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Within-family Relations in Objective Sleep Duration, Quality, and Schedule

Chrystyna D. Kouros and
Southern Methodist University

Mona El-Sheikh
Auburn University

Abstract

The current study examined within-family relations between mothers', fathers' and children's objectively assessed sleep. Participants were 163 children (M age=10.45 years; $SD=0.62$) and their parents. For seven nights, families wore actigraphs to assess sleep duration (minutes), quality (efficiency, long wake episode, total wake minutes), and schedule (wake time). A sleep log assessed bedtime. Multilevel models indicated that children's sleep minutes, sleep efficiency, wake minutes, and wake time were associated with fluctuations in their mothers', but not fathers', sleep that same night. The duration and quality of mothers' sleep was associated with both fathers' and children's sleep that night; whereas, fathers' sleep was positively associated with only mothers' sleep. Findings highlight the importance of examining sleep within a family context.

Keywords

Actigraphy; Sleep Quality; Sleep Duration; Children; Family Processes

Within-family Relations in Objective Sleep Duration, Quality, and Schedule

Sleep problems among typically developing school-aged children can include difficulty initiating and maintaining sleep, not sleeping enough, and having an inconsistent bedtime and wake time (Fricke-Oerkermann et al., 2007; El-Sheikh & Sadeh, 2015). Such sleep problems are common, affecting approximately 20–40% of children (Fricke-Oerkermann et al., 2007; Mindell & Owens, 2010). The prevalence of sleep problems is a national public health concern given documented links between sleep and children's development across multiple domains of health and adaptation (Colten, Altevogt, & Institute of Medicine Committee on Sleep Medicine and Research, 2006; El-Sheikh & Sadeh, 2015; Shochat, Cohen-Zion, & Tzischinsky, 2014). For example, short sleep duration and poor sleep quality—even at subclinical levels in community samples—are related to poor physical health (e.g., obesity; Nielsen, Danielsen, & Sørensen, 2011), impaired attention and cognitive functioning (Buckhalt, El-Sheikh, Keller, & Kelly, 2009; Kelly, Kelly, & Sacker, 2013;

Sadeh, Gruber, & Raviv, 2003), as well as children's mood and overall mental health (Kelly & El-Sheikh, 2014; Kouros & El-Sheikh, 2015; see also Astill, Van der Heijden, van IJzendoorn, & van Someren, 2012 and Gregory & Sadeh, 2012 for reviews). Moreover, sleep problems in childhood and adolescence are likely to continue into adulthood (Dregan & Armstrong, 2010), affecting later physical and psychosocial health outcomes (Gallicchio & Kalesan, 2009; Roth et al., 2006; Tavernier & Willoughby, 2014). Consistent with the definition of sleep problems in other investigations (Fricke-Oerkermann et al., 2007; El-Sheikh & Sadeh, 2015), we operationalize sleep problems in this study as sleep insufficiency, difficulties initiating and maintaining sleep, and inconsistent sleep schedules examined along a continuum and do not denote clinically significant sleep disorders (e.g., sleep apnea).

Sleep problems not only confer risk for one's own health and well-being, but also can affect other family members' health. For example, children's sleep problems predict parents' mental health and stress (Martin, Hiscock, Hardy, Davey, & Wake, 2007; Meltzer & Mindell, 2007), and parents' sleep problems have been found to predict children's behavior and functioning (Bajoghli, Alipouri, Holsboer-Trachsler, & Brand, 2013). However, studies of how the duration, quality, and schedule of family members' sleep are directly related on a nightly basis are limited.

Sleep is imbedded in a family context and there are increasing calls in the literature to investigate interrelations among children's and parents' sleep (El-Sheikh & Sadeh, 2015; Meltzer & Montgomery-Downs, 2011). Moreover, several theoretical perspectives support moving beyond individual-based models of sleep and instead examining sleep within the family context. First, sleep is a state of down-regulated vigilance and arousal, and the environment is critical for supporting a sleep state (Dahl, 1996). That is, environments that promote a sense of safety and security also promote longer and higher-quality sleep (Dahl & El-Sheikh, 2007). Indeed, research has shown that children's emotional insecurity about the family is related to children's sleep problems two years later (Keller & El-Sheikh, 2011), and anxiously-attached married couples report higher levels of sleep problems (Carmichael & Reis, 2005). Given that family members share many facets of their home, relationship, and emotional environments, it is likely that family members' sleep would be positively related on a nightly basis. Second, family systems theory (Cox & Paley, 1997) would also support positive relations between mothers', fathers', and children's sleep, as this theory posits interdependent relations between spouses and between parents and their children. Further, family systems theory highlights that an understanding of an individuals' functioning (e.g., sleep) will be enhanced when taking a whole-family approach. Third, Bronfenbrenner's (1986) theory of development underscores the need to examine contextual effects—such as the effects of other family members that are part of one's microsystem—in order to fully understand developmental outcomes. Notably, Bronfenbrenner's model has been adapted to children's sleep (El-Sheikh & Sadeh, 2015) to underscore that the health and functioning among family members are inextricably intertwined. Individual models of sleep, therefore, do not adequately capture the ecological context within which sleep occurs. Broadening models of sleep to encompass other family members is necessary for understanding the dynamic nature of sleep both within individuals and within families.

The majority of studies on family sleep have examined changes in parents' sleep after the birth of a child (Gay, Lee, & Lee, 2004; Lee, Zaffke & McEnany, 2000) or have examined relations between parents' (mostly mothers') and children's sleep among infants and preschool-aged children. This research has shown that parents' self-reports of sleep problems are positively correlated with parents' reports of their young child's sleep problems (Sinai & Tikotzky, 2012; Thomas & Foreman, 2005). Moreover, Countermine and Teti (2010) reported that mothers whose infant (24 months or younger) slept in the same room with them showed less sleep efficiency, based on actigraphy data, as compared to mothers whose babies slept alone in their own room. Also using actigraphy data, Tikotzky et al. (2015) showed that mothers' sleep efficiency when children were 3-months-old prospectively predicted their child's sleep efficiency at 6 months.

A small, yet growing, body of research has recently considered relations between parents' and children's sleep during the school-age and adolescent years. Based on questionnaire measures of sleep, the findings provide support for bidirectional relations between parents' and children's sleep problems, especially among mother-child dyads (Bajoghli et al., 2013; Boergers, Hart, Owens, Streisand, & Spirito, 2007; Brand, Gerber, Hatzinger, Beck, & Holsboer-Trachsler, 2009; Smedje, Broman, & Hetta, 1998; Lopez-Wagner, Hoffman, Sweeney, Hodge, & Gilliam, 2008). For example, Boergers et al. (2007) examined a clinic sample of children ages 2–13 years and had mothers report on their own and their child's sleep; fathers also completed self-report questionnaires of their own sleep. The authors found that children's total sleep problems on the *Sleep Habits Questionnaire* (reflecting greater sleep disturbance, such as bedtime resistance, shorter sleep duration, sleep anxiety, and daytime sleepiness) predicted mothers', but not fathers', daytime sleepiness. Further, having a child with multiple sleep diagnoses (e.g., obstructive sleep apnea and parasomnia) predicted both mothers' and fathers' daytime sleepiness. No relations were found between mothers' and fathers' self-reported sleep problems. Brand et al. (2009) asked adolescents to report on their own and their parents' sleep on a sleep log for 7 days. Significant relations were found between adolescents' sleep onset, total sleep time, and subjective sleep quality and their rating of their mothers' sleep problems (adolescent report of mothers' difficulty falling asleep, night wakings, and waking up earlier than intended); however, only a weak association was found between adolescents' and fathers' sleep.

Although the aforementioned studies have made important contributions to the literature, they tended to rely on a single reporter of parents' and children's sleep problems. Studies that use independent reports of parents' and children's sleep, however, have included only one parent in the study (Fuligni, Tsai, Krull, & Gonzales, 2015; Meltzer & Mindell, 2007). Fuligni and colleagues (2015) had adolescents and their primary caregiver (83% mothers) complete a sleep diary for 2 weeks, and found significant daily relations between adolescents' and their parent's bed time, wake time, and number of hours slept. Further, Bajoghli et al. (2013) examined sleep patterns in a sample of 81 Iranian families with an adolescent between 12 and 18. Mothers, fathers, and children self-reported on their own sleep problems. The results indicated significant correlations between mothers' and children's sleep duration, sleep onset latency (i.e., bedtime to sleep onset time), and the number of night-time awakenings. In contrast, children's sleep was not correlated with

fathers' sleep, and only mothers' and fathers' night-time awakening was moderately correlated.

Very few studies on family sleep have utilized objective measures of sleep. Notably, Kalak et al. (2012) examined 47 families with an adolescent between the ages 12 and 20 who participated in a one-night, home-based, sleep-EEG recording. Significant relations were found between mother and child sleep continuity (e.g., sleep efficiency, number of awakenings) and sleep architecture (light sleep, slow wave sleep). Sleep continuity in the father-child dyad and in the mother-father dyad were not found; only one significant relation between mothers' and fathers' sleep architecture (time/percent in Stage 2 sleep) emerged. Studies of sleep in children with developmental disabilities also provide evidence for relations between family members' objective sleep. Goldman, Wang, and Fawkes (2014) averaged actigraphy data across 14 nights in a sample of 6 typically developing children and 11 children with autism spectrum disorder. Combining data across the two groups of children, the authors found significant, positive relations for time in bed, total sleep time, and sleep fragmentation (sleep activity) between mothers and their child. Greater variability in children's sleep from night to night was also associated with mothers' daytime sleepiness.

With regard to relations between mothers' and fathers' sleep, most research relates couples' sleep to relationship functioning (Hasler & Troxel, 2010; Kane, Slatcher, Reynolds, Repetti, & Robles, 2014), and only a few studies have directly examined relations between mothers' and fathers' sleep. Meadows and colleagues (2009) noted that research on adult sleep has been limited by examining sleep as an "individual phenomenon" rather than considering the influence of partners' sleep on each other. Although limited, research does support relations between couples' sleep. For example, using actigraphs, Meadows et al. (2009) studied 36 heterosexual couples (approximately half with children) and found significant interdependence in couples on some sleep parameters, such as actual bed time, sleep latency, and wake bouts. Leonhard and Randler (2009) showed that partners' chronotype (morningness-eveningness) were highly correlated; however, this synchrony was higher in couples without children. Couples' sleep is also longitudinally related. Using the current study sample, El-Sheikh, Kelly, Koss, & Rauer (2015) found that wives' sleep minutes and sleep latency (averaged across 7 days of actigraphy data) predicted their husbands' sleep minutes and latency, respectively, one year later.

