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# Sleep Timing and Quantity in Ecological and Family Context: A Nationally Representative Time-Diary Study

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Associations between demographic characteristics, school schedules, activity choices, family functioning, and sleep behaviors were estimated using nationally representative time-diary data from 2,454 children (ages 5.5 to 11.9 years) and adolescents (ages 12.0 to 19.1 years). For weekdays, African American adolescents, Asian children, and those with earlier school start times and longer travel times to school reported fewer sleep hours. More time spent watching television (for children), doing homework (for adolescents), and engaging in religious activities predicted fewer hours, whereas a longer time spent on meals predicted greater hours of weekday sleep. For younger children, greater parental warmth predicted more hours of weekday sleep, whereas for adolescents, stricter household rules were protective. On weekends, African American adolescents and Hispanic children slept less, and there were strong effects of activity choices including time spent on television, computer and video-games, sports, religious activities, socializing, and employment. In accounting for age-related decreases in sleep hours from childhood to adolescence, earlier school start times, greater hours of homework, greater paid employment, less time spent on meals, and fewer household rules were all significant mediators.

*Keywords:* sleep, family functioning, time use, school start times, disparities

Child and adolescent sleep behaviors have recently received the attention of researchers, educators, parents, and policymakers because sleep behaviors, such as sleep timing, quantity, quality, and consistency have been shown to have immediate influences on emotion, cognition, and behavior, as well as long-term influences on emotional and physical health. Experimental studies have found that children's daytime cognitive and behavioral functioning are substantially impaired following even a slight truncation in sleep quantity the previous night (Sadeh, Gruber, & Raviv, 2003). A growing body of work finds associations between sleep and cognitive and socioemotional functioning in preschool and school-age children (Bates, Viken, Alexander, Beyers, & Stockton, 2002; Hofferth & Sandberg, 2001), and lack of sleep among adolescents is associated with increased risk for depression, school problems, and even motor-vehicle accidents (Carskadon, Acebo, & Jenni, 2004; Fredriksen, Rhodes, Reddy, & Way, 2004; Fuligni & Hardway, 2006; Wolfson & Carskadon, 1998). Evidence is also accumulating for associations between poor sleep and increased body mass and obesity in children and adolescents (Agras, Hammer, McNicholas, & Kraemer, 2004; Gupta, Mueller, Chan, & Meininger, 2002; Locard et al., 1992; Reilly et al., 2005; Sekine et al., 2002; Snell, Adam, & Duncan, 2007).

Whereas a substantial body of work exists examining the effects of variations in sleep hours and timing, less is known about the causes of sleep behaviors in children and adolescents. Although medical problems contribute to some individual differences in child sleep (Stein, Mendelsohn, Obermeyer, Amromin, & Benca, 2001), considerable variation in sleep behavior exists among those without obvious medical problems. Researchers have hypothesized that children's sleep patterns are determined by a combination of physiologically driven sleep needs and psychosocial demands, both of which may change with development (Carskadon, 2002; Dahl, 1996, 2005).

Recently, scholars have called for more research aimed at understanding the social-contextual determinants of children's sleep habits. In the current study, we investigated associations between demographic variables, school schedule variables, child activity choices, family process variables, and children's sleep behaviors in a large, nationally representative sample of children and adolescents. Prior research on each of these potential influences on child sleep is briefly reviewed, followed by a description of how the current project adds to the existing literature.

## Family SES, Race/Ethnicity, and Sleep

Given that variations in sleep are hypothesized to play a role in mediating the effects of demographic variables such as SES and race/ethnicity on physical and mental health outcomes (P. J. Moore, Adler, Williams, & Jackson, 2002;

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Van Cauter & Spiegel, 1999), it is surprising that very few studies have examined socioeconomic and racial/ethnic variations in sleep hours and timing in children. Several community-based studies have found ethnic minority children, in particular African American children, to have more problematic sleep patterns, including fewer hours of sleep (McLaughlin Crabtree et al., 2005), later bedtimes, and greater night-to-night variability in sleep than Caucasian children (Spilsbury et al., 2004). In contrast, Crosby, LeBourgeois, and Harsh (2005) found that African American children (ages 2 to 8 years) had fewer hours of nighttime sleep but were more likely to nap than Caucasian children, resulting in similar total sleep hours. Fuligni and Hardway (2006) found Mexican adolescents reported more sleep on weekdays than those from European or Chinese backgrounds and found no racial/ethnic differences in weekend sleep hours or sleep variability. In the current study, we extended this past research by examining the extent to which racial/ethnic differences in sleep patterns are present in a nationally representative sample of both children and adolescents, and whether associations between race/ethnicity and sleep are independent of the influence of family process, school schedule, and child activity variables.

