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Maternal antenatal stress has little impact on child sleep: results from a prebirth cohort in Mexico City☆

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ABSTRACT

Study objectives: Maternal antenatal stress may influence offspring development and behavior, but any association with child sleep is unknown.
Methods: From 2007 to 2011, we recruited pregnant women in Mexico City to the Programming Research in Obesity, Growth, Environment, and Social Stressors prebirth cohort. Mothers completed the Perceived Stress Scale (PSS, a 4-item questionnaire assessing past-month stress) and the Crisis in Family Systems measure assessing negative life events (NLEs; how many domains among the 11 assessed in which the mother experienced a stressful event in the prior 6 months)—with higher scores reflecting higher stress—and provided 5 timed salivary samples per day on 2 consecutive days, from which we derived cortisol area under the curve, slope, and awakening response. At age 4-6 years, children's sleep was estimated using accelerometry over a 7-day period. We performed secondary analysis of associations of antenatal maternal stress with child sleep duration and efficiency (time asleep/time in bed) using linear regression adjusted for maternal and child characteristics.
Results: Among 594 mother-child dyads, mean antenatal PSS score was 5.2 (SD = 3.2) out of 16, and mean NLE was 3.2 (SD = 2) out of 11; child sleep duration was 7.7 hours (SD = 0.7), and sleep efficiency was 79% (SD = 6). There was no association between any of the stress measures—PSS, NLE, or salivary cortisol—and sleep duration or sleep efficiency in adjusted or unadjusted models.
Conclusions: Among mother-child dyads in a Mexico City cohort, antenatal stress was not associated with important changes in child sleep at 4-6 years.

Introduction

Increasing evidence indicates that inadequate sleep is associated with higher risks for adverse health outcomes. Short sleep duration in infancy and childhood is a risk factor for subsequent obesity,[1,2] and there is a suggestion that it is also associated with type 2 diabetes

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mellitus biomarkers in children.[3] In a recent systematic review, short sleep duration was also associated with poorer cognitive performance among 8- to 12-year-olds, worse emotional regulation, and worse quality of life/well-being.[4] Short sleep duration is not the only sleep measure associated with undesirable health outcomes; low sleep efficiency is also associated with worse school outcomes in school-aged children, suggesting that frequent nighttime awakenings may affect cognition.[5] And unfortunately, recent evidence suggests that children and adolescents are getting less sleep than recommended,[6,7] with additional evidence that shorter sleep duration early in life persists over the life course.[8,9] Thus, understanding risk factors for poor sleep in childhood is important.

Maternal smoking during breastfeeding seems to impair infant arousal[10] and decrease infant sleep duration.[11] In prospective postnatal studies, maternal depression during childhood may affect child sleep patterns.[12] However, to our knowledge, no prospective studies starting in the antenatal period have examined maternal antenatal risk factors for shorter sleep duration and less efficient sleep in children.

Stress can be assessed based on the environmental demands one experiences (eg, negative life events), how one appraises a stressor in terms of whether it is threatening and whether they are able to cope effectively (eg, perceived stress), as well as biologically (eg, hypothalamic-pituitary-adrenal [HPA] response).[13] Cortisol binds to mineralocorticoid receptors in the hippocampus and glucocorticoid receptors elsewhere to regulate sleep and arousal. Both via an increase in cortisol levels and via an upregulation of cortisol-releasing hormone, increased stress leads to greater arousal and less sleep.[14] In numerous cross-sectional studies, higher stress has been associated with less sleep, as well as more fragmented and lower quality sleep.[15] Both stress and short sleep duration are associated with higher cortisol levels in a given individual.[16]

A small study in Newark, NJ, of 21 mother-child pairs demonstrated a cross-sectional relationship between concurrent maternal stress and shorter sleep duration in their preschool-aged children.[17] However, we could not find literature assessing the longitudinal relationship between maternal antenatal stress and subsequent child sleep. Higher maternal cortisol levels have been shown to influence other offspring neurobehavioral outcomes—for example, maternal antenatal stress has been associated with greater risks for attention-deficit disorder/hyperactivity and anxiety in childhood[18] and depression in adolescence.[19] Higher antenatal stress is associated with higher adrenocorticotropic hormone and cortisol during pregnancy,[20] as well as decreased ability of the placenta to metabolize cortisol.[21] Higher maternal antenatal stress is associated with higher salivary cortisol levels in their 14- to 15-year-old offspring.[19] Because maternal antenatal stress seems to impact the HPA axis in their offspring and because the HPA axis influences sleep, it is reasonable to hypothesize that maternal antenatal stress may also impair subsequent child sleep.