Together, the literature reviewed provides preliminary evidence that sleep duration and quality among mothers, fathers, and children are related, with perhaps stronger relations in the mother-child vs. father-child dyad. Stronger relations between mothers and their children is likely due to mothers being more involved in child-rearing and more likely to attend to children during the night (Crowe, Clark, & Quails, 1996; Pleck & Masciadrelli, 2004; Tikotzky, Sadeh, & Glickman-Gavrieli, 2011). Further, families typically share similar routines and bedtime sleep schedules, which likely accounts for relations in sleep duration, and perhaps sleep quality. As the field has shifted to consider the family context of sleep, research supports that the climate of the family environment, such as the quality of family relationships and level of family conflict, can have profound effects on one's sleep (Adam, Snell, & Pendry, 2007; Bernert, Merrill, Braithwaite, Van Orden, & Joiner, 2007; Kelly, Marks, & El-Sheikh, 2014).

The aim of the current study was to examine within-family relations between mothers', fathers', and children's sleep duration, quality, and schedule. The current study is novel in its assessment of relations between both mothers' and fathers' sleep and children's sleep using objective measures of sleep. Specifically, we examined different family dyads including the (a) mother-child dyad, controlling for fathers' sleep; (b) father-child dyad, controlling for mothers' sleep; and (c) parental dyad, controlling for children's sleep. We used actigraphy measures of sleep across 7 nights to assess each family member's sleep, and investigated within-family relations. Building off previous work which averages individuals' sleep data across several nights, we retained the intensive, longitudinal assessment of sleep to examine how fluctuations in sleep each night are related to other family members' sleep.

Sleep is a multi-faceted construct and examination of multiple sleep parameters is warranted (Sadeh, 2015) for better explication of examined relations and connecting findings from various studies, especially in this burgeoning area of inquiry. Thus, we assessed three key dimensions of sleep, including sleep duration (number of sleep minutes), sleep quality (sleep efficiency, long wake episode, total wake minutes), and sleep schedule (bedtime, wake time) to provide a more comprehensive examination of family sleep. We examined relations among family members' sleep in a relatively large and ethnically and economically diverse sample of families. We hypothesized that fluctuations in sleep (changes from one's typical sleep functioning) would be positively related to other family members' sleep that night. For example, more sleep minutes than usual and better sleep quality than usual would positively predict other family members' sleep minutes and sleep quality that night. Based on previous findings with questionnaire data (e.g., Bajoghli et al., 2013; Boergers et al., 2007), we also expected that relations would be more consistent between mothers and their children compared to the father-child dyad.

Method

Participants

Participants were part of a longitudinal study examining biopsychosocial influences on developmental outcomes (Auburn University Sleep Study; see El-Sheikh, Kelly, Buckhalt, & Hinnant, 2010; El-Sheikh et al., 2015 for sample details). Families were recruited through invitation letters distributed to children at public schools in the Southeastern United States. Sleep data from T2 of the larger study was used for the present investigation (data collection in 2010–2011; actigraphy-based parent sleep data were not available at the first wave of the larger study). At T2, a total of 280 families participated in the study (N at T1 was 282; an additional 57 families were recruited at T2 to account for attrition). Given the focus of the current study on sleep within mother-father-child triads, we excluded families that were from a single-parent household ($n = 77$) and if one or both parents was a shift worker ($n = 12$); we also excluded families that did not have useable sleep data for at least two family members ($n = 28$). The final sample for the current study was 163 two-parent families. All families lived together and slept in the same house.

The majority of parents were married (89%) and the remaining families included unmarried, cohabiting couples ($M = 5.21$ years cohabitating, $SD = 4.23$ years). Families included the biological mothers (90%) and fathers (70.6%) of the participating child; 68% of children

lived with both biological parents and had an average of 1.5 siblings ($SD = 1.09$, range: 0–7). On average, children were 10.45 years old ($SD = 0.62$; range: 9.08 to 11.58) and 55% were boys. Approximately 75% of children were European American and 25% were African American. Based on mothers' reports on the *Puberty Development Scale* (1 = prepubertal, 2 = early pubertal, 3 = midpubertal, 4 = late pubertal, 5 = post-pubertal; Petersen et al., 1998), boys were, on average, prepubertal ($M = 1.55$, $SD = 0.37$; range: 1 to 2.6) and girls were early pubertal ($M = 2.03$, $SD = 0.62$; range 1 to 3.8). Mothers' and fathers' mean age was 36.93 ($SD = 6.47$) and 40.02 ($SD = 7.77$), respectively. The mean income-to-needs ratio (annual family income divided by the poverty threshold based on family size for years 2010–2011; U.S. Department of Commerce, n.d.) was 1.78 ($SD = .91$), indicating that, on average, families lived 178% above the poverty threshold (range = 0.30 – 4.10); 22.7% of families lived below the poverty line. The median family income, as reported by mothers, was US \$55,000 ($SD = US\$33,740$).

Procedure

Actigraphs were mailed to the participants' homes along with sleep diaries. Participants were asked to wear the actigraphs on their non-dominant wrist for 7 consecutive nights. To corroborate actigraphy data, mothers and fathers completed a sleep diary log each night. Mothers completed the sleep log for their child. Actigraphy assessment occurred during the regular school-year, excluding holidays and vacations. Nights with occasional medication use (e.g., for headaches, colds, pain) were excluded from analyses. Following the week of actigraphy ($M = 3.24$ days later; $SD = 10.21$), families visited the research laboratory to complete questionnaires, including a demographic questionnaire created for the current study. To calculate child body mass index (BMI), a researcher measured the child's height and weight (CDC; apps.nccd.cdc.gov/dnpabmi). BMI scores were standardized, adjusting for age and sex. Children's average BMI score was 19.47 ($SD = 4.48$). This study was approved by the institution's internal review board. Mothers and fathers provided informed consent and children provided informed assent. Families were monetarily compensated for their participation.

Measures

Objective measure of sleep—Actigraphs were Octagonal Basic Motionloggers (Ambulatory Monitoring Inc., Ardsley, NY), which measured body motion in 1-min epochs using a zero crossing mode. Raw data were analyzed with ACTme software (Action W-User's Guide, 2002 Ambulatory Monitoring Inc., Ardsley, NY). We followed procedures for determining sleep onset and offset time recommended by the manual and protocol created at the E.P. Bradely Hospital Laboratory at Brown University (Acebo & Carskadon, 2001). To derive the sleep variables, Sadeh's well-established scoring algorithm (El-Sheikh & Sadeh, 2015; El-Sheikh, Tu, Saini, Fuller-Rowell, & Buckhalt, 2016; Sadeh, Sharkey, & Carskadon, 1994) was used for children's data. The actigraph and analysis software have shown good reliability and validity for estimating children's sleep when compared with polysomnography (Sadeh et al., 1994). Parent actigraphy data was scored using the Cole-Kripke algorithm (validated for adults; Cole & Kripke, 1989; Cole, Kripke, Gruen, Mullaney, & Gillin, 1992). Given recommendations to include multiple sleep parameters (Sadeh, Raviv, & Gruber, 2000), we analyzed the following six key sleep parameters that

represent sleep duration, sleep quality, and sleep schedule: (a) Sleep Minutes, total duration of actual sleep minutes between sleep onset and wake time; (b) Sleep Efficiency, percentage of motionless sleep; (c) Long Wake Episode, the number of wake episodes > 5 minutes; (d) Total wake minutes, total minutes during the night scored as being awake; (e) Bedtime, as reported by participants on their sleep diary log (mothers reported on child's bedtime), and represented in minutes of the day (e.g., 1350 = 10:30 pm). Bedtimes were adjusted to account for bedtimes after midnight (e.g., 1470 = 12:30 am); and (f) Wake Time based on actigraphy.

On average, children provided 6 nights ($SD = 1.2$) of useable actigraphy data. Specifically, approximately 45% of children had useable actigraphy data for all seven nights, 28% had data for six nights, 15% had data for five nights, 8% had data for four nights, 2% had data for three nights, and 2% had data for two nights. Mothers and fathers, respectively, provided 5.26 ($SD = 2.12$) and 3.66 ($SD = 2.92$) nights of useable actigraphy data. For mothers, 39.3% had useable actigraphy data for 7 nights, 20.2% had data for six nights, 13.5% had data for five nights, 10.4% had data for four nights, 6.1% had data for three nights, and 1.2% had data for 2 nights; 3.1% of mothers did not provide any actigraphy data and 6.1% of mothers' reported having a diagnosed sleep problem and their data was excluded from analyses. Approximately 21.5% of fathers' provided seven nights of useable actigraphy data, 19.1% had data for six nights, 12.3% had data for five nights, 6.7% had data for four nights, 3.1% had data for three nights, 1.8% had data for two nights, and 28.8% of fathers did not have actigraphy data; data from 6.7% of fathers was excluded from analyses because the father reported a diagnosed sleep problem.

Regarding common nights of useable actigraphy data from all family members, 17 families had data for all 7 nights from all family members, 25 families had data for 6 nights, 18 families had data for 5 nights, 19 families had data for 4 nights, 8 families had data for 3 nights, and 2 families had data for 2 nights; 73 families had data from one parent and child only and these families had, on average, 5 common nights of data ($SD = 1.54$). Missing actigraphy data was primarily due to not wearing the actigraph. Notably, our analytical approach of using multilevel modeling can accommodate missing nights of actigraphy data, using maximum likelihood estimation (Enders, 2010).

Analysis Plan—Family relations in sleep duration, quality, and schedule were examined using hierarchical linear modeling (HLM; Raudenbush & Bryk, 2002); analyses were conducted with HLM v. 7 software. HLM is an appropriate analytical method because it can accommodate the nested structure of the actigraphy data (i.e., multiple actigraphy nights per person), and examine within-person fluctuations in sleep (Bolger & Laurenceau, 2013). Notably, our sample size of 163 families, with 7 repeated assessments, exceeds minimum sample size recommendations for using HLM (Maas & Hox, 2005). The use of multilevel modeling is consistent with recent calls in the literature to utilize advanced methodology to better understand the family context of sleep (El-Sheikh & Sadeh, 2015). Our model building occurred in three steps. First, preliminary analyses tested whether the sleep variables systematically changed across the 7 nights of actigraphy data collection. Time was coded such that the first night of actigraphy data = 0. A dummy-coded covariate was included at Level 1 to control for whether each night was a weekday or weekend night.

