



UNDERSTANDING SLEEP DEVELOPMENT

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Outline



1. Normal sleep development in children
2. Sleep strategies
3. Sleep and Autism

Why do we sleep???

- Sleep regulation is a “two process” system
 - Process S (homeostatic): Controls length/depth of sleep
 - “somnogens” (adenosine, cytokines) build up during the day to create “sleep pressure”
 - Process C (circadian rhythm): Controls sleep-wake cycles
 - SCN: suprachiasmatic nucleus of hypothalamus triggers pineal gland to release melatonin
 - Controlled by “zeitgebers” or environmental cues
 - Light = LOW melatonin Dark = HIGH melatonin

Sleep Basics

- Sleep consists of two types of sleep: REM and Non-REM
- **Non-REM:** Stages 1 - 4 (*Light to deep sleep stages*)
- **REM:** “dreaming”
- Children and Adults have very different sleep patterns!

Infancy

Cycles ~ 50 mins

50% of sleep is REM

NREM mostly SWS

Childhood

gradually increases

gradually decreases

SWS peaks

Adulthood

Cycles ~100 mins

25% of sleep is REM

puberty 40-60% SWS drop

“Is this normal sleep?”



“Our baby is a week old and he sleeps so much during the day. He doesn’t know to sleep at night! What are we doing wrong?”

YES, this is normal for a newborn!



- Newborn Sleep
- Day sleep time = night sleep time
 - Average 8.5 hours at night and 5.75 during the day
 - Sleep is in 1- 4 hour intervals
- **Day/Night Differentiation** begins between 6 -12 weeks
 - Parents notice nocturnal sleep periods increase

“Is this normal sleep?”



“My 6 month old is STILL not sleeping through the night!”

Yes, this is normal sleep!

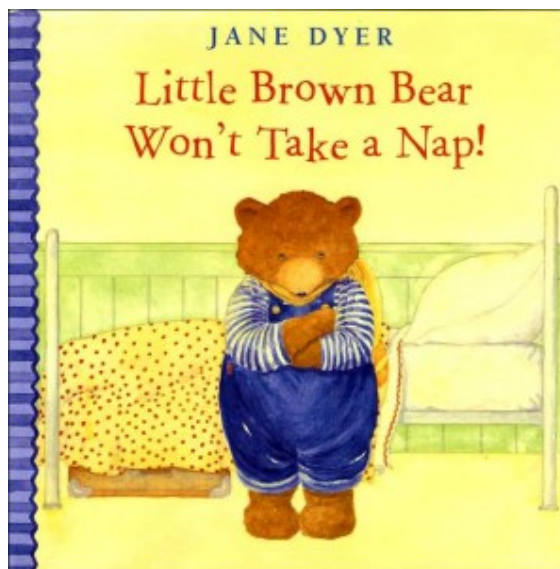


- **Sleep consolidation** (*sleeping through the night*) occurs at 9 months in 70-80% of infants
- **Infants: Total sleep is less (12 - 15 hours)** but sleep intervals are longer
 - **4 months**: Sleep 14 - 15 hours/day; ~ 4 hour intervals
 - **6 months**: Sleep 13 - 14 hours/day; ~ 6 hours

Normal Sleep Developmental Changes

- **Newborns:** Sleep is controlled by hunger and satiety. Sleep close to 20 hours a day in 1 - 4 hour periods.
- **Infants:** Sleep intervals start to increase
 - **4 months:** Sleep 14 - 15 hours/day; ~ 4 hour intervals
 - **6 months:** Sleep 13 - 14 hours/day; ~ 6 hours
- **Toddlers:** Sleep 12 hours; nighttime 9.5-10.5, naps 2-3 hrs
- **Preschool:** Sleep 11-12 hours; single nap to no nap
- **Middle childhood:** Sleep 10-11 hours
- **Adolescents:** Sleep 9 hours

“Is this normal sleep?”



“Is it normal that our toddler doesn't seem to need naps? She sleeps 10 hours each night but won't stop playing at naptime no matter what we do!”

“No, this is probably not normal sleep!”



