The Golden Tie –
Understanding and Supporting
Healthy Sleep in FASD

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Disclosure

• I have no conflicts of interest to declare
FASD, Sleep and the Whole Body...

“Sleep is...that golden chain that ties health and our bodies together”
(Thomas Dekker, English dramatist, 1572-1632)
Objectives

1. Review insomnia in FASD
2. Relate the biology of sleep disruption in FASD to clinical management
3. Discuss integrative approaches to sleep disruption in FASD
Typical consult

• “Please see this child with FASD and poor sleep. Family is exhausted.”
Example

• 3 year old boy with PAE/FASD referred because of frequent night wakenings

• Hx: “restless sleeper since birth”

• SHx: single mother, shift worker (evenings), lives in side by side, neighbours and family provide daycare

• Sees father irregularly on weekend, different schedules at his place
Case

• Sleep: child supposed to go to bed around 10pm when mother comes home from work but often takes 2-3 hours to fall asleep

• Frequently falls asleep on the LR couch in front of the TV “to calm him”; mother later transfers him to his room

• As he falls asleep he often rocks, chews bedclothes
• When he wakens at night he screams +++

• Mother finally allows him to sleep with her saying she’s afraid neighbours will call CFS

• Very aggressive and dysregulated during the day
Growing up....

• Child at 8 years old
  • In school, frequently tired and can’t concentrate
  • Very restless, hyperactive – just started on a stimulant for ADHD
  • Still can’t sleep – rocks himself and chews on his sheets

• Youth now 15 years
  • Tired during the day and has trouble concentrating
  • Up at night, friends, videogames – can’t settle
  • Using marijuana to help him relax and sleep
“Child is not sleeping”

• Sleep is a complex neurodevelopmental and integrative process
  • Memory
  • Cognition
  • Self-regulation

• Range of normal sleep and impairments related to individual biology, genetics, and environment
What is Insomnia?

• DSM-5 and ICSD-3 criteria require:
  • subjective report of a sleep complaint (difficulty initiating or maintaining sleep, or early morning awakening)
  • at least one related daytime impairment (fatigue, attention impairment, mood disturbance, or impaired performance)

• Chronic -- at least 3 times per week over a period of 3 months
Sleep in FASD: Poorly understood

• Sleep difficulties common: 85%
  • In keeping with other children with developmental disabilities (Chen et al. 2012; Robinson-Shelton and Malow 2016)

• Complex:
  • Shorter sleep
  • More frequent night wakenings
  • Elevated parasomnias
  • More frequent sleep anxiety (Wengel et al. 2011; Chen et al. 2012)
Recognizing Fatigue in Children with FASD

- may become more hyperactive
- may become more disorganized
- may become more aggressive
- increased sensory symptoms
- previous behavioural strategies aren’t working
Risk factors for sleeplessness in FASD

• Physical factors – whole body
• Sensory differences
• Behavioral challenges
• Learning difficulties
• Impaired communication

• Parent/family/caregiver behaviors --sleep in family and community context
Contributors to sleep disruption in FASD
(Hanlon-Dearman, Chen, Carmichael-Olsen, 2018)

• Physiologic changes resulting from PAE
  • sleep architecture
  • circadian physiology
  • respiratory control

• Lasting sequelae in health and daytime function
  • affected children
  • chronically sleep disrupted/deprived parents

• Impact on interpersonal relationships restructured by emotional, behavioral, and cognitive perceptions of a “difficult” sleeper
FASD Neurobehaviour & Sleep/Insomnia

- alcohol is a neurobehavioural teratogen
- adaptive dysfunction often severe and out of keeping with cognitive functioning

- PAE damage to **global integrative neurological processes**
  - reduced inhibitory control
  - impulsivity
  - attention deficits
  - impaired information processing
  - sensory dysregulation
  - problems in regulation of arousal

Sleep dysregulation -- insomnia
• Sleep is a self-regulatory process

• Short sleep reduces affective stability and increases emotional reactivity (Anderson 2011, Franzen 2009)
  • Disrupted prefrontal cortical functioning

• Sleep fragmentation associated with higher waking cortisol, increased behavioural reactivity and decreased inhibitory control in toddlers (Scher, 2010)
  • Influence on HPA axis

• Poor sleep has been related to increased impulsivity and aggression (Kamphius, 2014)
Sleep and PAE:
Early neurologic disorganization impacts long term development

Children
• EEG changes in infants with PAE correlated with subsequent motor and cognitive development (Ioffe et al, 1988; Ioffe et al, 1990)

Adults
• “...sleep deprivation, sleep inefficiency, and impaired sleep plasticity may be a continuing, lifelong insult following early EtOH exposure. This link is most pronounced with memory impairment” (Wilson et al, 2016)
Does Sleep Matter? (Mindell & Moore, 2018)

• Sleep’s impact on next day functioning

• Complex relationship between sleep and development
  • Differential biological reactivity leading to poorer developmental outcomes with poorer sleep, but better outcomes if sleep can be improved

• Are some children less “resilient” to insufficient or disrupted sleep – PAE?