Second, to minimize potential confounds, we tested and included several covariates of children's and parents' sleep. Third, we included the other family members' sleep in models. We followed centering guidelines proposed by Hoffman (2015) and Bolger and Laurenceau (2013). Specifically, we person-centered Level 1 sleep predictors, such that they represented fluctuations from one's average level of sleep, and we included the average score across all actigraphy nights as a predictor of the intercept at Level 2 (representing between-person or between-family relations). Level 2 predictors were grand-mean centered. Given this centering method, the analyses, therefore, can be interpreted as the extent to which within-person fluctuations in sleep (e.g., more sleep minutes or better sleep quality than is typical for that individual) predicts the sleep duration or sleep quality of another family member that same night. We report the results from the models with robust standard errors. A sample HLM model is presented below, with one sample covariate included at Level 2 for illustrative purposes (models included several covariates):

$$\begin{aligned}\text{Level 1: Child Sleep} &= \beta_0 + \beta_1 (\text{Time}) + \beta_2 (\text{Weekday/Weekend}) + \beta_3 (\text{Mother Sleep}) + \beta_4 (\text{Father Sleep}) \\ \text{Level 2: } \beta_0 &= \gamma_{00} + \gamma_{01} (\text{Mother Person-Mean Sleep}) + \gamma_{02} (\text{Father Person-Mean Sleep}) + \gamma_{03} (\text{Covariate}) + U_0 \\ \beta_1 &= \gamma_{10} + U_1 \\ \beta_2 &= \gamma_{20} \\ \beta_3 &= \gamma_{30} + U_3 \\ \beta_4 &= \gamma_{40} + U_4\end{aligned}$$

In this equation, mother and father sleep at Level 1 have been person-centered, and their average levels have been included as predictors of the intercept at Level 2. The Level 1 model, therefore, estimates the within-person relation between fluctuations in one family members' sleep and their own sleep that night. The Level 2 model aggregates these within-person estimates and provides parameter estimates for the average within-person association for the sample. Thus, the parameter γ_{30} represents the extent to which within-person fluctuation in mothers' sleep predicts children's sleep the same night, and γ_{40} represents the extent to which within-person fluctuation in fathers' sleep predicts children's sleep the same night.

Missing data—Overall, there was little missing data at Level 2 (covariates; between-family variables), which included approximately 3.7% missing data on mothers' age, 6% missing data on child BMI and child depressive symptoms, 6.7% missing data on child puberty and mother depressive symptoms, 13.5% missing data on income-to-needs ratio, and 14% missing on fathers' age. In contrast, 45 fathers were missing data on depressive symptoms. Little's MCAR test, however, was not significant, $\chi^2 (df = 969) = 1008.53, p = .18$, suggesting that it is reasonable to assume that the data were missing completely at random. Missing data at Level 2 was imputed using the expectation-maximization approach in SPSS v. 21. With regard to Level 1 missing data (i.e., missing nights of sleep data), HLM uses maximum likelihood estimation, which is a robust and powerful missing data approach that provides unbiased parameter estimates (Enders, 2010; Schafer & Graham, 2002).

Results

Descriptive Statistics

The majority of children (73.4%) had their own bedroom; 21.5% shared a bedroom with one other person, 3.7% shared a bedroom with two other people, and one child shared a bedroom with three people. Across the actigraphy nights, 4.9–7.4% of children slept with their parents, as reported by mothers. Table 1 provides descriptive statistics and correlations among mothers', fathers', and children's sleep variables; for brevity, these are provided for each sleep measure averaged across all available nights (see Supplemental Tables S1–S7 for descriptive statistics for each night and correlations per night).

As shown in Table 1, on average, children's bedtime was around 9 p.m., and they slept for an average of 7.44 hours; their sleep duration varied, on average by approximately 53 minutes across the nights. Children had an average of 3.48 long wake episodes per night with an average of 60 total wake minutes during the night. The average wake time was 6:19 a.m. Mothers and fathers had an average bedtime of approximately 10:30 p.m., and a wake time of 6:12 a.m. and 6:07 a.m., respectively. Mothers, on average, slept for 6.5 hours, and their sleep varied, on average, by approximately 65 minutes across the nights. They had an average of 1.76 long wake episodes per night, with an average of 28.68 total wake minutes. Fathers, on average, slept for 6.34 hours, and their sleep varied, on average, by approximately 77 minutes across the nights. They had an average of 2.45 long wake episodes per night, with an average of 39.28 total wake minutes. Intraclass correlations (ICCs), based on unconditional HLMs, ranged from 0.31 to 0.61 for children's sleep, 0.31 to 0.79 for mothers' sleep, and 0.23 to 0.74 for fathers' sleep (see Supplemental Table S1), indicating both between-person and within-person variability in all sleep parameters during the week. These values are comparable to ICCs typically found in self-report diary data (.2 to .4 range; Bolger & Laurenceau, 2013).

A within-subjects MANOVA indicated that there were significant mean differences in the sleep variables between mothers, fathers, and children, $F(14, 638) = 34.87, p < .001$. Follow-up paired sample *t*-tests indicated that compared to their mother and father, children had, on average, a longer sleep duration (Mothers: $t(162) = 8.99, p < .001$; Fathers: $t(162) = 9.12, p < .001$), less sleep efficiency ($M = 88.20$; Mothers' $M = 93.09, t(162) = 5.36, p < .001$; Fathers' $M = 90.87, t(162) = 3.71, p < .001$), and more frequent long wake episodes during the night (Mothers: $t(162) = 9.21, p < .001$; Fathers: $t(162) = 6.48, p < .001$). There was no significant difference between mothers' and fathers' sleep duration or sleep efficiency; however, mothers had less frequent long wake episodes compared to fathers, $t(162) = 2.15, p = .03$. There were no significant differences between any family members' bedtimes, wake times, or wake minutes.

Preliminary Analyses

Multilevel models with only time as a predictor were run for each sleep variable to test the extent to which participants' sleep, on average, linearly changed over the course of the actigraphy data collection period. On average, none of the sleep variables significantly changed across the 7 nights, indicating that sleep did not get better or worse, and bedtime

and wake times did not significantly change, as the week went by. However, there was significant between-person variability indicating individual differences in the rate of change over time for mothers' sleep efficiency, long wake episodes, wake time, and wake minutes, and for fathers' sleep efficiency and wake minutes. Based on Bolger and Laurenceau's (2013) recommendations, we controlled for time (i.e., night) in all models.

Next, we tested the following Level 2 covariates of children's sleep: age; sex; ethnicity/race (European American vs. African American); puberty status, as reported by mothers on the *Puberty Development Scale*; BMI (adjusted for sex and age); family income-to-needs ratio; whether the child had a chronic illness; asthma status (yes/no); parents' marital status (married vs. not married); whether the mother was the biological mother; whether the father was the biological father; mother, father, and child depressive symptoms; and two Level 1 covariates of whether it was a weekend or weekday and whether the child slept with the parents that night (yes/no). Age, race, pubertal status, BMI, family income-to-needs ratio, parents' marital status, mothers' depressive symptoms, and weekend vs. weekday predicted variability in one or more child sleep variables; these variables were included as covariates in all models predicting child sleep. The following covariates were tested for parents' sleep: age; ethnicity/race; marital status; medication use; whether the parent had a chronic illness; whether the parent was the biological parent of the target child; family income-to-needs ratio; mother, father, and child depressive symptoms; whether it was a weekend or weekday, and whether the child slept with the parents that night (yes/no); parent BMI was not assessed in this study. With regard to mothers' sleep, mothers' ethnicity/race, medication use, being the biological mother, family income-to-needs ratio, mother and child depressive symptoms, and weekend vs. weekday predicted variability in one or more of mothers' sleep outcomes; these variables were included as covariates in all models predicting mothers' sleep. With regard to fathers' sleep, fathers' marital status, family income-to-needs ratio, mother and father depressive symptoms, weekend vs. weekday, and whether the child slept with parents that night significantly predicted variability in one or more sleep variables, and were included as covariates in all models predicting fathers' sleep.

Parents' Sleep Predicting Children's Sleep

Children's sleep duration and sleep quality were significantly predicted by their mothers' sleep that same night; relations were also found for wake time the next morning (Table 2). Specifically, the results indicated that within-person fluctuations in mothers' sleep minutes, such that longer sleep duration for mothers than usual, positively predicted children's sleep minutes that night, $b = 0.17$, $SE = 0.05$, $p = .001$. Put into context, a 6-min increase in a mother's sleep duration, compared to her average sleep duration, would predict an approximate 1-min increase in her child's sleep duration. Within-person fluctuations in mothers' sleep efficiency also predicted children's sleep efficiency that same night. That is, better sleep efficiency than usual for mothers was related to higher levels of children's sleep efficiency, $b = .26$, $SE = .08$, $p = .002$. Specifically, a 4% change in a mother's sleep efficiency from her typical level would predict an approximate 1% change in her child's sleep efficiency that same night. Mothers who were awake more than usual during the night also predicted more total wake minutes among their child, $b = 0.28$, $SE = 0.10$, $p = .004$. For

example, 7 extra minutes in mother's wake minutes during the night, compared to her typical total wake minutes, would predict an increase of 2 wake minutes in her child.

Finally, within-person fluctuations in mothers' wake time the next morning significantly predicted their child's wake time, $b = 0.55$, $SE = 0.06$, $p < .001$, such when mothers' woke up earlier than usual, their child had an earlier wake time; conversely when mothers' woke up later than usual, their child had a later wake time. Specifically, for every 2-minutes that mothers wake up earlier or later than usual, children's wake time changes by 1-min. Fathers' sleep did not significantly predict children's sleep for any of the sleep parameters.

Notably, few of the covariates remained significant once mothers' and fathers' sleep were added to the models. Higher family income-to-needs ratio was related to better sleep efficiency, $b = 1.35$, $SE = 0.66$, $p = .046$, and less total wake minutes during the night, $b = -10.22$, $SE = 3.50$, $p = .004$; higher BMI predicted an earlier wake time, $b = 7.45$, $SE = 2.43$, $p = .002$. Higher maternal depressive symptoms predicted better child sleep efficiency, $b = 0.19$, $SE = 0.06$, $p = .002$, and less frequent long wake episodes, $b = -0.05$, $SE = 0.02$, $p = .028$.

Fathers' and Children's Sleep Predicting Mothers' Sleep

The duration, quality, and schedule of mothers' sleep was predicted by both fathers' and children's sleep that night (Table 3). Within-person fluctuation in fathers' sleep minutes, such that fathers slept longer than usual, predicted more sleep minutes for mothers that night, $b = .34$, $SE = .06$, $p < .001$. For example, for every 3 additional sleep minutes, compared to fathers' typical sleep duration, mothers' sleep duration would increase by approximately 1-min. Additionally, better father sleep efficiency, fewer long wake episodes, and fewer total wake minutes compared to fathers' usual sleep, predicted higher levels of sleep efficiency, $b = .22$, $SE = .06$, $p < .001$, fewer long wake episodes, $b = .15$, $SE = .07$, $p = .03$, and fewer wake minutes, $b = 0.22$, $SE = 0.06$, $p < .001$, respectively, for mothers that night. Specifically, a 5% change from fathers' typical sleep efficiency would predict an approximate 1% change in mothers' sleep efficiency that night; for every additional long wake episode, compared to fathers' typical number of long wake episodes, mothers' long wake episodes would increase by .15; and 5 extra wake minutes, compared to fathers' typical wake minutes, would predict an extra wake minute among mothers.