## Developmental Changes in Sleep Patterns

It is well established that as children go through puberty, their sleep patterns and circadian rhythms change (Carskadon, 1999). Key changes include a tendency toward later sleeping and waking times (Carskadon, Vieira, & Acebo, 1993) and more irregular sleep patterns, including a discrepancy between weekday and weekend sleep (Acebo & Carskadon, 2002; Wolfson & Carskadon, 1998). Irregular sleep schedules are thought to contribute to trouble falling asleep or awakening, poor quality of sleep, and resulting daytime sleepiness (Dahl & Carskadon, 1995). These patterns emerge from biological changes as well as through social and psychological processes, such as the impact of school schedules and activity choices.

## Child and Adolescent School Schedules and Sleep

Transitions to earlier school start times associated with moves into middle school and high school are associated with significant decreases in total sleep time for young adolescents (Carskadon, Wolfson, Acebo, Tzischinsky, & Seifer, 1998; Dahl & Lewin, 2002; Wolfson & Carskadon, 1998). The effects of earlier school start times are further exacerbated by the fact that adolescents tend to go to bed at approximately the same time regardless of their school start times (Carskadon et al., 1998; Dahl & Lewin, 2002), a tendency driven in part by the biological changes described earlier and in part by the social and academic demands adolescents face. An underexamined variable with respect to school schedule demands, which was examined in the current study, is the amount of time it takes for children to travel to their school, with longer travel times potentially influencing child sleep by requiring earlier wake times.

## Child and Adolescent Activity Choices and Sleep

Child and adolescent activity choices have been implicated as potential causes of reduced sleep hours, delayed sleep timing, or reduced sleep quality. Television viewing, especially around bedtime, has been linked to increased sleep disturbances such as nightmares (Van den Bulck, 2000) and anxiety around sleep (Owens et al., 1999). Children who have a television in their room go to bed significantly later on weekdays and weekend days and get up earlier on weekdays, spending significantly less time in bed (Van den Bulck, 2004). A similar effect was found in the same study for the presence of a computer in the child's room. Recent research suggests playing computer games may affect sleep quality (Higuchi, Motohashi, Liu, & Maeda, 2005), and time spent playing on computers has been associated with fewer sleep hours in adolescent samples (Fuligni & Hardway, 2006). Television viewing and computer use could affect sleep through several mechanisms, including impacts on time use or increased arousal due to stimulating content or artificial light exposure (Cajochen, Zeitzer, Czeisler, & Dijk, 2000).

Other activities relevant for children's sleep timing include time spent on academic obligations, such as homework, and extracurricular activities, such as sports, employment, and socializing with friends (Carskadon, 2002; Fuligni & Hardway, 2006). Rarely have multiple activity choices been examined simultaneously, however, such that their relative impacts can be compared with each other and with the effects of demographic, school, and family variables.

## Family Functioning

Prior studies focusing on infants and preschool-age children have explored the effects of a wide range of parent and family characteristics on children's sleep behaviors (Morrell, 1999; Rona, Li, Gulliford, & Chinn, 1998; Sadeh & Anders, 1993). Fewer studies have explored associations between family processes and sleep in older children and adolescents. Both of the major parenting dimensions, control (expectations, rule setting) and warmth (child-centeredness, expressions of positive regard), have been previously related to child sleep. Stricter parental rules about sleep and greater limit setting have been associated with children's time in bed (Meijer, Habekothe, & Van den Wittenboer, 2001) and quality of sleep (Owens-Stively et al., 1997). Family emotional climate is also important: Perceptions of a better home atmosphere are related to better sleep quality (Tynjala, Kannas, Levalahti, & Valimaa, 1999), whereas maternal psychiatric illness and observer ratings of poor family functioning predict shorter sleep times (Seifer, Sameroff, Dickstein, & Hayden, 1996). Recently, El-Sheikh, Buckhalt, Mize, and Acebo (2006) found associations between levels of marital conflict in the home and children's sleep quantity and quality. The extent to which family functioning effects are present in a nationally representative sample, independent of other influences on child sleep, remains to be determined. The extent to which

age-related differences in parenting and family functioning from childhood through the adolescent years predict age-related changes in sleep is also of interest.

