



Work/non-workday differences in mother, child, and mother–child morning cortisol in a sample of working mothers and their children

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ABSTRACT

Background: Mothers have been shown to have higher morning cortisol on days they go to work compared to non-workdays; however, it is unknown how maternal workday associates with child morning cortisol or the attunement of mother–child morning cortisol.

Aims: This study examined the presence and stability of morning cortisol levels and slopes (i.e., cortisol awakening response or CAR) in a sample of 2–4 year old children in out-of-home child care with working mothers. In addition, we examined the differential contributions of maternal workday on mother–child attunement in morning cortisol.

Method: Mother and child morning cortisol was sampled twice a day (awakening and 30 min later) across four consecutive days (2 non-workdays; 2 workdays) among 47 working mothers and their young children. Mothers also reported on compliance with sampling procedures and provided demographic information.

Results: While children exhibited stability in cortisol levels, children's CARs were variable, with children's non-work CARs not predictive of work CARs. Similarly, a significant morning rise in cortisol was only found on workdays, not non-workdays. Overall, mothers had higher cortisol levels and steeper CARs than their children. Further, maternal workday moderated the attunement of mother–child morning cortisol, such that mothers and children had concordant cortisol levels on non-workdays, but discordant cortisol levels on workdays.

Conclusions: Morning cortisol may be more variable in pre-school aged children than adults but may be similarly responsive to the social environment. Further, workday mornings may be a time of reduced mother–child cortisol attunement.

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1. Introduction

An emerging literature has highlighted morning cortisol levels and change across the morning (i.e., the cortisol awakening response or CAR) as indicators of chronic stress, and long-term mental and physical health [1]. This literature has focused on adults, and great strides have been made in understanding the factors that explain variability in morning cortisol [2]. For example, work schedules must be assessed given the higher morning cortisol levels [3], and steeper CARs [4] on workdays compared to non-workdays. The production and release of cortisol in children is also sensitive to context [5,6], however few studies have examined daily variation in morning cortisol during early childhood. The majority of pre-school aged children have a clear difference in daily routine based on work and weekend days. These systematic differences in morning routines have the potential to add unexplained variance in child morning physiology, yet to the best of our knowledge, no study has examined workday/non-workday differences in the morning cortisol of children of working mothers. Further, mother and child

cortisol levels have been found to be moderately to strongly correlated [7], with maternal cortisol levels being more strongly related to child cortisol, than a child's own biobehavioral relationships [8]. Given the documented effect of workday on maternal cortisol, there is the potential that workday may also lead to an “un-coupling” of mother–child shared physiology. Therefore, this study employs a “biosocial family systems” approach [9] to examine the relationships between maternal workday, child morning cortisol, and the coordination/attunement between mother and child morning cortisol across days.

Psychosocial stress translates into physiological change through the hypothalamic–pituitary–adrenal (HPA) axis and subsequent cortisol production. Cortisol functions to increase the availability of glucose, thus preparing the body to face perceived challenges [10]. Cortisol is released across the day following a distinct rhythm marked by a rise in the early morning and a decline across the afternoon. Super-imposed on this rhythm is a normative increase in cortisol across the first 30 to 45 min post-awakening [11]. Studies of adults have found cortisol levels to increase roughly 50–75% across this timeframe [12]. An emerging literature has linked dysregulations in morning cortisol in adulthood to worse health outcomes [2]. Furthermore, studies of acute HPA reactivity suggest that early experiences program the set point and threshold of reactivity of HPA axis functioning, providing a mechanism by which

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early experiences are translated into adult health outcomes [13]. Taken together, this literature suggests the importance of examining early environments in relation to children's morning cortisol.

Infants develop a diurnal rhythm that consists of relatively high morning and low evening cortisol levels by three months of age [14,15]. However, the CAR is a physiologically distinct phenomenon from the diurnal rhythm [11] and findings have been mixed regarding when a consistently occurring CAR emerges. Three recent studies have found a significant rise in cortisol levels across the first 30 min post-awakening, in infants in the first 6 months post-partum [16], in infants between 2 and 12 months [17], and in a highly controlled study of seven 2–4 year olds [18]. However, other researchers failed to capture a morning rise in cortisol among 7–17 month old infants on a single day of saliva collections by the mother [8]. Further, even studies that have found an overall increase in cortisol across awakening have noted significant variability in morning cortisol across days [17], with a decrease in cortisol across almost 40% of the mornings [16]. The day-to-day variability in child morning cortisol raises the possibility that daily changes in the child's environment may be related to cortisol levels and awakening responses.

Numerous studies utilizing laboratory stress tasks and reactivity paradigms have linked multiple family interaction patterns and family contexts to child cortisol reactivity and regulation [19,20]. Relatively less attention has been given to understanding naturally occurring fluctuations in daily cortisol levels among young children in their home environment [21]. Despite the paucity in research, two studies suggest that children's daily cortisol in the home is related to the social context of the home. Specifically, higher maternal parenting quality [22] and fewer parent–child conflicts [23] have been related to steeper cortisol declines across the afternoon. Yet these findings are not necessarily generalizable to morning cortisol, given the distinct physiological processes that occur in the morning (i.e., the cortisol awakening response).