- Napping:
- **Infants (0 - 12 mo):** Nap twice a day, between 1 - 2 hours
- **Toddlers (12 - 36 mo):** One LONG nap 18 months, 1.5 - 3 hours
- **Preschool (3- 5 years):** No more naps, 25% of 4 yrs and 15% of 5 yr olds still nap

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2. The Zuckerman Parker Handbook of Developmental and Behavioral Pediatrics for Primary Care, 3rd ed., Chapter 75 Sleep Problems, copyright 2011 Lippincott Williams & Wilkins
3. www.zerotothree.org/child-development/sleep

BEHAVIORAL INSOMNIA OF CHILDHOOD

Tyrone Chan, MD

Overview



- Common causes of behavioral insomnia in healthy children
- 4 management techniques for sleep-onset association disorder
- Evidence

Causes of Behavioral Insomnia of Childhood

- **Sleep-onset association disorder**
 - ▣ Child can sleep only under certain conditions or associations
- **Limit-setting sleep disorder**
 - ▣ Parent does not set consistent bedtime rules or enforce a regular bedtime, concedes to requests for attention
- **Psychophysiological insomnia**
 - ▣ Child develops conditioned anxiety around falling or staying asleep
- **Sleep anxiety**
 - ▣ Nighttime fears, increased emotional arousal

General Approach



- Gather a good history: Medical and developmental history, sleep patterns, sleep habits, polysomnographic evaluation if necessary
- Identify parental concerns
- Clarify mutually acceptable treatment goals
- Actively explore opportunities and obstacles
- Ongoing communication of issues and concerns

Extinction



- Parent puts the child to bed then ignores the child until a set time (while monitoring for illness or injury)
- Child learns that its parents' only response to crying is for them to come, check, and reinforce their presence
- Child develops “self-soothing” skills to fall asleep independently

1. Unmodified Extinction

2. Graduated Extinction

3. Extinction with Parental Presence

Unmodified Extinction

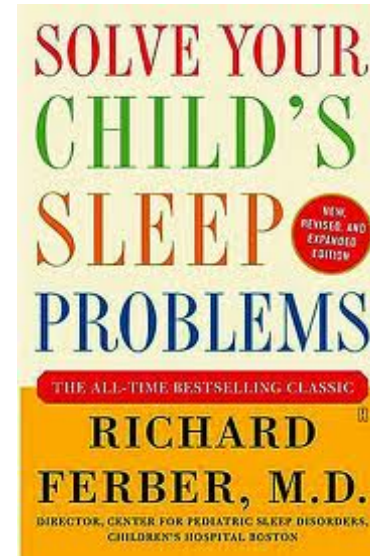


- Parent puts child to bed and then ignores the child until the next morning
- Parent continues to monitor for illness and injury, but ignores crying, tantrums, and calling

Graduated Extinction

(aka “Ferberizing”, “Cry it Out”)

- Parents perform periodic “checks” at successively longer time intervals during the sleep-wake transition



Graduated Extinction

- Parent starts with a nurturing bedtime routine
- When child is sleepy, parent places him/her in the crib and leaves the room even if he/she starts crying
- After 4-5 minutes, parent re-enters the room only to assure the child of their presence with soft voices and patting (15 seconds – 1 minute)
- Parent leaves again and wait 8-10 minutes, then repeats the same procedure
- Parent repeats at increasing time intervals, adding 5 minutes each time
- If done successfully, the child will have adapted within the first couple of weeks

Extinction with Parental Presence



- Parent sleeps in the child's bedroom, but not in the same bed for 1 week
- Parent “fakes” sleep and ignores inappropriate child behaviors
- After 1 week, parent sleeps in a separate room
- Easier for parents to tolerate, more consistent

Criticisms



- ❑ Perceived as cruel and would create emotional problems such as anxiety, fear, and a sense of insecurity
- ❑ Health risks such as increased heartbeat and elevated blood pressure from excessive crying
- ❑ Very stressful and difficult for parents to be consistent
- ❑ Extinction response bursts may occur

Evidence: Extinction



- Several randomized, well-controlled group trials highly support efficacy for bedtime resistance, night waking, and sleep continuity (stronger research for unmodified vs. graduated)
- Some evidence indicates that incremental increases between checks may not be necessary

Mindell JA, et al. Behavioral Treatment of Bedtime Problems and Night Wakings in Infants and Young Children. *American Academy of Sleep Medicine*. Vol. 29, No. 10, 2006.

Positive Routines / Faded Bedtime



- Relies on stimulus control as the primary agent of behavior change
- Teaches appropriate pre-bedtime behaviors and sleep onset skills
- Focuses on increasing appropriate behaviors rather than reducing inappropriate ones

Positive Routines / Faded Bedtime



- Parent develops a bedtime routine that includes activities the child enjoys
- Temporarily delay bedtime to ensure rapid sleep initiation, then establish appropriate cues for sleep onset
- Pair technique with positive parent-child interactions
- Once the pattern is well-established and the child is falling asleep quickly, bedtime is gradually moved earlier until the goal time is reached

Evidence: Positive Routines



- 2 studies concluded that this technique is rapid and effective
- A positive alternative to extinction, but less tested

Mindell JA, et al. Behavioral Treatment of Bedtime Problems and Night Wakings in Infants and Young Children. *American Academy of Sleep Medicine*. Vol. 29, No. 10, 2006.