Moreover, within-person fluctuations in fathers' sleep schedule also predicted mothers' sleep schedule, such that later bedtimes, $b = 0.27$, $SE = 0.07$, $p = .001$, and earlier wake times, $b = 0.33$, $SE = 0.05$, $p < .001$, than usual predicted a later bedtime and earlier wake time for mothers that night and the next morning. Fathers going to bed 4 minutes later than usual or waking up 3 minutes later than usual would predict an approximate 1-min change in mothers' bedtime and wake time.

A similar pattern was found for children's sleep predicting mothers' sleep that night. More sleep minutes than usual among children positively predicted more sleep minutes for mothers that night, $b = .24$, $SE = .05$, $p < .001$. For every additional 4 minutes in children's sleep minutes, compared to their typical sleep duration, mothers' sleep duration would be expected to increase by approximately 1 minute. Better sleep efficiency, fewer long wake

episodes, and fewer total wake minutes than usual for children was also related to higher levels of sleep efficiency, $b = .09$, $SE = .04$, $p = .009$, fewer long wake episodes, $b = .09$, $SE = .04$, $p = .03$, and fewer wake minutes, $b = 0.08$, $SE = 0.03$, $p = .015$, respectively, for mothers that night. Specifically, a 10% change from children's typical sleep efficiency would predict an approximate 1% change in mothers' sleep efficiency that night; for every additional long wake episode, compared to children's typical number of long wake episodes, mothers' long wake episodes would increase by .09; and 12.5 extra wake minutes, compared to children's typical wake minutes, would predict an extra wake minute among mothers. Additionally, within-person fluctuations in children's wake time significantly predicted mothers' wake time, $b = 0.57$, $SE = 0.07$, $p < .001$. That is, children waking up 3.5-min earlier than their typical wake time would predict an approximate 2-min earlier wake time for mothers. There was no significant relation, however, between children's and mothers' bedtimes.

Few of the covariates remained significant predictors of mothers' sleep parameters, once accounting for father and child sleep in the models. European Americans, $b = -54.66$, $SE = 14.89$, $p < .001$, and biological mothers, $b = 52.33$, $SE = 22.96$, $p = .025$, had more sleep minutes during the night; higher levels of child depressive symptoms also predicted more sleep minutes for mothers, $b = 2.70$, $SE = 0.75$, $p = .001$. Medication use among mothers was related to an earlier bedtime, $b = -25.26$, $SE = 9.55$, $p = .01$.

Mothers' and Children's Sleep Predicting Fathers' Sleep

Fathers' sleep was positively predicted by mothers' sleep, but not by their child's sleep (Table 4). Specifically, within-person fluctuations in mothers' sleep minutes (more sleep minutes than usual) positively predicted fathers' sleep minutes the same night, $b = .33$, $SE = .06$, $p < .001$. For example, a 3-min increase in mothers' sleep minutes, compared to mothers' typical sleep duration, would predict a 1-min increase in fathers' sleep minutes. Better sleep efficiency than usual for mothers also predicted higher levels of fathers' sleep efficiency, $b = .35$, $SE = .10$, $p = .001$, and fewer total wake minutes than usual for mothers predicted fewer total wake minutes for fathers, $b = 0.32$, $SE = 0.10$, $p = .002$, that same night. That is, a 3% change in mothers' sleep efficiency, compared to their typical sleep efficiency, and a 3-min increase in mothers' total wake minutes, compared to their typical total wake minutes, would predict an approximate 1% increase in fathers' sleep efficiency and 1-min increase in their total wake minutes, respectively.

Moreover, within-person fluctuations in mothers' sleep schedule predicted fathers' sleep schedule, such that a later bedtime and earlier wake time than usual for mothers predicted a later bedtime, $b = 0.36$, $SE = .09$, $p < .001$, and earlier wake time, $b = 0.52$, $SE = 0.52$, $p < .001$, respectively, for fathers. Mothers going to bed 3 minutes later than usual or waking up 2 minutes later than usual would predict an approximate 1-min change in fathers' bedtime and wake time.

As with mother and child sleep models, few covariates remained significant predictors of fathers' sleep after the inclusion of children's and mothers' sleep in the models. Being married was related to more father sleep minutes, $b = 64.92$, $SE = 25.03$, $p = .011$, and a

higher family income-to-needs ratio was related to less frequent long wake episodes, $b = -0.45$, $SE = 0.21$, $p = .034$.

Correction for Multiple Tests

We used Benjamini-Hochberg's false discovery rate (Benjamini & Hochberg, 1995) to account for the multiple tests conducted and maintain the family-wise alpha at .05. This method controls for the expected proportion of false positives (incorrectly rejecting the null hypothesis) by adjusting the p -value depending on the number of significant findings within a family of tests. All significant relations between family members' sleep remained significant.

Post-hoc Analyses

It is recommended that at least five nights of actigraphy data should be available when averaging sleep variables across multiple nights (Acebo et al., 1999). Although this recommendation is not relevant for the current study, given we tested nightly fluctuations in sleep and did not average the sleep variables across the different nights, we took a conservative approach and ran post-hoc analyses excluding cases with less than 5 nights of actigraphy data ($N = 135$ families included in post-hoc analysis). These tests yielded an identical pattern of results, with two exceptions. The relation between fathers' long wake episode predicting mothers' long wake episode the same night was marginally significant ($p = .051$). The relation between children's long wake episode predicting fathers' long wake episode the same night reached significance, $b = .14$, $SE = .07$, $p = .04$; however, after accounting for multiple tests, this relation was no longer significant.

Discussion

The findings document within-family relations among children's, mothers', and fathers' sleep duration, quality, and wake time using objective measures of sleep, as well as self-reported bedtime between mothers and fathers. Nightly fluctuations in mothers' sleep predicted children's sleep the same night. Also, mothers' sleep was predicted by both their partners' and child's sleep the same night, whereas fathers' sleep was only predicted by their partners' sleep. The current study builds on previous work in this area in several important ways. First, we examined children's, mothers', and fathers' sleep in order to more fully examine the family context of sleep. Notably, once family members' sleep was included in models, few demographic, health (e.g., BMI, medication use) and psychological (i.e., depressive symptoms) covariates remained significant, attesting to the robustness of the findings. Second, sleep duration, quality, and wake time were measured with actigraphs, whereas the majority of previous research has relied on questionnaire measures which may introduce recall bias and cannot capture within-person fluctuations in sleep. Additionally, previous research has typically had parents report on both their own and their child's sleep, or has had adolescents report on their own and their parents' sleep. Thus, mono-informant effects could have been operative. Third, we utilized multilevel modeling to examine how nightly fluctuations in sleep duration and quality—that is, better or worse sleep than usual—and sleep schedule can predict other family members' sleep that same night. Finally, we

examined the study questions in a large and ethnically and economically diverse sample of families.

Although studies including both mothers and fathers are limited, our finding that children's sleep was predicted by mothers', but not fathers', sleep is consistent with previous studies of subjective sleep duration and quality (Bajoghli et al., 2013; Brand et al., 2009; Boergers et al., 2007) and Fuligni et al.'s (2015) study which found concordance in bedtime and wake time in a predominately mother-adolescent sample (83%). Moreover, the findings are also consistent with Kalak et al.'s (2012) study using sleep-EEG, which showed that children's sleep continuity and architecture was more strongly related to their mothers' than fathers' sleep. One potential explanation for why mothers' sleep predicted children's sleep, but fathers' sleep did not, is that mothers' sleep is more closely linked to the quality of the family environment, which may then in turn affect children's sleep. For example, Gregory et al. (2012) found that, controlling for family socioeconomic status and maternal depression, mothers' insomnia significantly predicted the family socialization environment (e.g., greater chaos, less happiness). A growing body of research has demonstrated how the quality of the family environment can either promote or disrupt children's sleep (e.g., El-Sheikh, Buckhalt, Mize, & Acebo, 2006).

Mothers' sleep was predicted by both fathers' and their child's sleep that same night. In contrast, fathers' sleep was only predicted by mothers' sleep that night. Specifically, when children's sleep duration was less than usual and their sleep quality was worse than usual (less sleep efficiency, more frequent long wake episodes, more total wake minutes), mothers also showed less sleep duration and worse sleep quality that same night. Similarly, when fathers' sleep duration was less than usual and their sleep quality was worse than usual, mothers' sleep was negatively affected. Taken together, the results predicting mothers' and fathers' sleep highlight two important points. First, there is a likely a bidirectional relation between mothers' and fathers' sleep. This is consistent with previous studies that have documented cross-sectional concordance among couples' sleep (Beninati, Harris, Herold, & Shepard, 1999; Meadows et al., 2009), and provides further support for shifting sleep research from an individual level of analysis to considering the social context of sleep. Several mechanisms have been proposed for why couples' sleep are related, including cognitive, behavioral, neurobiological, and physiological pathways (Troxel, 2010). For example, Troxel's (2010) review posited that ruminative thoughts, unhealthy behaviors, as well as elevated sympathetic nervous system and hypothalamic-pituitary-adrenal activity related to marital stress may interfere with couples' sleep. However, given the few longitudinal studies in this area, further assessment of pathways of effects is warranted.

Second, nightly variation in children's sleep was predicted mothers', but not fathers', sleep. These findings are consistent with Leonhard and Randler (2009), who found that the presence of children affects women's sleep-wake rhythm when compared to pregnant woman and women without children. These results are also consistent with other studies which have found stronger relations between subjective measures of mother-child sleep duration and quality, as compared to the sleep in the father-child dyad (Bajoghli et al., 2013; Boegers et al., 2007; Brand et al., 2009). Thus, the current study, together with complementary studies, suggest that mothers' sleep is affected in more ways by disruptions

to other family members' sleep when compared to fathers. This may be due to the fact that mothers tend to be the primary caretaker in the family, and are more likely to respond to child sleep problems during the night as compared to fathers (e.g., Crowe et al., 1996). Further, mothers of children with sleep problems report greater parenting stress and caregiver overload (Meltzer & Mindell, 2007), and report more daytime sleepiness even when they have similar sleep duration as fathers (Boergers et al., 2007). Research also suggests that women may be more physiologically affected by relationship factors than men (Cross & Madson, 1997; Kiecolt-Glaser & Newton, 2001). In general, mothers are more likely to perceive themselves as responsible for the functioning of the family, and also play a central role in promoting active father-child relationships (Walker & McGraw, 2000). Thus, the stress and responsibility for managing the family may result in undue burden and anxiety that affects mothers' sleep. Evidently, all of these propositions are speculative and should be interpreted cautiously pending explication of underlying mechanisms.

