime awakenings)
- Inadequate duration of sleep for age (quantity of sleep)
- Poor sleep habits/sleep hygiene

Often a combination of these problems

Insomnia is Common in Adolescents with Chronic Pain



p's < .001

Palermo, T.M., Wilson, A.C., Lewandowski, A., Toliver-Sokol, M., Murray, C. (2011). Behavioral and psychosocial factors associated with insomnia in adolescents with chronic pain. Pain, 152:89-94.

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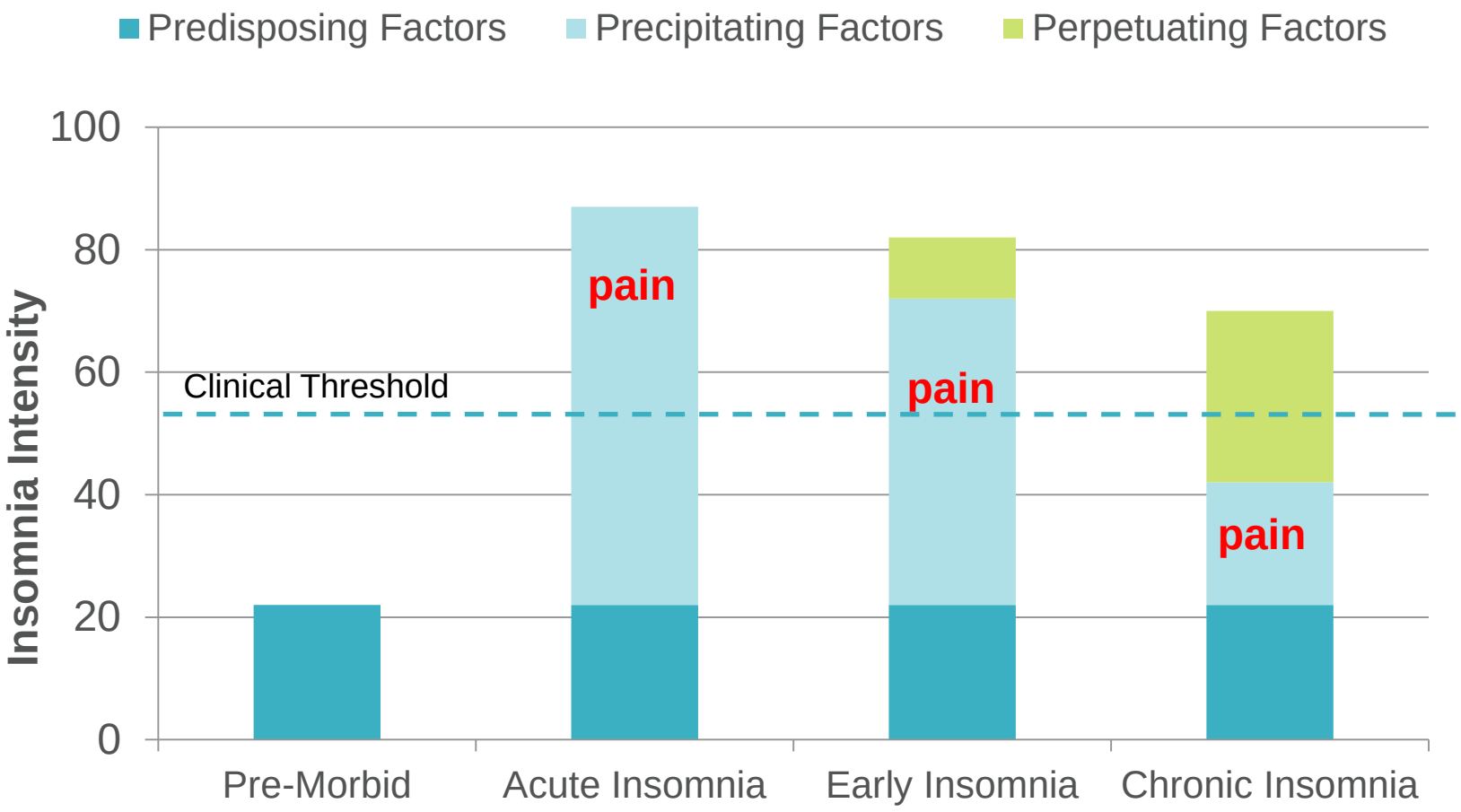
Insomnia has its own life



