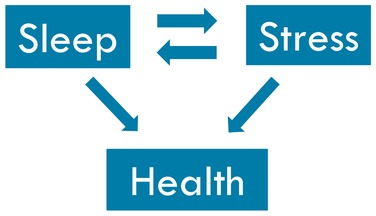
Nighttime sleep onset associated with hair cortisol levels in 3.5-year-olds

Eleanor B. Drury[1], Katie Kao[2], Sophie Schwartz[1], and Amanda R. Tarullo[1]

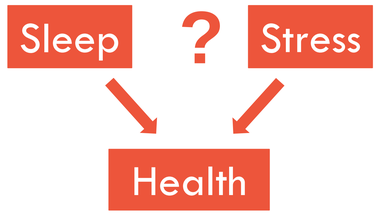
[1]Boston University, [2]Harvard Medical School

Introduction

In adults and adolescents:



In young children:



- Sleep and cortisol are both influenced by the **body's circadian rhythms** (Hirotsu, Tufik, & Andersen, 2015).
- **Inadequate sleep** in children may lead to **compromised cortisol** functioning (Ordway, Jeon, Sadler, Canapari, & Redeker, 2018).
- Compromised cortisol functioning places children at a **greater risk for poor mental and physical health** in adulthood (Manium, Antoniadis, & Morris, 2014)**.**

Aim

- To investigate the association of nighttime sleep onset, nighttime sleep duration, and morning wake time with child hair cortisol concentration.

Participants

- Eighty-two healthy 3.5-year-old children *(nMale* = 41, *nFemale* = 42*)* aged between 40.16 and 47.43 months *(*M_{age} = 42.37, *SD* = 2.45) from the greater Boston area.

Measures

Sleep characteristics

- Children wore a **mini-mitter actical** on their right ankle for **three consecutive nights**.
- Algorithms based on movement determined sleep onset time, sleep duration, and morning wake time.
- Parents completed the **Brief Child Sleep Questionnaire** (Mindell, Sadeh, Kwon, & Goh, 2013).

Hair cortisol concentration

- A **sample of hair** taken from the **posterior vertex**.
- The sample was hair taken **3cm closest to the scalp** and weighed 15-30 mg.
- Hair cortisol concentration is an **index of chronic stress** experienced over the **previous 3 months.**

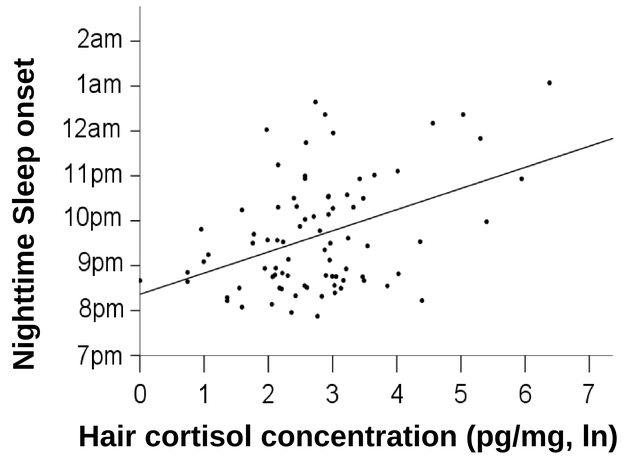
Results

Sleep characteristics

	Actigraphy recorded			Parent reported
	Onset	Wake	Duration	Duration
Mean	9:41pm	7:16am	9hrs 35mins	9hrs 50mins
SD	1hr 19mins	56mins	59mins	1hr 13mins

- **Later nighttime sleep onset was associated with higher hair cortisol concentration (*r* (82) = .421, p < .001).**
- Shorter sleep duration was associated with higher hair cortisol concentration (*r* = -.399, *p* < .001).
- Morning **wake time** was **not significantly correlated to hair cortisol concentration** (*r* (82) = -0.163, p = .144).
- A multiple linear regression established nighttime sleep onset and sleep duration (*F*(2,81) = 9.99, *p* < .001, adjusted R2 = .182) accounted for 20% of the variance in hair cortisol.
- **Nighttime sleep onset** (*B* = .279, *p* = .044) **uniquely contributed to hair cortisol concentration**, but nighttime sleep duration (*B* = -.211, *p* = .124) did not.

Nighttime sleep onset and hair cortisol concentration



Mean Sleep Duration: 9.5hrs

Discussion

- **Early sleep onset may buffer the cortisol stress response,** resulting in lower hair cortisol concentrations (Minkel et al., 2014).
- Children who **experience more stress may fall asleep later** (Sadeh, Amiran, & Reut, 2000).
- A lack of a unique association between sleep duration and hair cortisol may be due to **children waking up at a regular time each day** for preschool.
- The relationship may be further explained by daytime **naps**, sleep **quality**, sleep **stages**, and household **chaos** (Scher, Hall, Zaidman-Zait, & Weinberg, 2009).
- **Parents overestimated how much child their slept**, reinforcing the use of actigraphy (Kushnir & Sadeh, 2013).
- **Healthy sleep habits may minimize physiological stress and could offer a cost-effective strategy to negating stress-related health problems in adulthood.**
- An **earlier bedtime** can be promoted through a regular **bedtime routine, a cool, dark, quiet room, and no digital screens** (National Sleep Foundation).

Recommended Sleep Duration: 11-13hrs

Acknowledgments

We are so grateful for all of the parents and children who participated in our study and made this research possible. This research is supported by a National Institute of Child Health and Human Development 1R03HD082550 grant to Dr. Tarullo.