Scheduled Awakenings



- Parents awaken and console their child 15-30 minutes before a typical spontaneous awakening (after assessing a baseline for awakenings)
- Parent-induced awakenings are followed by rocking or nursing the child back to sleep
- Scheduled awakenings are then faded out by increasing the time span in between awakenings

Evidence: Scheduled Awakenings



- Slightly more complicated to study
- May take several weeks rather than days
- Not an appropriate treatment for young children with bedtime struggles

Mindell JA, et al. Behavioral Treatment of Bedtime Problems and Night Wakings in Infants and Young Children. *American Academy of Sleep Medicine*. Vol. 29, No. 10, 2006.

Parent Education/Prevention

- Parent education programs focus on early establishment of positive sleep habits
 - ▣ Bedtime routines
 - ▣ Consistent sleep schedule
 - ▣ Parental handling during sleep initiation
 - ▣ Response to nighttime awakenings
 - ▣ Parent education programs focus on early establishment of positive sleep habits
- Starts during prenatal period or during first 6 months
- Focuses on prevention rather than intervention

Evidence: Parental Education



- May set the standard as the most economical and time-efficient approach
- Not only statistically significant, but also clinically meaningful to parents who want to teach their newborn sleep skills

Mindell JA, et al. Behavioral Treatment of Bedtime Problems and Night Wakings in Infants and Young Children. *American Academy of Sleep Medicine*. Vol. 29, No. 10, 2006.

Summary



- Several well-defined behavioral approaches produce reliable changes in bedtime problems and night awakenings in children (94% of studies produced improvement)
- Unmodified Extinction and Parent Education have the strongest empirical support
- Graduated Extinction, Positive Routines/Faded Bedtime, and Scheduled Awakenings are also supported
- Because of methodological differences in the studies, it is difficult to suggest that one technique is superior to another

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SLEEP AND AUTISM

Taylor Loudon, MD

Important Numbers

- Studies have reported sleep disturbances in 44-83% of children (ages 3-15) with ASD
 - Hering et al., 1999; Richdale and Prior, 1995; Taira et al., 1998
- One Study out of Tokyo
 - Sleep disturbances in 56% of individuals
 - 90% of problems starting in infancy
 - Taira et al. 1998
- Prevalence of Chronic Insomnia
 - Ten times higher prevalence in ASD
 - Sivertsen et al. 2011

Important Number

- Sleep disturbances in children with ASD continue into adolescents and early adulthood
 - ▣ Less frequently reported by caretakers
 - Bjorvatn and Oyane 2005
- Develop more sleep problems over time
 - ▣ Incidence rate of 37.5% when compared to control group 8.6%
- Problems tend to be more persistent
 - ▣ Remission rate of only 8.3% when compared to 52.4% in control group
 - Sivertsen et al., 2011

Problems



- Children with Autism tend to suffer more problems with sleep onset and maintenance more than in other areas
 - Patzold et al., 1998; Krakowiak et al., 2008;
- The lower the IQ the more difficulty with sleep

Problems



- Decreased total sleep time
 - ▣ In individuals 5 to 16yo
 - ▣ Average of 7h 30mins in individuals with autism
 - ▣ Average of 8h 43mins in control group
 - Diomedi et al., 1999

- ▣ Two more recent studies refute this claim
 - Sleep time was not decreased just sleep offset was delayed
 - Hering et al., 1999 and Schreck and Mulick, 2000

Problems



- Decreased Sleep efficacy
 - Sleep as a percentage of time in bed
 - Study of individuals age 12-24
 - 81% in individuals with Autism
 - 92% in controls
 - Diomedi et al. 1999

Problems

- Increased number of nocturnal awakenings per night
 - ▣ 11.4 awakenings per night in Autistic group
 - ▣ 4.2 awakenings per night in control group
 - Diomedi et al., 1999
- Increase in early morning awakenings
 - Todjman et al, 2004
- Increased problems with parasomnias and sleep disordered breathing
 - ▣ Parasomnias involve abnormal and unnatural movements, behaviors, emotions, perceptions, and dreams that occur while falling asleep, sleeping, between sleep stages, or during arousal from sleep
 - Hoffman et al., 2006

Problems



- However, it was noted in the study performed by Hoffman that as the children with Autism age parents faced few struggles with bedtime resistance and sleep anxiety.