## The Present Study

In the present study, we simultaneously examined the associations between racial/ethnic and other demographic factors, school schedule variables, child and adolescent activity choices, and family functioning variables and children's total hours of sleep, bedtimes, and wake times in a large, nationally representative sample. Rather than relying on stylized or global self-report, we used a time-diary approach—having children report on all their activities (including sleep) on each of 2 randomly selected days (1 weekday, 1 weekend day). Because sleep hours, school schedules, activities, and family functioning may all change with child age or developmental stage, we examined models separately for children (ages 5.5 to 11.9) and adolescents (ages 12.0 to 19.1 years). We also examined models across the full age range (5.5 to 19.1 years) to identify variables that may help to account for changes in total sleep hours from childhood to adolescence.

Family functioning variables played a particularly prominent role in our theorizing about influences on child sleep. As sleep happens within the context of the home, it seems likely that broader demographic variables may influence sleep through their impact on family functioning. Whereas children's own opinions and choices regarding activities are certainly related to their sleep, we expected that activity choices would in part be determined by aspects of family functioning, such as family rules regarding recreational and nonrecreational time use. Aspects of family emotional climate, such as parent warmth, parent stress, and parent emotional well-being, may make more direct contributions to children's sleep, by affecting the feelings of safety and security required for falling asleep. We hypothesized that family rules would have stronger effects on sleep for older children, for whom biological drives toward later sleep times might, in the absence of limit setting, be more likely to lead to later bedtimes and lesser overall sleep. We expected that family climate variables would be more important for younger children's sleep because of their higher level of dependence on parents for emotion regulation and feelings of comfort and security.

## Method

### *Participants*

We used data from the second wave of the Child Development Supplement (CDS) of the Panel Survey of Income Dynamics (PSID). The PSID is a nationally representative, longitudinal data set consisting of survey data on close to 8,000 families and individuals collected since 1968. In 1997, all PSID families who had children between birth and 12 years of age were recruited to participate in the CDS. All children in families with one or two children were included in the study. When more than two children in the home met the eligibility requirement, two of them were randomly selected. In the first wave of the CDS, 2,394 families participated, providing information on 3,563 children. The second round of data collection took place in 2002–2003, when 2,021 families were reinterviewed, resulting in 2,907 child interviews, a reinterview rate of 81.6%. For the current analysis, we dropped children who are not currently in primary or secondary school (50 children) and those without time-diary sleep data (403 children). We adjusted for attrition occurring nonrandomly across participant characteristics by using weights provided by the CDS for this purpose. Our final sample is thus 2,454 children and their 1,718 families.

### *Procedure*

This study used information taken from each child's primary caregiver as well as from each child's time diary. The primary caregivers answered questions regarding their child's health and behavior, characteristics of the household (including income, parental education, work schedules, and family composition), and family processes. The survey was administered to the primary caregiver either in an in-home interview or through a telephone interview.

The CDS time diary was a paper diary that was mailed to participants with instructions to complete the diary regarding a preselected weekday (Monday–Friday) and weekend day prior to the scheduled in-home interview. Days were randomly selected when the interviewer completed the initial contact for the household, and there was no substitution of diary days once assigned. During the in-home CDS interview or by telephone, the interviewer reviewed and edited the diary with the child and primary caregiver.

The time diaries provide a detailed chronology of the type, number, duration, and location of activities for the two randomly selected 24-hr periods. The time diary asked the child or primary caregiver to record the child's flow of activities over a 24-hr period beginning at midnight of the randomly designated day; activity start and end times were recorded in hours, minutes, and seconds. Most diaries (43%) were completed by the primary caregiver alone, 21% by the caregiver and child together, and 36% by the child alone; there were no significant differences in our sleep or activity variables according to reporter. Respondents recorded the primary activity that was going on at that time, when it began and ended, and whether any other activity was taking place. Each child's time diary had from 15 to 40 entries per diary day, with an average of 20 activities per diary day. To facilitate data analysis, the study organizers assigned each activity to one of 365 activity codes and further assigned them to one of 39 different categories. Interrater agreement on coding of diary entries was 94%.

Although the randomly selected days may not be considered "typical" for any one child (8% reported their weekday and 6% reported their weekend day as "not at all typical"), because days were randomly sampled, they are representative of all days experienced by U.S. children. With child-based sampling weights, the time diaries give a representative sample of U.S. children's activities and can be

converted into time-use aggregates, which provide less biased estimates than global self-reports of time spent on activities (Juster, Ono, & Stafford, 2003).