The bivariate correlations between fathers' and children's sleep were significant; however, father and child sleep were no longer related in models that included mothers' sleep. Thus, the findings can be interpreted as showing that variation in fathers' sleep does not uniquely predict children's sleep, over and above mothers' sleep. Previous studies with infants and young children indicate that fathers may be less involved when it comes to caregiving during the night and related to sleep (Crowe et al., 1996). For example, Millikovsky-Ayalon, Atzaba-Poria, and Meiri (2015) found that fathers of children ages 1–3 with a sleep disturbance experienced similar levels of parenting stress as mothers; however, they were less sensitive during father-child interactions and less involved in caregiving, as compared to fathers of children without sleep problems. Although caution must be used when interpreting null findings, the lack of relations between father-child sleep in the current study suggest that fathers may continue to be less involved in caregiving surrounding sleep during early adolescence. Moreover, because in infancy mothers are primarily responsible for nighttime feedings (Tikotzky et al., 2011), this may develop into a family pattern leading to mothers becoming more sensitive to their child's needs during the night. These explanations are clearly speculative, as we did not explicitly assess parents' nighttime caregiving behavior, and there are no studies to our knowledge on father's involvement regarding sleep in early adolescence. However, the broader literature on father involvement does support that mothers remain more involved in and interact more with their children into adolescence (Lewis & Lamb, 2003). Indeed, the higher participation rate of mothers as compared to fathers in the actigraphy data collection of the current study may provide indirect support of greater involvement of mothers in child caregiving and development. Our understanding of children's sleep and the development of sleep problems will be enhanced by further study of the caregiving roles and involvement of mothers and fathers in children's sleep in early and late adolescence.

Supporting the robustness of the current findings, relations between family members' sleep were found for sleep duration, sleep quality, and sleep schedule (wake times). Although practical guidelines for parents and families typically focus on sleep duration (e.g., National Sleep Foundation, 2011), sleep quality is particularly important for children's adaptation and development, including physical growth and brain maturation (Feinberg & Campbell, 2010; Sadeh, Dahl, Shahar, & Rosenblat-Stein, 2009), cognitive development (Astill et al., 2012),

and emotional development and adjustment (Gregory & Sadeh, 2012; Kelly & El-Sheikh, 2014). Sleep quality is also frequently related to environmental stress and negative outcomes, even when sleep duration is not influential (Kelly et al., 2014; Kouros & El-Sheikh, 2015; Soffer-Dudek, Sadeh, Dahl, & Rosenblat-Stein, 2011). For example, Kouros and El-Sheikh (2015) found that disruptions in children's sleep efficiency and latency (but not sleep minutes) predicted higher levels of daily negative mood, which in turn predicted higher levels of internalizing and externalizing symptoms.

Limitations of the present study provide a context for the interpretation of findings and directions for future research. First, we examined relations among school-age children in two-parent family homes, which is a notable contribution given the majority of previous work has focused on family sleep in infancy and early-childhood. However, it is not known whether the findings would generalize to older adolescents and their parents, given family routines may be less synchronous during adolescence, and there are significant changes in sleep duration, quality and schedule in adolescence. Therefore, family members' sleep may be more or less intertwined during different development periods. Similarly, our findings may not generalize to other family structures, such as families with non-residential fathers or children reared by a mother and grandmother, or grandparents. Second, our sample included typically developing children and we excluded parents' data if they reported having a diagnosed sleep problem. Therefore, relations may vary in clinical samples; that is, clinical levels of sleep problems in one family member may be even more disruptive to other family members' sleep compared the effects observed in the present study. Third, our sample resided in semi-rural Alabama in mostly separate housing units (e.g., trailers, houses) and findings may not generalize to other locales and environments. Fourth, subjective measures of sleep using questionnaires and objective measures of sleep both have advantages and disadvantages (Sadeh, 2011; 2015). Using actigraphy to examine sleep duration and quality is an advance in this area of inquiry, and allowed us to measure multiple sleep parameters without recall bias. However, actigraphy does not allow for the assessment of sleep architecture. Examining concordance of other sleep dimensions among family members using polysomnography would illuminate examined relations. Additionally, actigraphy cannot measure behavioral sleep problems such as bedtime resistance. Fifth, the data are correlational, and therefore causal conclusions about family members' sleep cannot be made. Although the findings suggest that there are bidirectional relations among some family dyads' sleep, it is also likely that there are third variables that account for these relations. For example, shared stressors within the family environment may serve as a "third variable" that accounts for the concordance in poor sleep among family members. Relatedly, we did not consider the role of siblings in this study, and there were not enough cases to examine the role of sharing a bedroom. Notably, however, sleeping with their parents did not emerge as a significant predictor of family members' sleep.

Finally, an important future research direction is to understand the pathways linking family members' sleep, and to explicate which families are more or less likely to show concordance in sleep parameters. In addition to genetic underpinnings, many environmental and relationship factors (e.g., conflict, parental psychopathology) have been linked with poor sleep quality in both parents and children (Bernert et al., 2007; Brand et al., 2009; Rauer, Kelly, Buckhalt, & El-Sheikh, 2010). Additionally, understanding the consequences of

concordant sleep among family members for family functioning and health outcomes remains to be tested.

The current study provides support for the importance of studying sleep within a family context. The results demonstrated that within-person variation in sleep can predict other family members' sleep that night, especially between mothers and children. Understanding social and familial factors that predict sleep is especially important given the pivotal role sleep plays in children's and adults' health and well-being (El-Sheikh & Sadeh, 2015; Gallicchio & Kalesan, 2009). Moreover, sleep problems in one family member can have negative ramifications for other family members' health and well-being (e.g., Meltzer & Mindell, 2007; Bajoghli et al., 2013). Conversely, the findings from the current study also suggest that longer sleep duration and better sleep quality can positively predict better sleep outcomes for other family members. Evidence suggests that behavioral interventions for sleep problems can be effective for reducing sleep problems (Mindell, Kuhn, Lewin, Meltzer, & Sadeh, 2006). A practical implication of the study findings, thus, are that taking a family-wide approach to sleep interventions may further improve the efficacy of behavioral interventions and treatments for sleep problems for parents and their children.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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References

- Acebo, C., Carskadon, M. Scoring actigraph data using ACTION-W 2. EP Bradley Sleep Center, Brown University; Providence, RI: 2001. Unpublished laboratory manual
- Acebo C, Sadeh A, Seifer R, Tzischinsky O, Wolfson AR, Hafer A, Carskadon MA. Estimating sleep patterns with activity monitoring in children and adolescents: How many nights are necessary for reliable measures? *Sleep*. 1999; 22:95–103. [PubMed: 9989370]
- ActionW User's Guide version 2.4. Ardsley, NY: Ambulatory Monitoring, Inc; 2002.
- Adam EK, Snell EK, Pendry P. Sleep timing and quantity in ecological and family context: A nationally representative time-diary study. *Journal of Family Psychology*. 2007; 21:4–19. DOI: 10.1037/0893-3200.21.1.4 [PubMed: 17371105]
- Astill RG, Van der Heijden KB, Van IJzendoorn MH, Van Someren EJW. Sleep, cognition, and behavioral problems in school-age children: A century of research meta-analyzed. *Psychological Bulletin*. 2012; 138:1109–1138. DOI: 10.1037/a0028204 [PubMed: 22545685]
- Bajoghli H, Alipouri A, Holsboer-Trachsler E, Brand S. Sleep patterns and psychological functioning in families in northeastern Iran: Evidence for similarities between adolescent children and their parents. *Journal of Adolescence*. 2013; 36:1103–1113. DOI: 10.1016/j.adolescence.2013.08.016 [PubMed: 24215957]
- Bernert RA, Merrill KA, Braithwaite SR, Van Orden KA, Joiner TE Jr. Family life stress and insomnia symptoms in a prospective evaluation of young adults. *Journal of Family Psychology*. 2007; 21:58–66. DOI: 10.1037/0893-3200.21.1.58 [PubMed: 17371110]

- Beninati W, Harris CD, Herold DL, Shepard JW Jr. The effect of snoring and obstructive sleep apnea on the sleep quality of bed partners. *Mayo Clinic Proceedings*. 1999; 74:955–958. DOI: 10.4065/74.10.955 [PubMed: 10918859]
- Benjamini Y, Hochberg Y. Controlling the false discovery rate: A practical and powerful approach to multiple testing. *Journal of the Royal Statistical Society Series B (Methodological)*. 1995; 57:289–300.
- Boergers J, Hart C, Owens JA, Streisand R, Spirito A. Child sleep disorders: Associations with parental sleep duration and daytime sleepiness. *Journal of Family Psychology*. 2007; 21:88–94. DOI: 10.1037/0893-3200.21.1.88 [PubMed: 17371113]
- Bolger, N., Laurenceau, J-P. *Intensive longitudinal methods: An introduction to diary and experience sampling methods*. New York: Guildford Press; 2013.
- Brand S, Gerber M, Hatzinger M, Beck J, Holsboer-Trachsler E. Evidence of similarities between adolescents and parents in sleep patterns. *Sleep Medicine*. 2009; 10:1124–1131. DOI: 10.1016/j.sleep.2008.12.013 [PubMed: 19464234]
- Bronfenbrenner U. Ecology of the family as a context for human development: Research perspectives. *Developmental Psychology*. 1986; 22:723–742. DOI: 10.1037/0012-1649.22.6.723
- Buckhalt JA, El-Sheikh M, Keller PS, Kelly RJ. Concurrent and longitudinal relations between children's sleep and cognitive functioning: The moderating role of parent education. *Child Development*. 2009; 80:875–892. DOI: 10.1111/j.14678624.2009.01303.x [PubMed: 19489909]
- Carmichael CL, Reis HT. Attachment, sleep quality, and depressed affect. *Health Psychology*. 2005; 24:526–531. DOI: 10.1037/0278-6133.24.5.526 [PubMed: 16162047]
- Cole RJ, Kripke DF. Progress in automatic sleep-wake scoring by wrist actigraph. *Sleep Research*. 1989; 18:331.
- Cole RJ, Kripke DF, Gruen W, Mullaney DJ, Gillin JC. Automatic sleep/wake identification from wrist activity. *Sleep*. 1992; 15:461–469. [PubMed: 1455130]
- Colten, HR., Altevogt, BM. *Institute of Medicine Committee on Sleep Medicine and Research. Sleep disorders and sleep deprivation: An unmet public health problem*. Washington, DC: National Academies Press; 2006.
- Counterline MS, Teti DM. Sleep arrangements and maternal adaptation in infancy. *Infant Mental Health Journal*. 2010; 31:647–663. DOI: 10.1002/imhj.20276 [PubMed: 28543065]
- Cox MJ, Paley B. Families as systems. *Annual Review of Psychology*. 1997; 48:243–267. DOI: 10.1146/annurev.psych.48.1.243
- Cross SE, Madson L. Models of the self: Self-construals and gender. *Psychological Bulletin*. 1997; 122:5–37. DOI: 10.1037/0033-2909.122.1.5 [PubMed: 9204777]
- Crowe TK, Clark L, Quails C. The impact of child characteristics on mothers' sleep patterns. *OTJR: Occupation, Participation, and Health*. 1996; 16:3–22. DOI: 10.1177/153944929601600101
- Dahl RE. The regulation of sleep and arousal: Development and psychopathology. *Development and Psychopathology*. 1996; 8:3–27. DOI: 10.1017/S0954579400006945
- Dahl RE, El-Sheikh M. Considering sleep in a family context: Introduction to the special issue. *Journal of Family Psychology*. 2007; 21:1–3. DOI: 10.1037/0893-3200.21.1.1 [PubMed: 17371104]
- Dregan A, Armstrong D. Adolescent sleep disturbances as predictors of adulthood sleep disturbances—A cohort study. *Journal of Adolescent Health*. 2010; 46:482–487. DOI: 10.1016/j.jadohealth.2009.11.197 [PubMed: 20413085]
- El-Sheikh M, Buckhalt JA, Mize J, Acebo C. Marital conflict and disruptions to children's sleep. *Child Development*. 2006; 77:31–43. DOI: 10.1111/j.1467-8624.2006.00854.x [PubMed: 16460523]
- El-Sheikh M, Kelly RJ, Buckhalt JA, Hinnant JB. Children's sleep and adjustment over time: The role of socioeconomic context. *Child Development*. 2010; 81:870–883. DOI: 10.1111/j.1467-8624.2010.01439.x [PubMed: 20573110]
- El-Sheikh M, Kelly RJ, Koss KJ, Rauer AJ. Longitudinal relations between constructive and destructive conflict and couples' sleep. *Journal of Family Psychology*. 2015; 29:349–359. DOI: 10.1037/fam000083 [PubMed: 25915089]
- El-Sheikh M, Sadeh A. Sleep and development: Advancing theory and research. *Monographs of the Society for Research in Child Development*. 2015; 80:1–215. DOI: 10.1111/mono.12140