• Best measures of sleep quality may be day-to-day functioning and skill development in family context
Supporting sleep impacts everyone

- Social adaptive function (Streissguth et al. 2004)
- Caregiver and family function (Olson et al. 2009b)
- Physical health problems (Popova et al. 2012, 2016)
- Opportunities to maximize functioning and reduce morbidity in FASD are critical for affected individuals, their families, and communities
A Quick Sleep Primer: What Systems are Involved

Sleep is a neurologically mediated system

- Neurotransmitter systems
  - Interacting, overlapping across anatomic systems
- Brainstem/cortical systems
  - Pons – thalamus – cortex
  - Variety of brainstem and hypothalamic nuclei – Reticular activating system from which various neurotransmitters project to the cortex
- Cognitive Affective Systems
  - Overactivation of arousal system/emotion regulating system/parts of cognitive system is accompanied by reduced activation of prefrontal cortex and caudate

**THE ANATOMY OF SLEEP**
The ebb and flow of neurotransmitters switches our brains between sleep and wakefulness in carefully regulated cycles. By Mark Peplow.
A Quick Sleep Primer: What Systems are Involved

- Sleep Wake Regulating:
  - Homeostatic Drive
  - Circadian Timing
  - Influences of melatonin and adenosine

Two Process Model of Sleep Regulation
Riemann, Lancet 2015
A Quick Sleep Primer: What Systems are Involved

• Sleep Wake Switching
  • “sleep switch”
  • “wake stabilizing”

(Luthi et al, 2016) https://doi.org/10.1016/j.cub.2016.06.059
Final common pathway of insomnia

- Hyperarousal
  - Overactivity of the arousal systems, hypoactivity of the sleep-inducing systems, or both
  - Imbalance of sleep-wake regulation

- All systems interact and overlap (Lancet, 2015)

(Morin et al, Nature Reviews, 2015)
Sensory processing

• Sensory systems
  • retinotopic -- visual
  • somatotopic – motor
  • tonotopic – sound
  • odotopic - smell
  • gustatopic – taste

• Development is dependent on early experience/exposures

• In term infants, cortical regions, thalamus, basal ganglia, and brainstem are more often affected by adverse events
Sensory Processing and Sleep

- sensory processing is a critical part of sleep induction and maintenance
  - downregulation of the reticular formation (area that regulates alertness) in order to fall asleep
  - filtering of irrelevant sensory information in sleep balanced with maintenance of ability to react to important stimuli (modulation)
  - overlap of CNS centres regulating sleep, attention, and sensory processing

Jones, 2018
FASD & Sensory Physiology

• Sensory processing disorders involve primary and higher order cortical regions
  • posterior decrease in white matter microstructural integrity (Owen, 2013)

• Alcohol impacts spatial organization, synchronous functioning, and acuity of these systems (Sadrian, 2013)

• PAE -- atypical sensory responses
  • GABA enhancement (Wu, 2014)
  • disruption of sensory filtering/gating (Skylar, 2014)
Sleep anxiety and sensory processing

• Alterations in sensory processing associated with increased sleep anxiety and associated arousal sensitivity (Wengel, 2011)

• Biology of anxiety, FASD, and altered stress responsivity (Biggio et al, 2018; Kozanian et al, 2018; Rouzer et al, 2018)
  • impacts of adversity, trauma, poor EF, genetic factors
  • neurobiology of stress/toxic stress – HPA axis, heightened autonomic responsivity, GABA/neurotransmitter modulation

• Increased arousal and increased multisensory sensitivity – may correlate with sleep related anxiety
Understanding Sleep Difficulties in Young Children with PAE/FASD (Wengel et al, 2011)

• N=31 (19 FASD, 12 controls)

• Methods:
  • Children’s Sleep Habits Questionnaire (CSHQ)
  • Sleep log
  • Sensory Profile
  • Actigraphy

(Source: http://www.minimitter.com/Products/Actiwatch/index.htm)
Disrupted Sleep in Young Children with FASD