### *Outcome Measures*

Our dependent variables are measures of children's weekday and weekend total nighttime sleep hours, bedtimes, and wake times derived from the time-diary reports. Because the diary spans 24 hr starting at midnight, wake times and bedtimes recorded for that day were used to estimate total nighttime sleep time.

### *Child and Family Demographic Measures*

Three child demographic variables were examined: age, gender, and race/ethnicity. Age was measured as months from birth to the time of the interview in 2002. It ranged from 5.5 to 19.1 years. For gender, boys were given a code of 1, and girls were given a code of 0. Dummies for race/ethnicity were created, including African American, Hispanic, Asian, and other race/ethnicity, with non-Hispanic Whites being the reference group.

Parent income, parent education, marriage status, family size, and parent work hours were included as family socioeconomic variables. We included a measure of average family income in tens of thousands of dollars (continuous) for the year 2000, which was taken from the core PSID interview in 2001. The PSID–CDS provides information on the education of the head of the household (either male or female, but generally male) and of the spouse or cohabitor if one is present. Our measure of parental education is an average of the available parents' years of education. We measured family structure with a dummy variable indicating whether the head of household was married or not. The total number of children in the family is a continuous variable ranging from 1 to 9 individuals. The head of household's total work hours ranged from 0 to 100 hr, and the spouse/cohabitor's total work hours ranged from 0 to 99 hr.

### *Child Physical Health and Behavior Problems*

Our child well-being measures included measures of child physical health, as well as the child's internalizing and externalizing behavior problems. Child physical health was measured with a single item that asks the primary caregiver to rate the child's physical health on a scale of 1 (*excellent*) to 5 (*poor*). This item was reverse coded for ease of interpretation. The Internalizing Behavioral Problem Index and Externalizing Behavioral Problem Index (BPI) were used to measure children's behavioral problems. The CDS uses the same set of items for internalizing and externalizing behavior problems as was used in the National Longitudinal Study of Youth, which were originally developed by Peterson and Zill (1986). Items within the internalizing and externalizing domains were summed to create scales and then standardized (Cronbach's alphas were .82 and .87, respectively). Child health and behavior problems could be the result of sleep problems but could also contribute to child sleep and are likely also correlated with family functioning, such that failure to include them could upwardly bias estimates of the impact of family functioning. As a result, these variables are treated as control variables in our analyses.

### *Child School Schedule, Weekday Activity Variables, and Weekend Activity Variables*

We used the weekday time diaries to measure what time that day the child's school started and ended, the total time that the child spent traveling to school from home, and the time spent doing various activities on the weekdays. We used the weekend time diaries to measure the amount of time children spent doing various activities on the weekend. The weekday and weekend activities included in our analysis were watching television, playing video games or playing on the computer, playing sports, doing homework, engaging in religious activities, socializing, and eating meals (including breakfast, lunch, and dinner, but not snacks). Socializing included visiting with others, going to parties, and going to bars or out dancing. Sports included organized activities, such as team sports, as well as unorganized sports such as working out at the gym, skateboarding, or rollerblading. For the older children, we also included an activity measure for amount of time spent working (part-time employment). All activity variables are reported in the metric of hours spent on that activity that day.

### *Family Functioning Variables*

Family functioning was assessed with six measures: primary caregiver warmth, family rules, family economic strain, parenting stress, parent psychological distress, and family conflict. The warmth scale was designed by Child Trends, Inc., for the Job Opportunities and Basic Skills Program Child Outcomes Study, now known as the National Evaluation of Welfare-to-Work Strategies (NEWWS; K. A. Moore, Zaslow, Coiro, Miller, & Magenheim, 1995). Primary caregivers were asked "How many times in the last month have you: Told the child that you love him/her? Spent time with him/her doing favorite activities? Talked about things that interest him/her? Told him/her you appreciated something he/she did? Talked about other relationships, such as his/her friends? Talked about current events? Talked with your child about his or her day?" Responses are made on a 1–4 scale (1 = n*ot in the past month*, 2 = *1 or 2 times in the past month*, 3 = *about once a week*, 4 = *several times a week or every day*). Four items from the Home Observation for Measurement of the Environment (HOME) scale (Caldwell & Bradley, 1984) were also used for those children who had been in the presence of the caregiver during the interview (which was the case for 87% of the children). The HOME items assessed how frequently, in the presence of the interviewer, the primary caregiver expressed physical affection towards the child, the tone of the caregiver's voice conveyed positive feelings about the child, the caregiver offered spontaneous praise for the child, and warmth and affection was expressed toward the child during interactions. Responses are based on a scale of 1–4

(1 = *never*, 2 = *once*, 3 = *two to three times*, and 4 = *four times*). Response items are made on a 1–4 scale (1 = *never*, 2 = *once*, 3 = *2–3 times*, 4 = *4 times*). For children missing data on the HOME, the mean of this measure was used and a missing data dummy was included in the model. Items from both warmth measures were averaged ($\alpha$ = .79), and the final measure was standardized.