- El-Sheikh M, Tu KM, Saini EK, Fuller-Rowell TE, Buckhalt JA. Perceived discrimination and youth's adjustment: Sleep as a moderator. *Journal of Sleep Research*. 2016; 25:70–77. DOI: 10.1111/jsr.12333 [PubMed: 26260026]
- Enders, CK. *Applied missing data analysis*. New York: Guilford Press; 2010.
- Feinberg I, Campbell IG. Sleep EEG changes during adolescence: An index of a fundamental brain reorganization. *Brain and Cognition*. 2010; 72:56–65. DOI: 10.1016/j.bandc.2009.09.008 [PubMed: 19883968]
- Fricke-Oerkermann L, Plück J, Schredl M, Heinz K, Mitschke A, Wiater A, Lehmkuhl G. Prevalence and course of sleep problems in childhood. *Sleep*. 2007; 30:1371–1377. [PubMed: 17969471]
- Fuligni AJ, Tsai KM, Krull JL, Gonzales NA. Daily concordance between parent and adolescent sleep habits. *Journal of Adolescent Health*. 2015; 56:244–250. DOI: 10.1016/j.jadohealth.2014.09.013 [PubMed: 25620309]
- Gallicchio L, Kalesan B. Sleep duration and mortality: A systematic review and meta-analysis. *Journal of Sleep Research*. 2009; 18:145–158. DOI: 10.1111/j.1365-2869.2008.00732.x [PubMed: 19645959]
- Gay CL, Lee KA, Lee S-YL. Sleep patterns and fatigue in new mothers and fathers. *Biological Research for Nursing*. 2004; 5:311–318. DOI: 10.1177/1099800403262142 [PubMed: 15068660]
- Goldman SE, Wang L, Fawkes DB. Concordance of mother/child sleep patterns using actigraphy: Preliminary findings. *Journal of Sleep Disorder—Treatment and Care*. 2014; 3doi: 10.4172/2325-9639.1000133
- Gregory AM, Moffitt TE, Ambler A, Arseneault L, Houts RM, Caspi A. Maternal insomnia and children's family socialization environment. *Sleep*. 2012; 35:579–582. DOI: 10.5665/sleep.1750 [PubMed: 22467996]
- Gregory AM, Sadeh A. Sleep, emotional and behavioral difficulties in children and adolescents. *Sleep Medicine Reviews*. 2012; 16:129–136. DOI: 10.1016/j.smrv.2011.03.007 [PubMed: 21676633]
- Hasler BP, Troxel WM. Couples' nighttime sleep efficiency and concordance: Evidence for bidirectional associations with daytime relationship functioning. *Psychosomatic Medicine*. 2010; 72:794–801. DOI: 10.1097/PSY.0b013e3181ecd08a [PubMed: 20668283]
- Hoffman, L. *Longitudinal analysis: Modeling within-person fluctuation and change*. New York: Routledge; 2015.
- Kalak N, Gerber M, Kirov R, Mikoteit T, Puhse U, Holsboer-Trachsler E, Brand S. The relation of objective sleep patterns, depressive symptoms, and sleep disturbances in adolescent children and their parents: A sleep-EEG study with 47 families. *Journal of Psychiatric Research*. 2012; 46:1374–1382. DOI: 10.1016/j.jpsychires.2012.07.006 [PubMed: 22841346]
- Kane HS, Slaticher RB, Reynolds BM, Repetti RL, Robles TF. Daily self-disclosure and sleep in couples. *Health Psychology*. 2014; 33:813–822. DOI: 10.1037/hea0000077 [PubMed: 25068453]
- Keller PS, El-Sheikh M. Children's emotional security and sleep: Longitudinal relations and directions of effects. *Journal of Child Psychology and Psychiatry*. 2011; 52:64–71. DOI: 10.1111/j.1469-7610.2010.02663.x [PubMed: 20500540]
- Kelly R, El-Sheikh M. Reciprocal relations between children's sleep and their adjustment over time. *Developmental Psychology*. 2014; 50:1137–1147. DOI: 10.1037/a0034501 [PubMed: 24188035]
- Kelly Y, Kelly J, Sacker A. Time for bed: Associations with cognitive performance in 7-year-old children: A longitudinal population-based study. *Journal of Epidemiology and Community Health*. 2013; Published Online First [8 July 2013]. doi: 10.1136/jech-2012-20204
- Kelly RJ, Marks BT, El-Sheikh M. Longitudinal relations between parent-child conflict and children's adjustment: The role of children's sleep. *Journal of Abnormal Child Psychology*. 2014; 42:1175–1185. DOI: 10.1007/s10802-014-9863-z [PubMed: 24634010]
- Kiecolt-Glaser JK, Newton TL. Marriage and health: His and hers. *Psychological Bulletin*. 2001; 127:472–503. DOI: 10.1037/0033-2909.127.4.472 [PubMed: 11439708]
- Kouros CD, El-Sheikh M. Daily mood and sleep: Reciprocal relations and links with adjustment problems. *Journal of Sleep Research*. 2015; 24:24–31. DOI: 10.1111/jsr.12226 [PubMed: 25212526]
- Lee KA, Zaffke ME, McEnany G. Parity and sleep patterns during and after pregnancy. *Obstetrics & Gynecology*. 2000; 95:14–18. [PubMed: 10636494]

- Leonhard C, Randler C. In sync with the family: Children and partners influence the sleep-wake circadian rhythm and social habits of women. *Chronobiology International*. 2009; 26:510–525. DOI: 10.1080/07420520902821101 [PubMed: 19360493]
- Lewis C, Lamb ME. Fathers' influence on children's development: The evidence from two-parent families. *European Journal of Psychology of Education*. 2003; 2:211–228. DOI: 10.1007/BF03173485
- Lopez-Wagner MC, Hoffman CD, Sweeney DP, Hodge D, Gilliam JE. Sleep problems of parents of typically developing children and parents of children with autism. *The Journal of Genetic Psychology: Research and Theory on Human Development*. 2008; 169:245–260. DOI: 10.3200/GNTP.169.3.245-260
- Maas CJM, Hox JJ. Sufficient sample sizes for multilevel modeling. *Methodology: European Journal of Research Methods for the Behavioral & Social Sciences*. 2005; 1:86–92. DOI: 10.1027/1614-2241.1.3.86
- Martin J, Hiscock H, Hardy P, Davey B, Wake M. Adverse associations of infant and child sleep problems and parent health: An Australian population study. *Pediatrics*. 2007; 119:947–955. DOI: 10.1542/peds.2006-2569 [PubMed: 17473096]
- Meadows R, Arber S, Venn S, Hislop J, Stanley N. Exploring the interdependence of couples' rest-wake cycles: An actigraph study. *Chronobiology International*. 2009; 26:80–92. DOI: 10.1080/07420520802678452 [PubMed: 19142759]
- Meltzer LJ, Mindell JA. Relationship between child sleep disturbances and maternal sleep, mood, and parenting stress: A pilot study. *Journal of Family Psychology*. 2007; 21:67–73. DOI: 10.1037/0893-3200.21.1.67 [PubMed: 17371111]
- Meltzer LJ, Montgomery-Downs HE. Sleep in the family. *Pediatric Clinics of North America*. 2011; 58:765–774. DOI: 10.1016/j.pcl.2011.03.010 [PubMed: 21600354]
- Millikovsky-Ayalon M, Atzaba-Poria N, Meiri G. The role of the father in child sleep disturbance: Child, parent, and parent-child relationship. *Infant Mental Health Journal*. 2015; 36:114–127. DOI: 10.1002/imhj.21491 [PubMed: 25501300]
- Mindell JA, Kuhn B, Lewin DS, Meltzer LJ, Sadeh A. Behavioral treatment of bedtime problems and night wakings in infants and young children. *Sleep*. 2006; 29:1263–1276. [PubMed: 17068979]
- Mindell, JA., Owens, J., editors. *A clinical guide to pediatric sleep: Diagnosis and management of sleep problems*. Philadelphia, PA: Lippincott Williams & Wilkins; 2010. Evaluation of pediatric sleep problems; p. 42-54.
- National Sleep Foundation. How much sleep do we really need?. 2011. Retrieved from <http://sleepfoundation.org/how-sleep-works/how-much-sleep-do-we-really-need>
- Nielsen LS, Danielsen KV, Sørensen TIA. Short sleep duration as a possible cause of obesity: Critical analysis of the epidemiological evidence. *Obesity Reviews*. 2011; 12(2):78–92. DOI: 10.1111/j.1467-789X.2010.00724.x [PubMed: 20345429]
- Petersen AC, Crockett L, Richards M, Boxer A. A self-report measure of pubertal status: Reliability, validity, and initial norms. *Journal of Youth and Adolescence*. 1998; 17:117–133. DOI: 10.1007/BF01537962
- Pleck, JH., Masciadrelli, BP. Paternal involvement by US residential fathers: Levels, sources, and consequences. In: Lamb, ME., editor. *The role of the father in child development*. 4. Hoboken, NJ: Wiley; 2004. p. 222-271.
- Raudenbush, SW., Bryk, AS. *Hierarchical linear models: Applications and data analysis methods*. 2. Thousand Oaks, CA: Sage Publications, Inc; 2002.
- Rauer AJ, Kelly RJ, Buckhalt JA, El-Sheikh M. Sleeping with one eye open: Marital abuse as an antecedent of poor sleep. *Journal of Family Psychology*. 2010; 24:667–677. DOI: 10.1037/a0021354 [PubMed: 21171765]
- Roth T, Jaeger S, Jin R, Kalsekar A, Strang PE, Kessler RC. Sleep problems, comorbid mental disorders, and role functioning in the national comorbidity survey replication. *Biological Psychiatry*. 2006; 60:1364–1371. DOI: 10.1016/j.biopsych.2006.05.039 [PubMed: 16952333]
- Sadeh, A. Sleep assessment methods. In: El-Sheikh, M., editor. *Sleep and development: Familial and socio-cultural considerations*. New York: Oxford University Press; 2011. p. 355-374.