Glovinsky & Spielman, 1991

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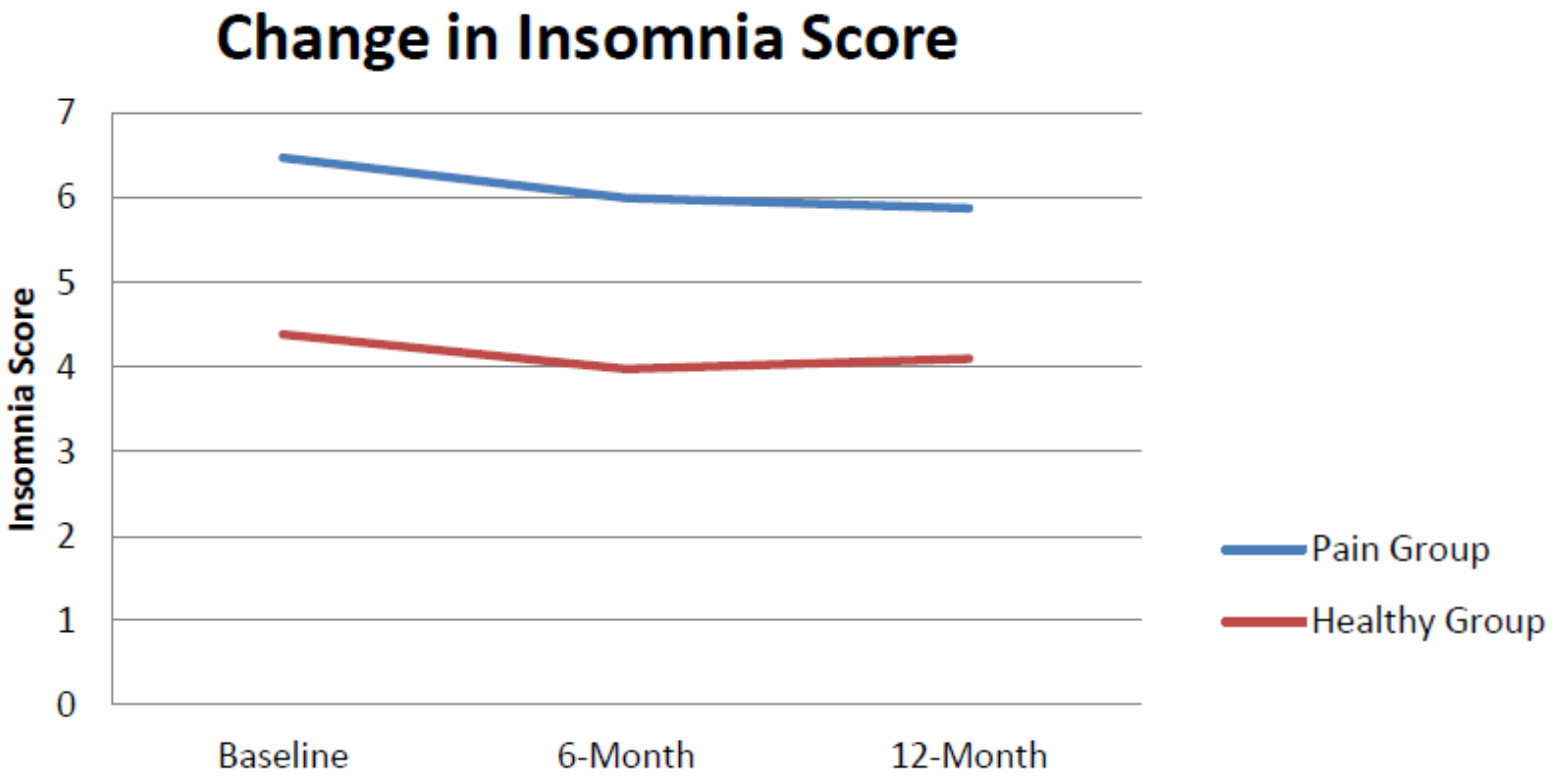
Trajectory of Insomnia Symptoms over Time (12 months)



Palermo, et al. (2012). J Pain.