Family rules was composed of the primary caregiver's response to whether or not there were household rules for the following issues: amount of TV, type of TV watched, eating sweets, with whom your children interacts, after-school activities, bedtimes, and when children should do homework. The questions come from the Detroit Area Study (Alwin, 1990). Items were summed then standardized. The alpha for the family rules scale was .76.

Family economic strain was determined by caregiver reports of whether or not the primary caregiver did any of the following or whether any of the following happened as a result of economic problems in the last 12 months: sold possessions or cashed in life insurance, postponed major purchases, postponed medical care, borrowed money, applied for government assistance, filed bankruptcy, behind in paying bills, loan to pay debts, a visit from a creditor, lien against property, property repossessed, moved to a cheaper residence, moved in with others, and/or sent children to live elsewhere. These items were drawn from Glen Elder's and Rand Conger's (1994) work measuring experiences of economic or financial stress and strain and practical responses to such financial pressures. Items were summed and then standardized to form a family financial strain scale. The alpha for this scale was .70.

Parenting stress items were taken from the NEWWS (K. A. Moore et al., 1995). Primary caregivers reported their level of agreement with the following three statements regarding the focal child: "There are some things that child does that really bother me a lot," "I find myself giving up more of my life to meet child's needs than I ever expected," and "I often feel angry with child." Response items are based on a scale of 1–5 (1 = *not at all true*, 5 = *completely true*). Items were summed and then standardized to form a caregiver parenting stress scale, with higher scores indication greater parenting stress. The alpha for this scale was .68.

Items from the Kessler's K–6 Non-Specific Psychological Distress Scale were used to measure caregiver psychological distress (Kessler et al., 2003). The K–6 includes six items. Primary caregivers were asked whether they felt: nervous, hopeless, restless, everything was an effort, so sad they couldn't be cheered up, and/or worthless during the prior 4 weeks. Responses were made on a 1–5 scale (1 = *all of the time*, 5 = *none of the time*). The items were reverse coded, summed, and standardized. The alpha was .84.

Family conflict was measured by the primary caregivers' reporting how much they agreed with the following five statements: family fights a lot, throws things, calmly discusses, criticizes, or hits each other. Response items were based on a 1–5 scale (1 = *completely disagree*, 5 = *completely agree*). These items were taken verbatim from National Survey of Families and Households to examine methods of conflict resolution among family members (Sweet, Bumpass, & Call, 1988). The items were appropriately reverse coded, summed, and then standardized. The alpha was .78.

### *Analyses*

After a brief examination of bivariate relationships, multiple regression analyses were conducted to examine the associations between children's sleep behaviors and the demographic, school schedule, activity, and family process variables. All control and independent variables were entered simultaneously such that the unique contribution of each could be observed. When modeling weekday sleep behaviors, we used weekday activity measures; when modeling weekend sleep, we used weekend activity measures. School schedule variables were retained in all models to account for carryover effects of weekday schedule variables to weekend sleep.

We expected that associations might vary considerably between younger versus older children, and preliminary analyses confirmed these expectations. As a result, we focus on regressions run separately for younger children (ages 5.5–11.9) and older children/adolescents (ages 12.0–19.1). This division was selected because many children move from elementary to junior high school and from pre-adolescence into adolescence at around 12 years of age, with accompanying changes in school pressures, school schedules, and autonomy, all of which may influence sleep schedules. Differences in coefficients for younger versus older children were tested by running a full model with age interactions. After running separate models, we conducted mediational models using both age groups combined, in which we identified which variables help to account for age-related changes in child total sleep hours across the full age span.

Analyses were weighted with PSID-supplied probability weights inversely proportional to the likelihood of being selected into and continuing to participate in the sample. Probability weights allow us to generalize to our population of inference, all children living in the United States. Missing data were assigned the mean value for that variable, and dummy variables were included, indicating when data were replaced. In all regressions, standard errors were adjusted using Huber–White methods to account for the lack of independence caused by family clustering of participants. For correlations, Bonferroni corrections for multiple comparisons were used.

