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Author manuscript

*Sleep Health*. Author manuscript; available in PMC 2023 February 01.

Published in final edited form as:

*Sleep Health*. 2022 February ; 8(1): 69–72. doi:10.1016/j.sleh.2021.11.006.

## Daily Associations between Family Interaction Quality, Stress and Objective Sleep in Adolescents

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### Abstract

**Objective:** To better understand the short-term impact of family interactions on adolescent sleep, this study examined daily associations between family interaction quality and sleep duration, sleep maintenance efficiency, and subjective sleep quality.

**Methods:** Participants were 517 diverse youth ( $M_{\text{age}}=15.4$  years, Range=15–18) in the Fragile Families and Child Wellbeing Study who completed daily reports of family interaction quality, mood and subjective sleep quality and provided actigraphy-based estimates of sleep duration and sleep maintenance efficiency.

**Results:** Following days when youth reported that they got along with their parents, they slept 26 minutes (95% CI [2.93, 49.88]) longer. Youth who reported greater quality interactions with other family members on average had longer sleep duration, and youth who reported higher levels of family stress perceived lower sleep quality.

**Conclusions:** Findings highlight the importance of considering daily family life, including the quality of brief family interactions, as an entry point for future sleep interventions for adolescents.

### Keywords

Parent-child interactions; family stress; sleep; daily diary; adolescence

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Sleep is important for all aspects of adolescent development,<sup>1,2</sup> yet most US youth do not regularly obtain the recommended sleep they need for optimal functioning.<sup>3</sup> The family promotes sleep health by providing a safe haven where adolescents find stability, routine and support that create a state of safety and down-regulate arousal prior to sleep.<sup>4</sup> Indeed, families characterized by cohesion and support promote healthy subjective and objective sleep,<sup>5-7</sup> whereas family conflict is associated with shorter sleep duration and poorer quality of sleep.<sup>6,8</sup>

However, sleep varies significantly from one day to the next depending on daily events and levels of arousal at bedtime.<sup>4</sup> As such, two studies examined specific day-to-day family processes that shape adolescent sleep in everyday life. On days when 11–18-year-old youth spent more time with family than usual, they experienced longer sleep latency, but among older youth only, higher sleep efficiency.<sup>9</sup> This contradictory finding suggests that the quality of family interactions is an important target of further research. In a sample of older Hispanic youth transitioning from high school to college, youth who spent more time connecting with parents slept longer, especially among those with better family communication; at the day level, youth slept longer on days when they spent more time connecting with their siblings.<sup>10</sup> These studies highlight the complexity of family influences on adolescence sleep, and suggest the need to explore individual variability. Moreover, examining the way family interactions make youth feel may help to clarify the complex links between family interactions and sleep.

The current study extends this past work by investigating daily associations between family interaction quality and sleep in a large, diverse cohort sample of middle adolescents. Specifically, we examine whether high quality family interactions reduce feelings of arousal (i.e., excitement and anger) and promote same day sleep. We further expand on extant research by exploring how same-day associations vary according to adolescents' underlying vulnerability to poor sleep, specifically depression.<sup>11,12</sup> We hypothesize that on days when youth report more positive family interactions, they would have longer sleep duration, better subjective sleep quality and greater sleep maintenance efficiency, over and above levels of family stress. We also hypothesize that these associations are mediated by lower daily levels of excitement and anger. We examine moderation by depressive symptoms, hypothesizing that youth with more symptoms may show a stronger daily association between family interaction quality and sleep, as those who suffer from both depression and sleep problems experience more interpersonal stressors and have greater difficulty coping.<sup>12</sup>

## Method

### Participants

Data are from the Fragile Families and Child Wellbeing Study (FFCWS; [www.fragilefamilies.princeton.edu](http://www.fragilefamilies.princeton.edu)), a longitudinal birth cohort study of children born between 1998 to 2000, oversampled for unmarried mothers. During the Age 15 Wave of FFCWS, 1,545 study youth were randomly selected to participate in the Age 15 home visit; 1,090 received a home visit; 1,049 assented to participate in the sleep sub-study.