In the present study, we conducted a secondary data analysis examining the relationship between maternal antenatal stress and child sleep duration and efficiency—the percentage of in-bed time a child spends asleep—in a cohort of mothers and children in Mexico City. We hypothesized that higher maternal antenatal stress would be associated with shorter duration of child sleep and lower child sleep efficiency in this cohort.

Methods

Population/setting

From 2007 to 2011, we recruited 1054 pregnant women in the early second trimester into the Programming Research in Obesity, Growth, Environment, and Social Stressors (PROGRESS) cohort. All women were receiving prenatal care at clinics belonging to the Mexican Social Security System in Mexico City. Exclusion criteria included multiple fetuses (eg twins); consumption of 1 or more alcoholic beverages per day; history of heart or kidney disease or seizure disorder requiring daily medications; use of corticosteroids; any other medical conditions that could cause low birth weight; and logistic reasons that would interfere with data collection, such as living in a household outside the metropolitan area. After birth, we further excluded infants with an Apgar score at 5 minutes of 6 or less, a condition requiring treatment in neonatal intensive care unit, or serious birth defects. We excluded children with severe prematurity (<32 weeks) from this analysis. The recruitment process has been described in detail elsewhere.[22,23] Research ethics committees of the participating institutions approved the study.

Procedures

Study staff explained the study to the participants and obtained written informed consent. During the mother's initial study visit during pregnancy (second trimester), we collected information on health status and on social and demographic characteristics. Research staff collected information on newborn characteristics from the hospital delivery record. After delivery, each mother-infant pair visited the research center at the National Institute of Perinatology in Mexico City for evaluation at a series of study visits, conducted every 6 months until 24 months and at 4-6 years of age. In the present analysis, we included the 609 mother-child dyads who had completed the 4- to 6-year visit as of April 2016. We included data collected from mothers at the prenatal visit, data collected from birth records about the newborn infants, and data collected from mothers and children at the 4- to 6-year visit.

Antenatal stress measures

The exposure in this study was maternal antenatal stress, which we assessed based on self-reported measures of environmental demands (negative life events) and stress appraisal (perceived stress), as well as a biological measure of HPA functioning (salivary cortisol). During the initial visit, a psychologist conducted a face-to-face interview with mothers assessing global stress appraisal with the 4-item Perceived Stress Scale (PSS).[24] The PSS consists of 4 general questions about stress (eg, "In the last month, how often have you felt that you were unable to control the important things in your life?") with 4 response choices reflecting frequency ("0 = never, 1 = almost never, 2 = sometimes, 3 = fairly often, 4 = very often"), resulting in a cumulative score from 0 to 16. A higher score indicates higher level of stress. The PSS demonstrates good internal consistency, test-retest reliability, and factorial validity[25] and has been validated in a Spanish-speaking population in Mexico.[26] During the same interview, we assessed negative life events experienced in the past 6 months with the original 64-item Crisis in Family Systems (CRISYS) scale.[27] The 64-item CRISYS asks about stressful life events in 11 domains (financial, legal, career, relationships, medical pertaining to respondent and to others, safety in the community and at home, other home issues, difficulty with authority, and discrimination) over the previous 6 months, with several items asked in each domain. For example, in the financial domain, participants were asked, "Did you go without food because you did not have the money to pay for it?" and in the relationships domain, "Did you get a divorce or break up with a partner?" Because research demonstrates increased vulnerability when experiencing events across multiple life domains,[28] we summed the number of domains in which mothers reported at least 1 negative life event to get a negative life events (NLE) domain count from 0 to 11, with higher scores indicating stress in more domains, as has been done in prior research.[29] Because stressful events were assessed