## Results

### *Descriptive Analyses*

Descriptive statistics for the study variables, presented separately for younger and older children, are shown in Table 1, along with *t* tests of mean differences on these variables by age group. Pearson product–moment correlations for the associations between the major study variables are presented in Table 2. As can be seen in this table, sleep behaviors had first-order associations with many of our

Table 1
*Descriptive Statistics*

| Variable | Younger | | Older | | |
|---|---|---|---|---|---|
| | *M* | *SD* | *M* | *SD* | *t* |
| Outcome measures | | | | | |
| Hours of sleep (weekday) | 9 hr 49 min | 1 hr 6 min | 8 hr 37 min | 1 hr 40 min | −19.62*** |
| Hours of sleep (weekend) | 10 hr 47 min | 1 hr 26 min | 10 hr 15 min | 2 hr | *ns* |
| Bedtime (weekday) | 9:09 p.m. | 57 min | 10:24 p.m. | 1 hr 17 min | 26.74*** |
| Bedtime (weekend) | 9:25 p.m. | 1 hr 9 min | 10:48 p.m. | 1 hr 32 min | 23.91*** |
| Wake time (weekday) | 6:58 a.m. | 48 min | 7:02 a.m. | 1 hr 35 min | 2.19* |
| Wake time (weekend) | 8:12 a.m. | 1 hr 10 min | 9:04 a.m. | 1 hr 44 min | 14.12*** |
| Child demographics | | | | | |
| Age | 8.90 | 1.81 | 15.20 | 1.87 | 85.73*** |
| Male | 0.49 | 0.50 | 0.49 | 0.50 | *ns* |
| African American | 0.14 | 0.34 | 0.17 | 0.37 | *ns* |
| White | 0.64 | 0.48 | 0.63 | 0.48 | *ns* |
| Hispanic | 0.15 | 0.35 | 0.13 | 0.34 | *ns* |
| Asian | 0.03 | 0.18 | 0.03 | 0.17 | *ns* |
| Other race | 0.05 | 0.22 | 0.04 | 0.20 | *ns* |
| Child well-being | | | | | |
| Child's health | 4.42 | 0.77 | 4.42 | 0.82 | *ns* |
| Internalizing problems | −0.04 | 0.53 | 0.03 | 0.61 | *ns* |
| Externalizing problems | 0.02 | 0.59 | −0.04 | 0.60 | −3.56* |
| Family characteristics | | | | | |
| Family income ($10,000s) | 6.22 | 6.04 | 7.96 | 10.38 | 5.15*** |
| Parental education (years) | 12.39 | 3.68 | 12.40 | 3.71 | *ns* |
| Parents married | 0.65 | 0.48 | 0.66 | 0.47 | *ns* |
| Head's working hours | 42.45 | 15.79 | 41.85 | 14.83 | *ns* |
| Spouse–cohabitor's working hours | 18.98 | 19.50 | 23.29 | 20.63 | 4.21*** |
| Total no. of children | 2.35 | 1.01 | 2.33 | 1.19 | *ns* |
| School start, end, and travel | | | | | |
| School start time | 8:09 a.m. | 40 min | 7:56 a.m. | 42 min | −6.14*** |
| School end time | 2:44 p.m. | 54 min | 2:44 p.m. | 1 hr | *ns* |
| Time traveling to school | 16 min | 17 min | 16 min | 15 min | *ns* |
| Weekday activities (in hours) | | | | | |
| Television | 1.68 | 1.62 | 1.88 | 1.84 | 3.12** |
| Computer–video games | 0.38 | 0.81 | 0.84 | 1.41 | 8.15*** |
| Sports | 0.15 | 0.50 | 0.19 | 0.62 | 2.68* |
| Homework | 0.56 | 0.67 | 0.81 | 1.14 | 3.89*** |
| Religious activities | 0.09 | 0.36 | 0.08 | 0.39 | *ns* |
| Socializing | 0.15 | 0.59 | 0.33 | 1.02 | 3.97*** |
| Meals | 0.74 | 0.46 | 0.58 | 0.46 | −9.71*** |
| Work | NA | NA | 0.23 | 1.04 | |
| Weekend activities (in hours) | | | | | |
| Television | 2.85 | 2.18 | 2.87 | 2.38 | *ns* |
| Computer–video games | 0.77 | 1.21 | 1.30 | 2.04 | 5.43*** |
| Sports | 0.38 | 1.00 | 0.37 | 1.00 | *ns* |
| Homework | 0.11 | 0.38 | 0.35 | 0.91 | 7.48*** |
| Religious activities | 0.68 | 1.30 | 0.54 | 1.29 | *ns* |
| Socializing | 0.61 | 1.50 | 0.80 | 1.68 | 2.03* |
| Meals | 1.09 | 0.60 | 0.76 | 0.60 | −12.61*** |
| Work | NA | NA | 0.38 | 1.46 | NA |
| Family functioning | | | | | |
| Parental warmth | 0.30 | 0.89 | −0.09 | 1.00 | −11.47*** |
| Family rules | 0.29 | 0.79 | −0.50 | 1.10 | −20.72*** |
| Family economic strain | 0.02 | 1.25 | −0.12 | 1.13 | −3.04** |
| Parenting stress | −0.17 | 0.92 | 0.05 | 1.03 | 5.02*** |
| Parent distress | −0.04 | 1.14 | 0.03 | 1.21 | *ns* |
| Family conflict | −0.11 | 1.24 | −0.02 | 1.20 | *ns* |