## Procedures

Every evening for seven consecutive days, youth completed web-based surveys assessing last night's subjective sleep and today's school attendance, family interactions and mood,<sup>13</sup> and wore an Actiwatch Spectrum (Philips-Respironics, Murrysville, PA) on their non-dominant wrist. Two independent coders scored sleep from the actigraphy data using previously validated scoring algorithms.<sup>13</sup> See Nahmod et al., (2019)<sup>14</sup> and Master et al. (2019)<sup>15</sup> for details on sleep coding and the integration of actigraphy and daily survey data. Of those who assented, youth wore the actigraph on mean 5.2 days (SD=3.0), and completed daily surveys on mean 5.3 days (SD=2.8). Five hundred forty-nine youth provided at least three nights of valid actigraphy data and corresponding daily surveys. Two were missing data on income-to-poverty ratio, a covariate, resulting in an analytical sample of 547 participants. Mean number of days with valid and corresponding actigraphy and daily survey data in the analytical sample were 5 days (SD=1.4, Range=3–7). See Table 1.

Youth reported on their depressive symptoms and youth and caregivers provided demographic information during in-person interviews with research staff. All procedures were approved by the appropriate Institutional Review Boards; caregivers provided consent and youth provided assent.

## Daily survey measures

**Family interaction quality.**—“Did you get along with your parents?” (yes/no), assessed the *quality of the parent-youth interaction*. “Did you get along with your other family members?” (yes/no), measured the *quality of interaction with other family members*. Previous daily survey research has successfully used single-item measures to assess daily experiences.<sup>16</sup>

Family stress was scored as the sum of four yes/no items: argued with your mother, father or another family member; parents had an argument with someone else; had a lot of work at home; and had a lot of demands made by your family. Then, we computed a person-level mean of daily family stress for each individual.

**Angry and excited mood.**—Participants reported the extent to which they felt “*angry/mad*” and “*excited*” during the day on a 1 “very slightly or not at all” to 5 “extremely” Likert scale.

Subjective sleep quality was assessed with a single daily survey item, “How would you rate your sleep quality,” on a 1 “very good” to 4 “very bad” scale, reverse coded such that a high score indicated better quality.

## Daily Actigraphy Measures

Nighttime sleep duration was the hours between sleep onset and sleep offset for the longest interval between 10 PM and 8 AM. Sleep onset was the time of the last 30-second epoch containing 10 activity counts, followed by 5 consecutive epochs containing 10 activity counts. Sleep offset was the time of the first 30-second epoch containing 10 activity counts, preceded by 5 consecutive epochs containing 10 activity counts.

Nighttime sleep maintenance efficiency was the percent of nighttime sleep duration when participants were actually sleeping. Higher sleep efficiency indicated better sleep quality.

### Depressive symptoms

Prior to the sleep assessments, past four-week depressive symptoms were assessed using five items adapted from the Center for Epidemiological Studies on Depression (4=strongly agree to 1=strongly disagree) as part of the larger study.<sup>17</sup> Items were averaged such that higher scores indicated greater severity of symptoms.

### Statistical analysis

First, we examined Pearson's correlations between key-variables at the between-person level (Supplemental Table A). Then, to test hypothesis depicted in Supplemental Figure A, we conducted multi-level regression models, which are ideal for nested data (i.e., days within individuals), and applied maximum likelihood estimation to account for missingness (*mixed* in Stata/SE 15.0). See Table 2 note for more information. Daily levels of anger and excitement were examined as mediators of the same-day association between family interaction quality and that night's sleep in separate models. Past 4-week depressive symptoms was examined as a moderator.

## Results

Participant characteristics and descriptive statistics are in Table 1, and bivariate correlations between key variables at the between-person level are in Supplemental Table A. Intraclass correlations (ICC), reported in Table 1, indicate the proportion of variance explained by between-person, as opposed to within-person (i.e., day-to-day) differences.

### Daily family interaction quality and sleep characteristics

In six separate models, we examined the associations between two daily family interaction quality variables (i.e., parents, other family members) and three sleep variables (i.e., duration, subjective quality, maintenance efficiency), over and above mean family stress and other demographic controls (Table 2). Following days when youth got along with their parents, they slept 26.4 minutes longer (95% CI [2.93, 49.88]). In comparison to youth who stated that they *never* got along with other family members, those who reported that they got along *everyday* got on average 45.0 minutes more sleep (95% CI [2.73, 87.28]). Both models of sleep quality showed that youth who reported more family stress perceived worse sleep ( $b=-0.17$ , 95% CI [-0.25, -0.09]).