- Sadeh A. III. Sleep assessment methods. *Monographs of the Society for Research in Child Development*. 2015; 80:33–48. DOI: 10.1111/mono.12143 [PubMed: 25704734]
- Sadeh A, Dahl RE, Shahar G, Rosenblat-Stein S. Sleep and the transition to adolescence. A longitudinal study. *Sleep*. 2009; 32:1602–1609. [PubMed: 20041596]
- Sadeh A, Gruber R, Raviv A. The effects of sleep restriction and extension on school-age children: What a difference an hour makes. *Child Development*. 2003; 74:444–455. DOI: 10.1111/1467-8624.7402008 [PubMed: 12705565]
- Sadeh A, Raviv A, Gruber R. Sleep patterns and sleep disruptions in school-age children. *Developmental Psychology*. 2000; 36:291–301. DOI: 10.1037/0012-1649.36.3.291 [PubMed: 10830974]
- Sadeh A, Sharkey KM, Carskadon MA. Activity-based sleep-wake identification: An empirical test of methodological issues. *Sleep*. 1994; 17:201–207. [PubMed: 7939118]
- Schafer JL, Graham JW. Missing data: Our view of the state of the art. *Psychological Methods*. 2002; 7:147–177. DOI: 10.1037/1082-989X.7.2.147 [PubMed: 12090408]
- Shochat T, Cohen-Zion M, Tzischinsky O. Functional consequences of inadequate sleep in adolescents: A systematic review. *Sleep Medicine Reviews*. 2014; 18:75–87. DOI: 10.1016/j.smrv.2013.03.005 [PubMed: 23806891]
- Sinai D, Tikotzky L. Infant sleep, parental sleep and parenting stress in families of mothers on maternity leave and in families of working mothers. *Infant Behavior and Development*. 2012; 35:179–186. DOI: 10.1016/j.infbeh.2012.01.006 [PubMed: 22306183]
- Smedje H, Broman JE, Hetta J. Sleep disturbances in Swedish pre-school children and their parents. *Nordic Journal of Psychiatry*. 1998; 52:59–67. DOI: 10.1080/080394898422580
- Soffer-Dudek N, Sadeh A, Dahl RE, Rosenblat-Stein S. Poor sleep quality predicts deficient emotion information processing over time in early adolescence. *Sleep*. 2011; 34:1499–1508. [PubMed: 22043121]
- Tavernier R, Willoughby T. Bidirectional associations between sleep (quality and duration) and psychosocial across the university years. *Developmental Psychology*. 2014; 50:674–682. DOI: 10.1037/a0034258 [PubMed: 23978302]
- Thomas KA, Foreman SW. Infant sleep and feeding pattern: Effects on maternal sleep. *Journal of Midwifery & Women's Health*. 2005; 50:399–404. DOI: 10.1016/j.jmwh.2005.04.010
- Tikotzky L, Sadeh A, Glickman-Gavrieli T. Infant sleep and paternal involvement in infant caregiving during the first 6 months of life. *Journal of Pediatric Psychology*. 2011; 36:36–46. DOI: 10.1093/jpepsy/jsq036 [PubMed: 20444853]
- Tikotzky L, Sadeh A, Volkovich E, Manber R, Meiri G, Shahar G. VII. Infant sleep development from 3 to 6 months postpartum: Links with maternal sleep and paternal involvement. *Monographs of the Society for Research in Child Development*. 2015; 80:107–124. DOI: 10.1111/mono.12147 [PubMed: 25704738]
- Troxel WM. It's more than sex: Exploring the dyadic nature of sleep and implications for health. *Psychosomatic Medicine*. 2010; 72:578–586. DOI: 10.1097/PSY.0b013e3181de7ff8 [PubMed: 20467000]
- U.S. Department of Commerce. How the Census Bureau measures poverty. n.d. Retrieved from <http://www.census.gov/hhes/www/poverty/about/overview/measure.html>
- Walker AJ, McGraw LA. Who is responsible for responsible fathering? *Journal of Marriage and Family*. 2000; 62:563–569. DOI: 10.1111/j.1741-3737.2000.00563.x

Table 1
Means, Standard Deviation, and Correlations among Mothers', Fathers', and Children's Actigraphy-based Sleep Variables

	<i>M</i>	<i>SD</i>	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.
1. Mother Sleep Minutes	393.05	65.05	--																	
2. Mother Sleep Efficiency	93.09	9.52	.30**	--																
3. Mother Long Wake Episode	1.76	1.84	-.33**	-.63**	--															
4. Mother Wake Minutes	28.68	33.00	-.34**	-.68**	.93**	--														
5. Mother Bedtime	1349.60	68.43	-.31**	.12	-.23**	-.19*	--													
6. Mother Wake Time	372.24	54.14	.19*	-.01	.02	-.002	.30**	--												
7. Father Sleep Minutes	380.61	77.53	.25*	.14	-.13	-.15	-.14	.13	--											
8. Father Sleep Efficiency	90.87	10.17	.11	.20*	-.25*	-.26*	-.03	.07	.64**	--										
9. Father Long Wake Episode	2.45	2.99	-.30**	-.14	.13	.18†	.02	.02	-.48**	-.62**	--									
10. Father Wake Minutes	39.28	42.18	-.10	-.23*	.26*	.27**	.004	-.04	-.56**	-.98**	.68**	--								
11. Father Bedtime	1353.17	93.71	-.14	.14	-.16	-.13	.45**	.30**	-.11	.02	-.03	-.04	--							
12. Father Wake Time	367.35	77.14	-.03	.02	.03	-.01	.20*	.40**	.37**	.02	.10	.05	.62**	--						
13. Child Sleep Minutes	446.38	52.83	.16†	.19*	-.24**	-.28**	.14†	.12	.35**	.31*	-.39**	-.30**	.07	.12	--					
14. Child Sleep Efficiency	88.20	8.19	.06	.20*	-.25**	-.30**	.20*	.18*	.33**	.35**	-.44**	-.36**	.13	.13	.78**	--				
15. Child Long Wake Episode	3.48	2.31	-.10	-.20*	.25**	.30**	-.17*	-.17*	-.33**	-.39**	.50**	.39**	-.11	-.08	-.66**	-.91**	--			
16. Child Wake Minutes	60.49	41.29	-.04	-.19*	.21*	.29**	-.21*	-.18*	-.29**	-.35**	.43**	.35*	-.14	-.12	-.71**	-.99**	.92**	--		
17. Child Bedtime	1273.88	42.84	-.09	.03	-.01	-.002	.27**	.35**	.02	-.06	.13	.06	.31**	.28**	-.21**	.08	-.10	-.12	--	
18. Child Wake Time	379.12	44.83	-.02	-.02	.10	.06	.13	.55**	.19†	.04	-.07	-.04	.19*	.45**	.27**	.15*	-.07	-.12	.41**	--

Note. *N* = 163 families. Sleep variables averaged across 7 nights for descriptive purposes.

$p < .10$
 $p < .05$
 $p < .10$

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Table 2

Parameter Estimates from HLM Analyses Predicting Children's Sleep from Mothers' and Fathers' Sleep the Same Night

	Sleep Parameter					
	Sleep Minutes	Sleep Efficiency	Long Wake Episode	Wake Minutes	Bedtime ^a	Wake Time
	b (SE)	b (SE)	b (SE)	b (SE)	b (SE)	b (SE)
Level 1 (Within-family relations)						
Intercept	456.33 (6.10)	88.34 (0.72)**	3.41 (0.29)**	60.21 (3.63)**	1272.85 (4.04)**	377.07 (4.56)**
Time	-0.30 (1.31)	0.16 (0.15)	-0.04 (0.06)	-0.73 (0.73)	0.13 (0.90)	1.50 (0.99)
Weekend vs. Weekday	-6.60 (5.96)	-1.07 (.58) [†]	0.41 (0.22) [†]	6.15 (3.30) [†]	64.93 (5.74)**	-3.77 (4.37)
Mother's Sleep	0.17 (.05)**	0.26 (0.08)**	0.13 (0.09)	0.28 (0.10)**	-0.01 (0.03)	0.55 (0.06)**
Father's Sleep	0.06 (.06)	0.09 (0.12)	0.11 (0.08)	0.01 (0.12)	0.01 (0.02)	0.02 (0.04)
Level 2						
Averaged Mother Sleep	0.03 (.07)	0.29 (0.06)**	0.32 (0.12)*	0.18 (.06)**	0.15 (0.06)**	0.43 (0.08)**
Averaged Father Sleep	0.20 (.08)*	0.09 (0.05) [†]	0.23 (0.12) [†]	0.17 (0.08)*	0.08 (0.05) [†]	0.11 (0.05)*
Child Age	-7.72 (7.35)	0.95 (0.94)	-0.00 (.31)	4.94 (4.87)	5.26 (7.10)	8.05 (5.68)
Child Race	1.69 (11.39)	1.88 (1.54)	-0.44 (0.53)	-4.32 (7.32)	13.27 (7.73) [†]	1.69 (8.06)
Child BMI	-4.00 (3.77)	0.08 (0.47)	0.03 (0.19)	-0.74 (2.56)	3.49 (2.93)	7.45 (2.43)**
Parents' Marital Status	-30.11 (19.81)	-1.33 (2.24)	1.12 (0.72)	12.10 (10.71)	16.78 (13.14)	22.65 (14.11)
Family Income-to-Needs Ratio	6.94 (5.11)	1.35 (0.66)*	-0.35 (0.24)	-10.22 (3.50)**	6.78 (4.23)	0.36 (3.91)
Pubertal Status	-3.80 (8.66)	-1.33 (2.24)	-0.56 (0.44)	-3.14 (6.68)	13.38 (7.93) [†]	-4.22 (7.96)
Mother Depressive Symptoms	0.37 (.51)	0.19 (0.06)**	-0.05 (0.02)*	-0.70 (0.36) [†]	0.80 (0.49)	-0.25 (0.52)
Level 2						
			Random Effects (Variance Estimates)			
		Variance (SD)	Variance (SD)	Variance (SD)	Variance (SD)	Variance (SD)
Intercept	1942.17 (44.08)**	24.64 (4.96)**	4.41 (2.10)**	895.52 (29.93)**	894.47 (29.91)**	1010.94 (31.80)**
Time	20.88 (4.57)	0.09 (0.31)	0.12 (0.34)*	8.20 (2.86)*	12.17 (3.49)	13.11 (3.62)
Mother's Sleep	0.03 (.16)	0.08 (0.29)	0.13 (0.36) [†]	0.18 (0.43)*	0.02 (0.13)	0.11 (0.33)**