*Note.* Younger participants (5.5–11.9 years old), $n = 1{,}267$; older participants (12.0–19.1 years old), $n = 1{,}187$. All weekday activity means are significantly different from weekend means at $p < .01$. NA = not applicable.
* $p < .05$. ** $p < .01$. *** $p < .001$.

variables of interest, and many of our variables of interest were significantly intercorrelated, suggesting that they may not make independent contributions to child sleep. For the sake of parsimony, we forgo detailed discussion of the simple associations and instead focus on the independent effects of each variable on children's sleep, as determined in our multiple regression analyses, commenting on simple effects only when they aid interpretation of multivariate effects.

Table 2
*Intercorrelations Between Independent Variables (N = 2,454)*

| Independent variable | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Weekday sleep hours | — | | | | | | | | | | | |
| 2. Weekend sleep hours | .22* | — | | | | | | | | | | |
| 3. Age | −.40* | −.15* | — | | | | | | | | | |
| 4. Male | .03 | −.03 | −.02 | — | | | | | | | | |
| 5. Health | −.01 | −.01 | −.03 | −.01 | — | | | | | | | |
| 6. Internalizing problems | −.01 | .03 | .03 | .01 | −.27* | — | | | | | | |
| 7. Externalizing problems | .06 | .04 | −.09* | .05 | −.24* | .71* | — | | | | | |
| 8. Family income | −.08* | −.05 | .10* | −.03 | .17* | −.09* | −.11* | — | | | | |
| 9. Parental education | .00 | −.04 | .00 | −.02 | .13* | −.10* | −.11* | .27* | — | | | |
| 10. Parents married | .04 | −.04 | −.03 | .00 | .13* | −.18* | −.20* | .26* | .22* | — | | |
| 11. Head's working hours | −.03 | −.06 | −.03 | −.01 | .11* | −.05 | −.05 | .21* | .14* | .28* | — | |
| 12. Spouse–cohabitor's working hours | −.06 | −.04 | .09* | .00 | .10* | −.09* | −.11* | .21* | .09* | .41* | .20* | — |
| 13. Total no. of children | −.06 | .06 | −.06 | −.04 | −.03 | .01 | .03 | −.06 | −.10* | .06 | −.04 | −.05 |
| 14. School start time | .29* | .02 | −.14* | .02 | .04 | −.01 | .03 | −.02 | .00 | .05 | .01 | −.03 |
| 15. School end time | .07 | .03 | −.01 | .03 | −.01 | .03 | .05 | −.02 | −.02 | −.04 | .00 | .01 |
| 16. Time traveling to school | −.23* | −.01 | .03 | .05 | .01 | .02 | .00 | −.05 | −.01 | −.07 | −.06 | −.02 |
| 17. Television | −.04 | −.02 | .08* | .02 | −.11* | .05 | .04 | −.08* | −.11* | −.04 | −.05 | −.02 |
| 18. Computer–video games | −.04 | −.05 | .17* | .18* | .03 | −.04 | −.05 | .04 | .03 | .02 | .01 | .01 |
| 19. Sports weekday | .02 | .00 | .05 | .14* | −.04 | −.01 | .03 | −.02 | −.03 | −.01 | −.04 | .00 |
| 20. Homework weekdays | −.15* | −.05 | .09* | −.05 | .04 | .00 | −.06 | .10* | .08* | .06 | .02 | .02 |
| 21. Religious weekdays | −.05 | −.04 | .00 | −.02 | .01 | −.02 | −.04 | −.01 | .06 | .07 | .00 | .04 |
| 22. Socializing weekdays | −.01 | .03 | .11* | .02 | .00 | .00 | .02 | .02 | .03 | −.05 | −.04 | .00 |
| 23. Meals weekdays | .23* | .06 | −.23* | .02 | .04 | −.02 | −.01 | .02 | .05 | .04 | .01 | −.01 |
| 24. Work weekdays | −.06 | −.01 | .27* | −.03 | .00 | −.04 | −.04 | −.01 | −.02 | −.05 | −.01 | .02 |
| 25. Parental warmth | .12* | .02 | −.20* | −.06 | .14* | −.10* | −.12* | .08* | .13* | .11* | .08* | .06 |
| 26. Family rules | .22* | .09* | −.46* | .05 | −.04 | .02 | .06 | −.12* | −.01 | −.07 | −.03 | −.10* |
| 27. Family economic strain | .01 | .01 | −.08* | .03 | −.11* | .18* | .20* | −.16* | −.15* | −.21* | −.09* | −.11* |