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Predictors of Chronic Insomnia over 12 months

	Coefficient	95% CI	P value
Pain Group	1.52	0.90, 2.14	<0 .001
Puberty status	-0.15	-0.41, 0.11	0.262
Depression (CES-D)	0.05	0.01, 0.10	0.031
Sleep hygiene	-0.98	-1.62, -0.34	0.003
Pre-sleep arousal, cognitive	0.03	-0.03, 0.10	0.327
Pre-sleep arousal, somatic	-0.02	-0.11, 0.07	0.644
Pain intensity	0.08	-0.05, 0.21	0.208

- Pain is not a predictor of chronic insomnia

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Insomnia as a Predictor of Longitudinal Quality of Life and Activity Limitations

	Coefficient (95% CI)
PedsQL, total	-0.81 (-1.3, -0.31)**
PedsQL, psychosocial	-0.69 (-1.24, -0.14)*
PedsQL, physical	-1.10 (-2.00, 0.22)*
CALI, total	0.58 (0.04, 1.13)*

- Controlling for group, pain intensity, and depression
- *p < .05, ** p < .01

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Longitudinal Association of Insomnia Symptoms with Health Care Use

- Parents reported on medical visits (inpatient, outpatient, specialty care, etc)
- As expected, adolescents with chronic pain had significantly more medical visits at baseline and throughout the 12-month period compared to healthy youth ($p < 0.001$)
- In univariate regression analysis, persistent insomnia symptoms were associated with a greater number of medical visits ($p < 0.001$)
  - Controlling for group status (pain vs. healthy), insomnia symptoms approached statistical significance as a predictor of the number of medical visits ($p=0.055$)

Do Sleep Problems Improve with Pain Treatment?

- Sleep included as one of 8 core outcome domains (PedIMMPACT) recommended for measurement in clinical trials with youth with chronic pain
- Limited data from previous trials on sleep outcomes – no data from RCTs
- Hypothesis:
  - Sleep may improve in tandem with improvements in pain
  - Sleep may be independent from improvements in pain

Pilot Study: Sleep Outcomes following Cognitive-Behavioral Treatment

- RCT of Internet-delivered cognitive-behavioral therapy: 8-10 weeks treatment in core CBT skills (youth and parents)
- Main trial: Significant improvements in pain and activity limitations for the Internet tx group
  - Added a sleep assessment for subset of youth (actigraphy)

- Palermo TM, et al. Randomized controlled trial of an Internet delivered family cognitive behavioral therapy intervention for children and adolescents with chronic pain. Pain, 2009, 146, 205-213.

Pilot Trial

- Subset of youth from the RCT
- 33 youth ages 11-17 years, M age = 14.8 years, 69% female
  - Youth had abdominal, headache, or musculoskeletal pain present for at least 3 months, occurring daily for most of the sample
- N =16 Wait-list control condition
- N =17 Internet CBT condition

Baseline Sleep as a Predictor of Treatment Response

- Total sleep time was a significant predictor of post-treatment disability
  - Shorter duration of sleep at baseline predicted higher levels of post-treatment activity limitations (β=-.29, $p < .03$)
  - Poorer baseline sleep predicted less improvement in treatment

Fales, Palermo, Law, & Wilson (2014). Sleep outcomes in youth with chronic pain participating in a randomized controlled trial of online cognitive-behavioral therapy for pain management. Behav Sleep Med. 2014 Jan 31. [Epub ahead of print]

Sleep Interventions are not a Standard part of Pain Management

- Sleep is typically minimally assessed (e.g., how many hours do you sleep?)
- Pharmacological interventions (e.g., prescribing antidepressants or soporifics) more likely to be tried than behavioral interventions for the specific purpose of facilitating sleep
- Pain providers do not have training in sleep assessment or in implementing sleep interventions

Sleep Assessment

- Sleep history and patterns (Sleep schedule, consistency of routines)
- Sleep habits and physical environment (Caffeine, media in the bedroom)
- Parent behaviors (co-sleeping)
- Mood, affect, cognitions about sleep (Anxiety and worry about sleep loss, depressive symptoms)
- Nocturnal behaviors (Awakenings during the night, symptoms of sleep-disordered breathing)
- Daytime behaviors (Fatigue, napping)
- Medication regimens (Prescription medicines, timing, Over the counter medications)

Lewandowski, A.S., Ward, T.M., Palermo, T.M. (2011). Sleep problems in children and adolescents with common medical conditions. Pediatric Clinics of North America, 58:699-713.