Sleep Parameter						
	Sleep Minutes	Sleep Efficiency	Long Wake Episode	Wake Minutes	Bedtime ^a	Wake Time
Fixed Effects						
Level 1 (Within-family relations)	b (SE)	b (SE)	b (SE)	b (SE)	b (SE)	b (SE)
Father's Sleep	0.25 (.06)	0.64 (0.80)**	0.07 (0.26)*	0.62 (0.79)**	0.001 (0.03)	0.02 (0.13)*
Level 1 residual	2188.88 (46.79)	26.46 (5.14)	3.54 (1.88)	829.74 (29.81)	1285.10 (35.85)	1341.86 (36.63)

Note. Estimates with robust standard errors reported. Mother's and Father's sleep at Level 1 were person-centered, and the person-mean across nights for each was included at Level 2.

^aBedtime and Wake Time are in minutes of the day. Time was coded such that 0 = night 1 of data collection. Weekend vs. Weekday coded as 0 = weekday, 1 = weekend. Child race coded 0 = European American, 1 = African American. Parents' marital status coded as 0 = not married, 1 = married.

[#] $p < .10$,
* $p < .05$,
** $p < .01$

Table 3

Parameter Estimates from HLM Analyses Predicting Mothers' Sleep from Fathers' and Children's Sleep the Same Night

	Sleep Parameter					
	Sleep Minutes	Sleep Efficiency	Long Wake Episode	Wake Minutes	Bedtime ^a	Wake Time
	b (SE)	b (SE)	b (SE)	b (SE)	b (SE)	b (SE)
Level 1 (Within-family relations)						
Intercept	388.23 (7.31) **	92.65 (1.06) **	1.89 (0.22) **	30.81 (4.01) **	1353.31 (5.48) **	376.64 (5.05) **
Time	-0.46 (1.45)	0.24 (0.17)	-0.03 (0.04)	-0.51 (0.54)	-1.41 (1.28)	-1.76 (1.06) †
Weekend vs. Weekday	26.04 (6.64) **	0.19 (0.39)	0.13 (0.16)	-0.20 (1.86)	3.16 (7.05)	11.67 (3.94) **
Father's Sleep	0.34 (0.06) **	0.22 (0.06) **	0.15 (0.07) *	0.22 (0.06) **	0.27 (0.07) **	0.33 (0.05) **
Child's Sleep	0.24 (0.05) **	0.09 (0.04) **	0.09 (0.04) *	0.08 (0.03) *	0.01 (0.11)	0.57 (0.07) **
Level 2						
Averaged Father Sleep	0.12 (0.09)	0.09 (0.11)	0.11 (0.13)	0.15 (0.10)	0.30 (0.12) *	0.14 (0.09)
Averaged Child Sleep	0.27 (0.14) †	0.12 (0.11)	0.07 (0.08)	0.10 (0.09)	0.34 (0.13) **	0.55 (0.14) **
Mother Race	-54.66 (14.89) **	-0.84 (2.11)	-0.07 (0.48)	-2.61 (7.96)	9.18 (11.54)	-11.17 (10.21)
Medication Use	3.88 (14.24)	-0.53 (1.44)	-0.02 (0.37)	5.10 (6.01)	-25.26 (9.55) *	1.85 (8.43)
Biological Mother Status	52.33 (22.96) *	2.04 (2.13)	-0.86 (0.74)	-2.92 (8.80)	-20.99 (17.89)	-1.24 (18.74)
Family Income-to-Needs Ratio	2.63 (9.38)	1.58 (1.09)	-0.36 (0.29)	-8.39 (4.92) †	-1.55 (4.70)	0.38 (6.39)
Mother Depressive Symptoms	-2.32 (1.24) †	0.01 (0.10)	0.02 (0.03)	-0.44 (0.37)	0.83 (0.73)	0.33 (0.55)
Child Depressive Symptoms	2.70 (0.75) **	0.10 (0.11)	-0.02 (0.03)	0.25 (0.50)	-1.06 (0.68)	-0.09 (0.81)
Random Effects (Variance Estimates)						
Level 2	Variance (SD)	Variance (SD)	Variance (SD)	Variance (SD)	Variance (SD)	Variance (SD)
Intercept	2830.88 (53.21) **	84.84 (9.21) **	3.01 (1.74) **	1661.19 (40.76) **	1636.37 (40.45) **	2151.92 (46.39) **
Time	20.87 (4.57)	1.34 (1.16) **	0.05 (0.22)	11.95 (3.46) *	12.12 (3.48)	33.55 (5.79) *
Father's Sleep	0.11 (0.33)	0.07 (0.26) †	0.13 (0.36)	0.09 (0.31)	0.21 (0.46) **	0.07 (0.27) **
Child's Sleep	0.01 (0.12)	0.00 (0.03)	0.04 (0.19) *	0.01 (0.11)	0.25 (0.50) **	0.27 (0.52) **

Sleep Parameter					
	Sleep Minutes	Sleep Efficiency	Long Wake Episode	Wake Minutes	Bedtime ^a Wake Time
Fixed Effects					
Level 1 (Within-family relations)	b (SE)	b (SE)	b (SE)	b (SE)	b (SE)
Level 1 residual	2718.17 (52.14)	15.04 (3.88)	1.50 (1.22)	277.80 (16.67)	2936.61 (54.19) 1178.42 (34.33)

Note. Estimates with robust standard errors reported. Fathers' and Child's sleep at Level 1 were person-centered, and the person-mean across nights for each was included at Level 2.

^aBedtime and Wake Time are in minutes of the day. Time was coded such that 0 = night 1 of data collection. Mother ethnicity/race coded as 0 = European American, 1 = African American/minority. Biological mother status was coded as 0 = not biological mother, 1 = biological mother.

[†] $p < .10$,
* $p < .05$,
** $p < .01$

Table 4

Parameter Estimates from HLM Analyses Predicting Fathers' Sleep from Mothers' and Children's Sleep the Same Night

	Sleep Parameter					
	Sleep Minutes	Sleep Efficiency	Long Wake Episode	Wake Minutes	Bedtime ^a	Wake Time
	b (SE)	b (SE)	b (SE)	b (SE)	b (SE)	b (SE)
Level 1 (Within-family relations)						
Fixed Effects						
Intercept	338.38 (8.73) **	90.66 (1.31) **	3.18 (0.70) **	43.25 (4.85) **	1363.20 (8.44) **	372.32 (9.18) **
Time	-2.31 (1.44)	0.11 (0.19)	-0.17 (0.10) †	-1.02 (0.65)	-1.06 (1.56)	-1.01 (2.38)
Weekend vs. Weekday	21.89 (8.96) *	-0.14 (0.64)	0.37 (0.20) †	4.75 (2.68) †	7.14 (8.77)	18.23 (11.00)
Child Slept with Parents	-8.72 (16.58)	0.86 (1.21)	0.68 (0.68)	5.98 (6.53)	-18.79 (13.77)	-0.21 (16.37)
Mother's Sleep	0.33 (0.06) **	0.35 (0.10) **	-0.02 (0.25)	0.32 (0.10) **	0.36 (0.09) **	0.52 (0.09) **
Child's Sleep	0.08 (0.08)	0.01 (0.06)	0.11 (0.07) †	0.05 (0.03)	0.01 (0.07)	0.13 (0.08) †
Level 2						
Averaged Mother Sleep	0.26 (0.09) **	0.16 (0.15)	0.23 (0.17)	0.16 (0.13)	0.51 (0.11) **	0.42 (0.15) **
Averaged Child Sleep	0.49 (0.14) **	0.37 (0.16) *	0.32 (0.10) **	0.38 (0.12) **	0.39 (0.16) *	0.38 (0.22) †
Marital Status	64.92 (25.03) *	6.17 (3.92)	-1.68 (1.16)	-16.73 (13.82)	9.33 (23.70)	6.96 (21.86)
Family Income-to-Needs Ratio	3.69 (7.02)	1.18 (0.77)	-0.45 (0.21) *	-4.84 (2.92)	4.82 (6.32)	6.02 (6.01)
Mother Depressive Symptoms	0.21 (1.14)	-0.03 (0.11)	-0.01 (0.02)	-0.10 (0.38)	2.45 (1.40) †	2.79 (1.48) †
Father Depressive Symptoms	1.37 (1.75)	-0.02 (0.14)	0.01 (0.03)	-0.47 (0.47)	-0.99 (0.67)	-0.33 (0.97)
Random Effects (Variance Estimates)						
Level 2	Variance (SD)	Variance (SD)	Variance (SD)	Variance (SD)	Variance (SD)	Variance (SD)
Intercept	4336.64 (68.09) **	131.70 (11.48) **	41.25 (6.42) **	2172.85 (46.61) **	5106.46 (71.46) **	3844.54 (62.00) **
Time	11.02 (3.31)	1.68 (1.30) **	0.83 (0.90) **	15.28 (3.91) *	30.41 (5.51) †	150.36 (12.26) **
Mother's Sleep	0.03 (0.17)	0.43 (0.66) **	4.81 (2.19) **	0.45 (0.67) *	0.42 (0.65) **	0.11 (0.33) **
Child's Sleep	0.11 (0.33)	0.13 (0.36) **	0.24 (0.49)	0.10 (0.32) **	0.18 (0.42) *	0.04 (0.21) **
Level 1 residual	3155.18 (56.17)	15.52 (3.94)	1.77 (1.33)	423.83 (20.59)	3940.26 (62.77)	5739.35 (75.76)

Note. Estimates with robust standard errors reported. Mothers' and Children's sleep at Level 1 were person-centered, and the person-mean across nights for each was included at Level 2.

^a Bedtime and Wake Time are in minutes of the day. Time was coded such that 0 = night 1 of data collection. Marital status coded as 0 = not married, 1 = married.

^c $p < .10$,
* $p < .05$,
** $p < .01$