### No mediation by mood or moderation by depressive symptoms

There was no evidence of mediation by daily anger or excitement. Parent-youth interaction quality was associated with greater same-day anger ( $b=-0.39$ ,  $SE=.10$ ,  $p < .001$ ), but anger was not associated with subsequent sleep duration ( $b=-3.44$ ,  $SE=2.75$ ,  $p=.211$ ). Parent-youth interaction quality was not associated with same-day excitement ( $b=0.23$ ,  $SE=0.12$ ,  $p=.064$ ), but excitement was associated with subsequent shorter sleep duration ( $b=-4.45$ ,  $SE=1.91$ ,  $p=.020$ ). Depressive symptoms did not moderate the associations between family interaction quality and sleep characteristics. See Supplemental Table B.

## Discussion

The current study examined daily associations between the quality of family interactions and sleep in a diverse adolescent sample. Following days when youth got along with their parents, they slept 26 minutes longer. This daily association was not evident on days when youth got along with other family members, suggesting that interactions with parents, in comparison to other family members, may be more salient to youth in the short-term and help to nurture a safe *state* at home. Youth who got along with other family members (e.g., siblings) more often had longer sleep duration on average. The extent to which a youth gets along with other family members may represent the overall congeniality of the family environment. Analyses did not support the hypothesis that the family promotes sleep by decreasing state arousal, approximated by daily self-reports of anger and excitement. To improve precision, future studies should consider conducting ambulatory assessments of psychophysiological arousal prior to sleep. A complementary explanation for the same-day association between getting along with parents and sleep duration may be rooted in parent and youth behaviors. Youth personal preferences (e.g., clothing, music), household rules, and peer relations are the three most common topics of parent-youth conflict, and the latter two topics often implicate bedtime.<sup>18</sup> Youth and parents may have been disagreeing about the very activities associated with delayed bedtime (e.g., staying out past curfew). Although replication is needed, the quality of daily family interactions has a protective impact on sleep, which may in turn has important consequences for next-day behavioral, emotional, and cognitive functioning.<sup>15,19</sup> Daily family interaction quality is an important target of preventive interventions for improving sleep and its health correlates in adolescents.

Youth who reported fewer stressors in the home endorsed better subjective sleep quality. Negative affective experiences in one context, such as conflict with parents, impact adolescent mood and subsequent perceptions of behaviors in a different context (i.e., nighttime sleep).<sup>20</sup> Predicting later mental and physical health outcomes such as cardiovascular health, obesity, diabetes, depression and anxiety, subjective sleep quality may be as important for health as objective sleep duration.<sup>21,22,23</sup>

Findings should be interpreted in the context of limitations. To reduce participant burden, daily survey items were succinct. More sensitive or objective measures of family interaction quality, mood and arousal may capture greater variances. The associations between family interaction quality and sleep did not vary by levels of depressive symptoms. However, a more in-depth assessment of symptoms, or samples with clinical levels of depression may show different findings.

Nonetheless, the study used objective and ecological methods to examine the daily associations between family interactions and sleep in diverse adolescents. Findings add to the growing body of research on the protective effects of family interactions on adolescent sleep health – at the daily and between-person levels. They further highlight the importance of considering the psychosocial climate of the family, including the quality of brief family interactions, as an entry point for sleep interventions for adolescents.

## Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

## Funding:

Research reported in this manuscript was supported by the Eunice Kennedy Shriver National Institute of Child Health and Human Development (NICHD) of the National Institutes of Health under award numbers R01HD073352 (LH), R01HD36916, R01HD39135, and R01HD40421, a consortium of private foundations, and the Karl R. and Diane Wendle Fink Early Career Professorship for the Study of Families (SB).

**Disclosure:** Outside of the current work, Dr. Orfeu M. Buxton discloses that he received subcontract grants to Penn State from Proactive Life (formerly Mobile Sleep Technologies), doing business as SleepSpace (National Science Foundation grant #1622766 and NIH/National Institute on Aging Small Business Innovation Research Program R43AG056250, R44 AG056250), received honoraria/travel support for lectures from Boston University, Boston College, Tufts School of Dental Medicine, New York University, Harvard Chan School of Public Health, and Allstate, consulting fees for SleepNumber, and receives an honorarium for his role as the Editor in Chief of the journal *Sleep Health*. Dr. Lauren Hale discloses that she received consulting fees from New York University, Auburn University and Baylor University, received an honorarium for a lecture from Spring Health, Willis Towers Watson, received an honorarium for her role as Founding Editor-in-Chief of the journal *Sleep Health*, and serves as the chair of the National Sleep Foundation. Dr. Sunhye Bai and Ms. Lindsay Master have nothing to disclose.