Figure 1: Children's Sleep Habits Questionnaire Mean Scores in Children with FASD

Wengel, Fjelsted, Hanlon-Dearman, 2011
Significant Correlations Between CSHQ and Sensory Profile

**Bedtime Resistance**
- Fine Motor Perception ($r = .573$)

**Sleep Onset Delay**
- Behavioural Outcomes of SP ($r = .621$)

**Sleep Duration**
- Sensory Sensitivity ($r = .639$)

**Night Wakening**
- SP Affecting Endurance/Tone ($r = .581$)
- Low Endurance/Tone ($r = .581$)
- Behavioural Outcomes of SP ($r = .736$)

**Parasomnia**
- Registration ($r = .543$)
- Mod of Visual/Emotional Input ($r = .662$)
- Emotional/Social Response to SP ($r = .610$)
- Behavioural Outcomes of SP ($r = .522$)

**CSHQ Total**
- Behavioural Outcomes of SP ($r = .613$)
- Sedentary ($r = -.543$)
Sleep Architecture in FASD
(Chen et al, 2012)

• N=33
• FASD + elevated scores on CSHQ -- offered PSG

• Results:
  • 85% of children with FASD scored above clinical cutoff for sleep disorders on CSHQ, esp. pediatric insomnia
  • PSG (n=5) showed mild sleep disordered breathing and fragmented sleep with elevated non-respiratory arousal indices.
Sleep and Circadian Rhythm  (Goril et al, 2016)

• PSG & DLMO in school age children with FASD (N=36, ages 6-18 years)

• High prevalence of sleep disorders (58%)
  • Parasomnia (27.9%)
  • Insomnia (16.8%)
  • Sleep apnea (5.6%)

• PSG: high rates of sleep fragmentation (19.5%), lower sleep efficiency

• 79% abnormal melatonin profile
Model of PAE, Sensory Dysregulation, Sleep Disorder and Behaviour

- Prenatal Alcohol Exposure
- Toxic Stress

CNS Disruption
- Neuronal Disruption
- Neurotransmitter Dysfunction
- Disrupted Regulatory Systems

Disrupted Sensory Modulation
- Underresponsive
- Overresponsivity
- Disordered systems

Disrupted Sleep/Wake Systems
- inability to downregulate
- Increased arousal
- Increased wakefulness

Dysregulation & Maladaptive Behaviour
- fatigue
- cognitive disorganization
- anxiety
Treating Sleep in FASD
Managing complex symptoms

• Goal is to reduce burden of care
• May need to address multiple areas at once

• Special care:
  • Child with history of trauma
  • Child in and out of hospital
  • Child newly adopted
General Considerations

- Team approach – child, family, therapists, physicians, other caregivers
- Treat early to avoid secondary behavioural/family consequences
- Comprehensive developmental evaluation to identify strengths, weakness and overall profile
- Manage complex symptoms
  - Mental health & behaviour
- Environmental evaluation
- Sleep hygiene needs to be individualized
- Melatonin; other medications
Sleep Health (adapted from Jan, 2010)
Circadian Considerations

“Biological clock” – 24 hour clock

generated by suprachiasmatic nucleus (SCN) in the hypothalamus
contribution of light receptors found in the retina which have a pathway (the retinohypothalamic tract) leading to the SCN
melatonin – linked to memory and learning

Linked with brain wave activity, hormone production, body temperature, cell regeneration and other biological activities

Regulation of day and night dependent on
internal rhythm
external regulators eg. light, temperature
Circadian Approaches

• “A good night’s sleep begins first thing in the morning” (M. Kurchinka)
  • integrated regulation of day and night hours incl. both light and time
  • eg. bed time, wake time, ambient light in morning and at night, regularity of rhythm

• Integration with behavioural and sensory approaches
  • methods for waking in the morning
  • what to serve for breakfast
  • regularly scheduled movement breaks and “heavy work”
  • calming snacks and deep pressure input as tolerated at bedtime
Sleep Hygiene

• Principles based in science and behaviour

• Individualize principles based on needs of child and family depending on:
  • cognitive abilities
  • health issues
  • temperament and behavioural considerations
  • sensory considerations
  • environmental considerations
  • family needs
Sleep Hygiene

- Establish a bedtime routine
- Avoid big meals close to bedtime
- Avoid caffeine
- Comfortably cool bedroom
- Dark bedroom
- Quiet bedroom
- No TV/media in bedroom