Importance



- Several studies have shown significant associations between sleep problems and problematic behaviors in children with ASD
 - Patzold et al. (1998)

Risk Factors



- In a longitudinal study by Sivertsen and others, they followed children between the ages of 7 and 9 years of age and 11 and 13 years of age with ASD in 2011 (screened with ASSQ)
 - ▣ Confirmed earlier findings with sleep and autism
 - ▣ Identified other cofactors
 - Hyperactivity as measured by SDQ
 - Lower socioeconomic status (not typical in other reports)
 - Male Gender
 - ▣ In contrast to other studies, showed no link between level of mental retardation and sleep

Theories for differences in sleep



- Importance of social cues in the regulation of diurnal rhythm
 - Aschoff et al. 1971; Ehlers et al. 1988
- Individuals with autism have higher sensitivity to photoperiodic changes
 - Hayashi, 2001
- Increased levels of anxiety and fear
 - Nelson, 2001
- Differences in Melatonin

Melatonin



- Produced in the pineal gland from serotonin
- Plays a key role in regulating human circadian rhythms including sleep wake and body-temperature cycles.
- Secreted almost entirely at night with peak secretion around 2am
- Powerfully suppressed by light via the retinohypothalamic tract
- This system is fully developed in humans around 3 months of age

Melatonin and Autism



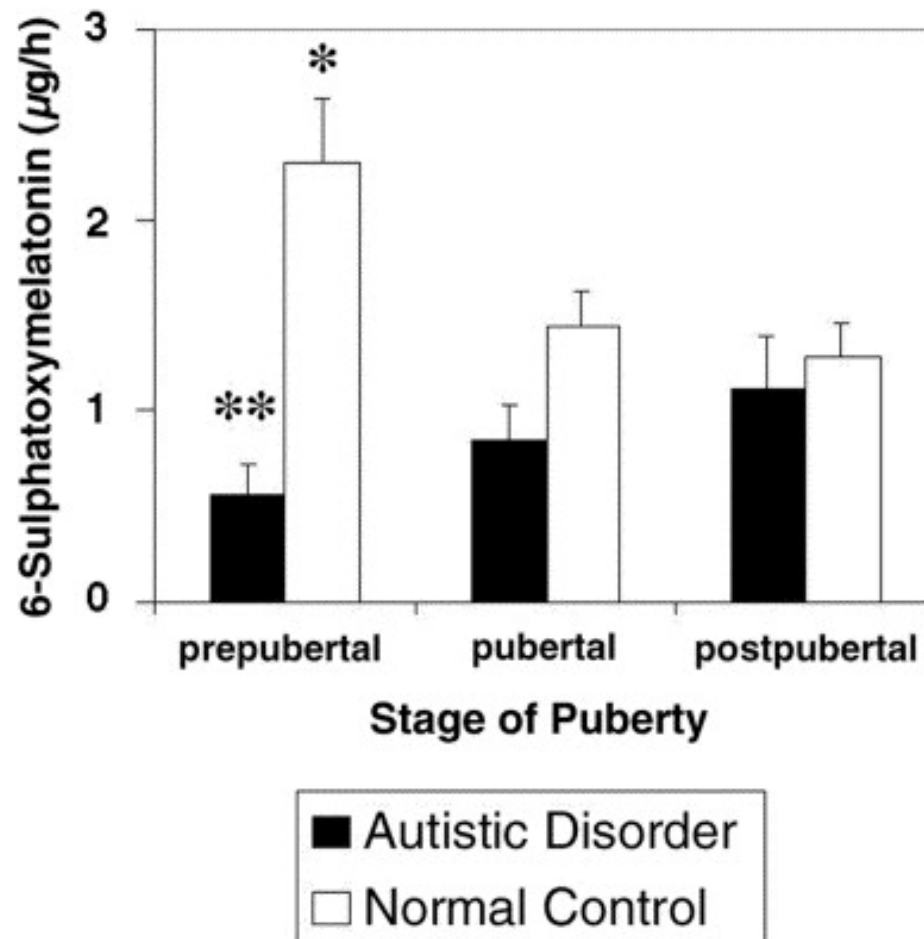
- Most studies have been around the topic of melatonin and developmental disorder associated with mental retardation
- 4 studies on autism and melatonin secretion

Melatonin and Autism



- Last study measured UO of prominent melatonin metabolite 6-SM.
- Nocturnal 6-SM excretion rate was significantly and substantially lower in patients with autistic disorder than in normal comparison subjects
- Significantly negatively correlated with the severity of autistic impairments in verbal communication and play.
- Significantly positive correlation between IQ and 6-SM levels

Melatonin and Autisms



Possible Treatments



- Melatonin
 - ▣ Controlled release
- Ramelteon (Rozerem)
 - ▣ High affinity melatonin receptor agonist
- Antihistamines
- A-2 agonist
 - ▣ Clonidine and guanfacine
- Mirtazapine (Remeron)
 - ▣ Noradrenergic and specific serotonergic antidepressant (NaSSA)
 - Myers et al 2007

Problems with older studies



- Most used very wide range of ASD with wide range of symptoms with limited definitions of autism.
- Used online parent support groups to recruit participants.
- Small studies

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