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**Table 1.**

Participant characteristics and descriptive statistics of study variables

<i>Person level variables</i>	N	% or M(SD)			
Age (M, SD; Range = 15–18)	547	15.4 (0.6)			
Female (N, %)	289	52.8			
Race/Ethnicity (N, %)					
White	100	18.3			
Black	224	41.0			
Hispanic	144	26.3			
Other, multiracial, unknown	79	14.4			
Primary caregiver (N, %)					
Biological mother	502	91.8			
Biological father	29	5.3			
Other	16	2.9			
Income-to-poverty ratio (N, %)					
0–49%	54	9.9			
50–99%	97	17.7			
100–199%	146	26.7			
200–299%	91	16.6			
> 300%	159	29.1			
Education (N, %)					
Less than HS	79	14.4			
HS or equivalent	98	17.9			
Some college	254	46.4			
College or beyond	116	21.2			
Depressive symptoms (M, SD; Range = 1–4)	547	1.6 (0.6)			
<i>Day level variables</i>	N	Mean	SD	Range	ICC
Sleep duration (minutes)	2,776	470.0	113.7	40–1007.5	0.14
Subjective sleep quality	2,769	3.36	0.68	1–4	0.46
Sleep maintenance efficiency (%)	2,776	91.0	3.6	74.3–98.7	0.51
Got along - parent	2,712	0.93	0.25	0–1	--
Got along - other family	2,619	0.92	0.27	0–1	--
Family stress	2,776	0.38	0.77	0–4	0.48
Angry	2,561	1.55	0.98	1–5	0.39
Excited	2,579	2.69	1.39	1–5	0.49
School days	2,762	0.44	0.50	0–1	--

ICC, intra-class coefficient, i.e., proportion of variance explained by between-person differences



**Table 2.**

Associations between daily family interaction quality and sleep duration, subjective sleep quality and sleep maintenance efficiency

	Sleep duration (minutes)		Sleep quality <sup>a</sup>		Sleep maintenance efficiency (%)	
	B (SE)	<i>d</i>	B (SE)	<i>d</i>	B (SE)	<i>d</i>
<i>Get along with parents</i>						
Daily parent-youth interaction	26.41 (11.98)*	0.23	-0.03 (0.06)	-0.04	-0.53 (0.31) <sup>t</sup>	-0.15
Mean parent-youth interaction	-2.62 (22.98)	-0.04	0.25 (0.16)	0.49	0.96 (0.89)	0.34
Mean family stress	-2.46 (5.48)	-0.04	-0.17 (0.04)***	-0.32	0.13 (0.23)	0.05
<i>Get along with family</i>						
Daily family-youth interaction	4.19 (11.01)	0.04	0.00 (0.06)	-0.01	-0.40 (0.29)	-0.11
Mean family-youth interaction	45.00 (21.57)*	0.69	0.24 (0.15)	0.45	1.17 (0.85)	0.42
Mean family stress	0.45 (5.41)	0.01	-0.16 (0.04)***	-0.31	0.22 (0.23)	0.08

<sup>t</sup> p < .10

\* p < .05

\*\* p < .01

\*\*\* p < .001

<sup>a</sup> Sleep quality range = 1–4, higher scores indicate better subjective sleep quality

Note: Models include the day-level score (i.e., “daily”) and the person-mean score (i.e., between-person) of the family interaction variable. Models controlled for *school day* (0=not a school day), *child sex* assigned at birth (0=male), *child race/ethnicity* (0=White), *household income-to-poverty threshold ratio* (0= 300%), *primary caregiver’s highest level of educational attainment* (0=college or graduate school) and *primary caregiver type* (0=biological mother). Models included a random intercept and first-order autoregressive covariance structure for the residuals to account for time dependencies between adjacent daily reports. All between-person variables were grand mean centered.