Biological Psychology 107 (2015) 52–60

Contents lists available at ScienceDirect

Biological Psychology

journal homepage: www.elsevier.com/locate/biopsycho

Cortisol secretion and change in sleep problems in early childhood: Moderation by maternal overcontrol

Elizabeth J. Kiel*, Alexandra C. Hummel, Aaron M. Luebbe

Miami University, Department of Psychology, 100 Psychology Building, 90 N. Patterson Ave., Oxford, OH 45056, United States

ARTICLE INFO

Article history:
Received 4 September 2014
Accepted 2 March 2015
Available online 9 March 2015

Keywords:
HPA axis
Sleep/wake
Parental care

ABSTRACT

Childhood sleep problems are prevalent and relate to a wide range of negative psychological outcomes. However, it remains unclear how biological processes, such as HPA activity, may predict sleep problems over time in childhood in the context of certain parenting environments. Fifty-one mothers and their 18–20 month-old toddlers participated in a short-term longitudinal study assessing how shared variance among morning levels, diurnal change, and nocturnal change in toddlers' cortisol secretion predicted change in sleep problems in the context of maternal overprotection and critical control. A composite characterized by low variability in, and, to a lesser extent, high morning values of cortisol, predicted increasing sleep problems from age 2 to age 3 when mothers reported high critical control. Results suggest value in assessing shared variance among different indices of cortisol secretion patterns and the interaction between cortisol and the environment in predicting sleep problems in early childhood.

1. Introduction

Childhood sleep problems are prevalent (Halbower & Marcus, 2003) and relate to a wide range of negative psychological outcomes both in childhood and extending into adulthood (e.g., Alfano, Zakem, Costa, Taylor, & Weems, 2009; Forbes et al., 2008; Gregory et al., 2005; Hartzinger et al., 2008; Johnson, Chilcoat, & Breslau, 2000). To work towards the prevention of such problems, it is important to further study both biological and environmental contributions to sleep difficulties in young children. Given that sleep problems are thought to reflect, in addition to other influences, biological dysregulation (Buxton, Spiegel, & Van Cauter, 2002), they may be predicted by other biological processes relevant to stress. In particular, aspects of HPA activity (i.e., cortisol levels), which are thought to reflect regulation of the stress response system, have been found to be related to sleep problems in children and adults (Garde, Karlson, Hansen, Persson, & Akerstedt, 2012; Kumari et al., 2009; Scher, Hall, Zaidman-Zait, & Weinburg, 2010; White, Gunnar, Larson, Donzella, & Barr, 2000). Given that cortisol secretion may reflect dysregulated stress response and that stress may impair sleep, it seems likely that these processes are related. However, whether aspects of cortisol functioning *predict* sleep problems over time in early childhood, a salient period for prevention, remains unclear and requires a longitudinal design. Moreover, little research has addressed contexts that may affect this association. Theoretical and empirical work suggests the parenting environment often determines whether or the extent to which biological processes relate to maladjustment. Parental overcontrol, in particular, has been found to shape a variety of child outcomes (McLeod, Wood, & Weisz, 2007; McShane & Hastings, 2009; Rothbaum & Weisz, 1994; Van Leeuwen, Mervielde, Braet, & Bosmans, 2004) and is thought to create a stressful family environment (Chorpita & Barlow, 1998) that could serve as a context under which biological stress dysregulation influences toddlers' sleep quality. Studying sleep problems in the context of parenting seems particularly important in toddlerhood because, during this period, parents play an important role in helping children navigate important developmental issues (Calkins & Hill, 2007). Whether parenting affects how cortisol secretion predicts sleep problems remains unknown. Thus, the goal of the current study was to determine how multiple indices of toddlers' cortisol secretion (morning levels, diurnal change, and nocturnal change) predict change in sleep problems in the context of overcontrolling parenting. Below, we describe why sleep problems are so disruptive for child development, how cortisol and sleep have been associated in past studies, and why overcontrolling parenting might affect this association.

1.1. Sleep problems in childhood

Sleep plays an essential role in children's brain development and the emergence of adaptive emotional, cognitive, and behavioral regulation (Dahl, 1996). Unfortunately, sleep difficulties are

* Corresponding author. Tel.: +1 5135295430; fax: +1 5135292420..
E-mail address: kielluej@MiamiOH.edu (E.J. Kiel).

http://dx.doi.org/10.1016/j.biopsycho.2015.03.001
0301-0511/

prevalent in young children, with estimates ranging from 25% to 46% in the infancy and preschool years (Halbower & Marcus, 2003). Common sleep problems in childhood include short sleep duration, delayed sleep onset, poor sleep quality, and nighttime awakenings (Carter & Briggs-Gowan, 2000; Hartzinger et al., 2008).

Previous research suggests that sleep problems in childhood relate to a wide range of negative socioemotional outcomes. For example, decreased sleep efficacy has been associated with increased levels of impulsivity, peer victimization, and social inhibition in kindergarten children (Hartzinger et al., 2008). Other research has found significant associations between youths' sleep problems and their concurrent depressive and anxious symptoms (Alfano et al., 2009; Forbes et al., 2008; Johnson et al., 2000), and sleep problems in childhood have also shown prospective relations to anxiety and depressive disorders in adulthood (Gregory et al., 2005). Additionally, infant sleep disruptions have also been related to decreased psychological well-being in mothers (Brand, Furlano, Sidler, Schulz, & Holsboer-Trachsler, 2014), which could have negative implications for the parent–child relationship. Investigation into predictors of the development of sleep problems would therefore assist in the early identification of children at risk for these problems and inform intervention and prevention efforts.