Visual supports from the Autism Speaks ATN/AIR-P Sleep Tool Kit.
Sleep Hygiene

- Exercise in morning or late afternoon
- Ensure adequate exposure to natural light
- Maintain emotionally stable and positive tone
- Associate bed and bedroom with sleep
- Use of a transition object
- Review medications with physician prn

The circadian clock. Illustration by fuzzyscience
https://www.pbs.org/newshour/science/science-sleeping-in
Sleep Support for Parents/Caregivers

• important to address sleep needs of parents

http://babyblues.com/comics/october-6-2013/
Sleep Support for Parents/Caregivers

• important to address emotional and physical needs of parents
• parent sleep patterns are linked to children’s patterns – may be in sync or not in sync
• parental TV/screen time should be addressed
• what are parents using to cope – functional, dysfunctional patterns

http://babyblues.com/comics/august-17-2013/
Sensory Strategies -- Environment

- **Visual**
  - calm and uncluttered bedroom
  - dark and quiet bedroom
  - “nesting” – eg. small tent

- **Auditory**
  - white noise
  - quiet

- **Tactile**
  - pajama fabric, tags
  - sheet fabric, pillows

- **Proprioceptive**
  - deep pressure/massage
  - sleeping bag
  - surrounded by stuffies

- **Vestibular**
  - slow rhythmic linear rocking

- **Olfactory**
  - laundry soap
  - toothpaste
  - bath soap, shampoos
  - ambient air
First Line Approach to Insomnia (adults)

• Cognitive Behavioural Therapy....
  • Available...
  • Appropriate...

• Eg. in hyperarousal syndromes (eg PTSD), combination of pharmacotherapy and CBT may be required (Akinnusi et al 2019)
Cognitive–behavioural therapies for persistent insomnia

Sleep restriction (level 1a*)
A method designed to restrict time spent in bed (the sleep window) as close as possible to the actual sleep time, thereby strengthening the homeostatic sleep drive. This sleep window is then gradually increased over a period of a few days or weeks until optimal sleep duration is achieved.

Stimulus control (level 1a)
A set of instructions designed to reinforce the association between the bed and bedroom with sleep and to re-establish a consistent sleep–wake schedule:
- Go to bed only when sleepy
- Get out of bed when unable to sleep
- Use the bed or bedroom for sleep only (no reading or watching television, and so on)
- Arise at the same time every morning
- No napping

Relaxation training (level 1b)
Clinical procedures, for example progressive muscle relaxation, aimed at reducing autonomic arousal, muscle tension and intrusive thoughts that interfere with sleep. Most relaxation procedures require some professional guidance initially and daily practice over a period of a few weeks.

Cognitive therapy (level 2b when used alone)
A psychological approach using Socratic questioning and behavioural experiments to reduce excessive worrying about sleep and reframe unhelpful beliefs about insomnia and its daytime consequences. This therapy usually requires a trained and skilled clinician. Additional cognitive strategies might involve a paradoxical intention technique to alleviate performance anxiety that is associated with the attempt to fall asleep.

Mindfulness-based interventions (level 3b)
The core principle of mindfulness-based interventions is non-judgemental awareness in the present moment. It is derived from meditation, and its most common variant is mindfulness-based stress reduction.

Sleep hygiene education (insufficient evidence)
General guidelines about health practices, including diet, exercise and substance use, and environmental factors, such as light, noise and excessive temperature, that might promote or interfere with sleep. This might also include some basic information about normal sleep and changes in sleep patterns with ageing.

Cognitive–behavioural therapy (level 1b†)
A multimodal intervention that combines some of the above cognitive and behavioural procedures, such as stimulus control, sleep restriction and relaxation training. Multicomponent behavioural therapy would include more than one behavioural procedure but without a cognitive component.

*Indicates level of evidence (University of Oxford Centre for Evidence-Based Medicine).
†For cognitive–behavioural therapy with or without relaxation; level 1a for multicomponent behavioural therapy without cognitive therapy. Adapted with permission from REF. 199, Elsevier.
A Clinical/Physiologic Approach to Choosing Medication

- Always in conjunction with sleep hygiene and environmental modification

- Targeted concern approach
  - Difficulty falling asleep
  - Difficulty staying asleep

- Targeted symptom approach
  - Circadian
  - Overactivity, impulsiveness, inattentiveness
  - Anxiety/Mood stabilization
  - Behavioural stabilization
  - RLS

- Targeted mechanism approach?
  - Hyperarousal

Pink == arousal
Blue == circadian/homeostatic
Green == sleep/wake “switch”

Buyess et al, 2011
Treatment Approaches and the Biology of Sleep (Buyess et al, 2011)

- Cognitive-behavioral treatments for insomnia may specifically target dysregulated physiologic processes

- Pharmacologic treatment may directly affect neural centers including cognitive-affective circuits and hypothalamic-brainstem arousal centers.
Medication Approach

Difficulty Falling Asleep

- Circadian
  - Melatonin
- Overactivity
  - Stimulant
- Anxiety
  - Alpha Agonist
  - Alpha Agonist?
  - SSRI
Medication Approach

Difficulty Staying Asleep

Anxiety/Mood Stabilization
- SSRI
- Anticonvulsant?