Stress physiology is highly sensitive to social influence and in particular, early familial and parent–child interactions [19,20]. Thus, day-to-day changes in family experiences are likely to be linked to daily fluctuations in child cortisol [23]. Families are composed of numerous, ever-changing interactions [24], and many of these interactions have the potential to be related to cortisol [20]. This study focuses on fluctuations in morning cortisol with the recurring schedule change associated with maternal work and non-workdays. From a behavioral perspective, the highly concentrated family interactions that occur in the morning might be particularly important for dual-earner families who spend a large portion of their waking hours apart [3]. Additionally, juggling the demands of paid work and family obligations can strain maternal mental and physical resources [25] and reduce maternal emotional engagement with her children [26]. Further, biosocial studies have consistently linked workday to morning cortisol in adults [4] and, among mothers of pre-school aged children, workday stressors have been found to affect not only maternal cortisol levels but also the cortisol levels of other family members [27]. Thus, we hypothesize that the differential routines and behaviors that are expressed on maternal workdays will lead to child cortisol being higher on maternal workdays than non-workdays.

Recent studies have revealed maternal cortisol to be an important predictor of child cortisol in the morning [8], across the day [28], and in response to challenge [7,29,30]. While the previously cited studies span a large developmental age range, we acknowledge that mother–child physiological attunement at each stage of development may have unique developmental implications for the mother–child dyad. However, one unifying implication of these studies suggests that in addition to members of the dyad influencing one another's behavior, emotions, and physiology [7,31], shared environments or emotions can be translated into shared physiological levels (i.e., mutual or parallel coordination/attunement) [7]. For example, Papp and colleagues [28] found that dyads who engaged in more shared activities had a stronger relationship between mother and child cortisol across the day than dyads who engaged in fewer shared activities. Inherent in this framework is the

idea that mother–child physiological coordination is not a characteristic of the dyad, but dependent on the cognitions, behaviors, and social context of the dyad. However, past studies examining mother–child physiological coordination have focused on between-dyad differences, as opposed to examining how mother–child concordance might fluctuate *within* a dyad [29]. Given the known relationship between work and parental morning cortisol [3], and the potential for work stress to spill over into other family members' physiology [27], we will examine how the attunement of mother–child morning cortisol changes across maternal non-work and workdays.

Current estimates reveal that 64.2% of mothers with pre-school aged children are participating in the labor force [32]. Correspondingly, reports show that 86% of children between birth and age 4 with working mothers are cared for by non-relatives while their mothers work [33]. Thus, maternal work schedules have the potential to play a role in the majority of young children's day-to-day morning cortisol, as well as influence the morning cortisol attunement of many mother–child dyads. We hypothesize that for both mothers and children, non-workday morning cortisol will positively predict workday morning cortisol. However, we expect that the interactions and routines required of mothers and children on days the dyad is leaving the home for work and child care will increase cortisol levels and steepen awakening responses compared to non-workday mornings. Further, mothers' morning cortisol will predict children's morning cortisol; however, we expect workday to moderate this relationship, such that mother and child morning cortisol will not be attuned on workdays when mothers are mentally and physically preparing for their workday.

2. Method

2.1. Participants

Fifty-six working mothers and their pre-school aged children were recruited through fliers posted in local child care centers and public places. Of these dyads, 47 children were cared for outside of the home. Because we hypothesize that linkages between maternal workday and child cortisol attunement may be driven, in part, by the routines involved in the dyad leaving the house for work and non-maternal care, we excluded families of working mothers whose children were cared for by in-home caregivers. Eligibility criteria required that mothers were employed outside the home and were the biological mother of a child between the ages of 2 and 4 ($M = 3.51$ years, $SD = .90$) who attended out-of-home child care, and that both mother and child were free of chronic illnesses. Pregnant mothers were excluded regardless of trimester.

We focus on biological mother–child dyads with children between 2 and 4 years old for several reasons. Children in this age range are old enough that they are typically no longer breastfed, and therefore not directly exposed to maternal physiology. However, these children are young enough that they are not in compulsory schooling, thus their schedules are more likely dictated by family routines as opposed to the timing of public education. Further, mothers tend to be primary caregivers [34] and are more likely to take primary responsibility for readying their children for the upcoming day. Additionally, we opted to limit our examination to biological mothers to control for heritability. Thus, to be more confident in reports of biological parenthood and reduce variability in parent–child cortisol attunement, we limited our study to mothers [35].

Mothers ranged in age from 22 to 43 years ($M = 31.15$ years, $SD = 4.85$), and the majority (74.5%) were married at the time of this study. The majority of mothers (80.4%) reported their ethnicity as non-Hispanic white and 75% percent of the mothers reported their total combined annual household income at or below \$89,999. Fifty-seven percent (57.3%) of the mothers worked 40 h per week or more and 97.9% worked 20 h or more. Only one mother worked less than 20 h a week ($M = 36.62$ h, $SD = 8.98$, range: 11–60 h/week). Correspondingly, 76.5% of the children spent 40 h per week or more in

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