1.2. Cortisol secretion and sleep

An intermediary step in understanding the development of sleep problems that may confer risk for negative socioemotional outcomes is to investigate potential biological mechanisms that may underlie sleep problems. In general, sleep patterns are associated with the functioning of the neuroendocrine system, and the hypothalamic–pituitary–adrenal (HPA) axis has received particular attention. The HPA axis is one of the body's stress response and regulation systems, and the secretion of the hormone cortisol is an end-product of a chain of events signifying the activation of this system (Gunnar & Quevedo, 2007). Dysregulation of the stress response system is thought to contribute to sleep problems and disorders, such as insomnia (Buckley & Schatzberg, 2005). Thus, biological indices of stress appear to be related to sleep quality. Additionally, cortisol secretion may be a significant process in relation to sleep problems because the HPA axis follows a normal circadian rhythm related to the sleep–wake cycle. Typically, the sleep–wake cycle is characterized by a nadir in cortisol during the first few hours of nighttime sleep, a steady rise in cortisol into the waking hours, a peak after waking, and then a gradual decline in cortisol throughout the day (Buckley & Schatzberg, 2005). In typically developing children, significant decreases in cortisol have been observed between wake-up and mid-morning and between mid-afternoon and bedtime, and these patterns of cortisol secretion throughout the day are thought to be adaptive and relate to the emergence of children's self-regulation abilities (Watamura, Donzella, Kertes, & Gunnar, 2004). Therefore, a secretion pattern characterized by higher morning levels, a more negative diurnal slope, and a higher nocturnal increase seem to be shared features of an adaptive cortisol secretion pattern. In other words, steeper diurnal decline and nocturnal incline are positive.

Sleep difficulties have been related to HPA dysfunction in adults (Garde et al., 2012; Kumari et al., 2009), and a small number of studies have examined this association in children. These studies with adults suggest that, whereas sleep characterized by shorter duration and more disruption appears to be related to higher evening cortisol and a flatter daytime slope (Kumari et al., 2009), longer sleep duration is related to more dynamic cortisol secretion, with low evening cortisol levels, steep diurnal deviation of cortisol, and high area under the curve (Garde et al., 2012). Studies with infants and children have found that fragmented or otherwise poorer quality sleep has been related to higher awakening/morning and afternoon cortisol levels (Brand, Furlano, Sidler, Schulz, & Holsboer-Trachsler, 2011; El-Sheikh, Buckhalt, Keller, & Granger, 2008; Hartzinger et al., 2008; Mueller, Kalak, Schwenzer-Zimmerer, Holsboer-Trachsler, & Brand, 2014; Scher et al., 2010). The extent to which diurnal decline and nocturnal incline in cortisol secretion relate to sleep is less clear. Less sleep has been related to blunted or flattened rhythm of cortisol secretion in infants with colic (White et al., 2000), but others have found that a sharper increase from evening to morning relates to sleep problems (Scher et al., 2010). Taken together, these studies suggest that high values at a single time point relate to sleep problems but do not yield a consistent answer about whether flatter or steeper slopes across the day and night relate to sleep problems. One approach that might clarify these discrepancies is assessing multiple indices of cortisol secretion simultaneously and determining how shared variance among them (or patterns) relates to sleep problems. To this end, the current study included measures of morning cortisol, diurnal slope, and nocturnal slope.

Foundational work on the concurrent relation between cortisol secretion and sleep problems has stimulated interest in understanding the directionality of this association. Research focused primarily on adults suggests that the relation between sleep and HPA activity may be bidirectional, such that HPA dysfunction may be both a cause and a consequence of sleep problems (Buckley & Schatzberg, 2005; Garde et al., 2012). Prospective research with young children may be particularly suited to answering questions about the development of sleep problems. Few of these studies exist, although there are notable exceptions. Hartzinger et al. (2013) found that sleep problems did not predict cortisol secretion from 5.4 to 6.4 years despite being concurrently related at the latter time point, but cortisol was not assessed as a predictor of sleep. El-Sheikh et al. (2008) found that children with higher afternoon cortisol levels exhibited increased sleep disruptions as measured by self-report and actigraphy. However, it is unclear whether these children started out with higher cortisol levels in the morning or did not decrease as much during the day, which could be informed by studying multiple aspects of cortisol secretion patterns. Together, these studies warrant the investigation of the predictive relation between more holistic patterns of cortisol secretion and sleep problems. Inconsistency of results across studies also suggests that moderators may determine the extent to which cortisol secretion predicts sleep problems. We suggest that overcontrolling parenting, which may evince stress that also relates to cortisol secretion and sleep, may play such a role.

1.3. The context of overcontrolling parenting

Overcontrolling parenting behavior likely influences children's experience of stress, which would be reflected in both their cortisol secretion patterns and their sleep quality. Two aspects of overcontrolling parenting, overprotection and critical control, may be particularly important to examine in relation to sleep problems, as they have been associated with a range of maladaptive developmental outcomes (McLeod et al., 2007; Mills & Rubin, 1998; Rothbaum & Weisz, 1994; Van Leeuwen et al., 2004). Overprotective parenting involves excessive comforting and the facilitation of avoidance of stressors, which limits children's independent coping and impedes autonomy (Rubin, Burgess, & Hastings, 2002). Parents may also control their children through derisive or critical responses, rejection, and negative labeling, a constellation of behaviors characterized as critical control (McShane & Hastings, 2009). These parenting behaviors are thought to create a stressful environment for the child in that they foster a cognitive style characterized by interpretations of events as out of one's control, thereby creating stress and psychological vulnerabilities for problems like anxiety (Chorpita & Barlow, 1998).