Self-Regulation
- Stimulant

Behavioral Stabilization
- Atypical Antipsychotic

RLS
- Iron
Medication Approach

- Early Morning Wakening
  - Anxiety
    - SSRI
  - Circadian Rhythm
  - Decreased sleep need
    - Melatonin
Treatment Recommendations

(Hanlon-Dearman, Chen, Carmichael-Olson, 2018)

1. Access early FASD assessment and diagnosis
2. Advocate for healthy families
3. Apply principles of sleep hygiene in a comprehensive sleep management plan
4. Use melatonin or other medications appropriately with input of an experienced clinician
5. Consider sensory needs of the individual with FASD
Treatment Recommendations
(Hanlon-Dearman, Chen, Carmichael-Olson, 2018)

6. Screen for mood disorders/disorders of arousal
7. Screen for attachment difficulties
8. Advocate for healthy and safe environments
9. Advocate for appropriate caregiver support
Final thoughts

• Sleep is a integrative process and enhances daily functioning and health
• Sleep disruption is multifactorial and may contribute to many of the challenging behaviours and anxiety seen in FASD
• Awareness and clinical recognition of sleep disorders in individuals with FASD is critical to accessing appropriate treatment
• Sleep health and management when needed should be a priority at all ages
Thank you
SLEEP DURATION RECOMMENDATIONS

NEWBORN 0-3 months: 14-17 hours
INFANT 4-11 months: 12-15 hours
TODDLER 1-2 years: 10-12 hours
PRE-SCHOOL 3-5 years: 8-10 hours
SCHOOL AGE 6-13 years: 7-9 hours
TEEN 14-17 years: 6-8 hours
YOUNG ADULT 18-35 years: 7-9 hours
ADULT 36-64 years: 6-7 hours
OLDER ADULT 65+: 5-6 hours

Recommended: Dark Blue
May be appropriate: Light Blue
Not recommended: Yellow

Environmental Biology Relevant to FASD and Sleep

- Stress in prenatal environment influences physiologic organization
  - increased risk of sleep disruption

- Prenatal stress and malnutrition impact circadian rhythm with resulting poor sleep quality

- Maternal prenatal mood disorder may predict poor sleep in toddlers
Other Environmental Influences Relevant to FASD and Sleep

• Increased susceptibility to sleep disruption in high risk populations ie. foster care (Tininenko, 2010)
  – overrepresentation of FASD (Astley, 2002)

• FASD may be complicated by disrupted attachment and family/social disruption

• Resultant disordered sleep hygiene and parental frustration
Sleep and PAE:
Early neurologic disorganization

- Early EEGs showed disorganized and higher voltage patterns in EEGs of mothers who used EtOH prenatally (Havlicek & Childaeva, 1976; Havlicek et al, 1977; Rosett et al, 1979; Chernick et al, 1983; Ioffe et al, 1988; Ioffe & Chernick, 1990)

- EEG changes prolonged and not related to withdrawal (Ioffe et al, 1984)

- Atypical sleep cycling (Scher et al, 1988)
Sleep and PAE: Architecture

- reduced REM
- shortened circadian sleep-wake cycle
- abnormal circadian neurotrophin expression in SCN

Impact on circadian rhythmicity may be long term (Allen et al, 2005):
- PAE may affect regulatory genes in hypothalamus which may predispose to sleep fragmentation

Rat binge pattern PAE: impaired and fragmented slow wave sleep (Wilson, 2016):
- memory impairment
Measuring Sensory Processing & Self-Regulation in FASD

• Strong correlation between SP and behaviour on CBCL (Franklin, 2008)
  – including anxiety
  – Recent study (Engel-Yeger et al, 2017) uses measures of sensory processing in adults to predict anxiety, sleep efficiency, and daytime function

• Children with FASD show more difficulties with sensory processing and resulting adaptive deficits not uniquely explained by cognitive deficits (Carr, 2010; Wengel et al 2011)