Subjective Sleep Measures

- Amount, timing, regularity of sleep
- Sleep quality (e.g., Adolescent Sleep Wake Scale)
- Daytime sleepiness (e.g., Cleveland Adolescent Sleepiness Scale)
- Sleep habits and behaviors (e.g., Adolescent Sleep Hygiene Scale)
- Multidimensional Measures – Screening for Sleep Disorders:
  - Child Sleep Habits Questionnaire (CSHQ)
  - Sleep Disturbance Scale for Children (SDSC)

Unique Challenges in Youth with Chronic Pain: Additional Areas of Assessment

- Impact of medications on sleep
- Lack of routine/schedule
  - Often not in school; irregular sleep/wake times
- Physical inactivity
  - Increased sedentary activities
  - Increased screen time
- Parent responses
  - Parent protectiveness – associated with poorer pain coping

Resources: Sleep Interventions for Chronic Pain

- ***Cognitive-behavioral therapy for chronic pain in children and adolescents.*** Palermo, T.M. (2012). New York: Oxford University Press.
  - Appendices are available for printing at: http://www.seattlechildrens.org/research/childhealth-behavior-and-development/palermolab/selected-recent-publications/
  - Audio files of relaxation exercises

- ***Managing Your Child's Chronic Pain***. By Tonya M. Palermo and Emily F. Law. Oxford University Press. [forthcoming in April 2015]

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Sleep Interventions

- Sleep hygiene education
  - Proper amount of sleep (8-9 hours for teens)
  - Timing of sleep
  - Consistency between days
- Management of co-sleeping
  - Extinction/graduate extinction
  - Operant strategies
- Interventions for insomnia
  - Modifying sleep habits
  - Stimulus control/sleep restriction
  - Cognitive strategies

Example of Sleep Hygiene Interventions

- Make a schedule to allow for 9 hours of nightly sleep
- Remove television and electronics from bedroom
- Establish positive bedtime routine and waking routine
- Use alarm clock to awaken in the a.m.
- Keep a consistent weekend/weekday sleep schedule (no more than 1-2 hour variation in morning wake time)

CBT- Insomnia Treatment

- CBT recommended for treatment of adult insomnia - practice parameters (AASM)
  - Stimulus control/sleep restriction
  - Cognitive strategies
  - Relaxation/deep breathing
  - Sleep hygiene education
- CBT-Insomnia used successfully in adult pain populations
  - Behavioral insomnia treatment improved sleep in multiple pain populations such as fibromyalgia and osteoarthritis, e.g., Vitiello, Rybarczyk, Von Korff, & Stepanski (2009)
- Few published trials of CBTi in children and adolescents (although used often clinically)

Sleep Restriction and Stimulus Control

- Limit the amount of time you spend in bed to the actual amount of time you sleep.
  - Sleep titration based on sleep diary patterns
- Go to bed only when you are sleepy, and no sooner than your target bedtime.
- Use the bed and bedroom for sleep only. Sleep in your own bed.

Sleep Restriction and Stimulus Control

- Allow yourself at least 30 minutes to unwind before bedtime
- Get out of bed and go to your “nesting place” if you are unable to fall sleep after 15 to 20 minutes. You can do boring activities there (reading, etc)
  - Return to bed only when sleepy again. Repeat this step as needed during the night.
- Regular Wake Up: get out of bed at the same time each morning
  - No more than an extra 1-2 hours on weekends
  - Do not take daytime naps (or limit)

Summary and Future Directions

- Children and adolescents with chronic pain evidence impairments in sleep quantity and quality and may contribute to chronicity and disability associated with pain
- Insomnia symptoms are not transient
- ***Sleep is a potential modifiable target that may serve to either prevent or interrupt a cycle of persistent, disabling pain***.
- Although effective at decreasing pain and disability, pain treatment does not appear to modify sleep
- Future research testing more intensive sleep interventions is needed in this population