| 28. Parenting stress | −.07 | −.01 | .09* | .02 | −.21* | .48* | .57* | −.08* | −.07 | −.16* | −.05 | −.11* |
| 29. Psychological distress | −.01 | .01 | −.02 | −.01 | −.17* | .35* | .32* | −.11* | −.13* | −.15* | −.07 | −.11* |
| 30. Family conflict | −.06 | .01 | .05 | −.02 | −.13* | .22* | .26* | −.15* | −.12* | −.40* | −.14* | −.25* |
| 31. White | .05 | −.02 | −.03 | −.03 | .20* | −.07 | −.05 | .29* | .29* | .32* | .20* | .18* |
| 32. African American | −.10* | .00 | .05 | .03 | −.16* | .03 | .04 | −.24* | −.14* | −.39* | −.23* | −.19* |
| 33. Hispanic | .07 | .02 | −.03 | −.01 | −.09* | .06 | −.01 | −.09* | −.25* | .12* | .04 | .03 |
| 34. Asian | −.01 | .02 | −.01 | .01 | −.01 | .00 | −.01 | .06 | .00 | .06 | .06 | .00 |
| 35. Other race | .03 | .03 | −.01 | −.01 | .01 | .02 | .03 | −.03 | −.05 | −.03 | −.02 | −.02 |

*Note.* To conserve space, we show only weekday activity variables, and intercorrelations among racial/ethnic categories are excluded. All correlations greater than +.09 or less than −.09 are significant at $p < .01$.
* $p < .05$ with Bonferroni correction.

### *Regression Analyses Predicting Weekday Sleep Behaviors*

Table 3 shows the results of regression analyses testing associations between child weekday sleep behaviors and our set of demographic, school schedule, child activity, and family functioning variables, presented separately for the younger and older age groups. In presenting these results, we focus most on variables associated with differences in total sleep hours. Starting with child demographics, we found that within the younger age group, child age was associated with fewer total hours of sleep during the week because of later bedtimes. Child age was not associated with total sleep time with the group of older children/adolescents, but only because both bedtimes and wake times occur significantly later with each year of age. Older boys go to bed 0.28 hr earlier than older girls on weekdays but wake up marginally earlier as well, such that there is no overall effect on total weekday sleep. Older African American children sleep on average 0.42 hr less than non-Hispanic White children because of a combination of later bedtimes and earlier wake times. Younger Asian children also sleep 0.68 hr less than non-Hispanic White children on weekdays, primarily because of later bedtimes. Note that differences remained significant when time spent napping was included in the measure of total hours of sleep. Surprisingly, family demographic/socioeconomic characteristics had only small associations with children's weekday sleep behaviors; although there were some small effects on wake times and bedtimes, these were not significantly related to total hours of weekday sleep (see Table 3).

By contrast, children's school schedules and time spent traveling to school showed strong associations with weekday sleep behaviors, many of which were moderated by child age, with effects being significantly larger for older children. For younger children, an hour later school start time was associated with a 0.33-hr increase in weekday sleep time, and for older children, an hour later school start time was associated with 0.57 hr more weekday sleep, in both cases due primarily to later wake times. The same is true for time spent getting to school; for every additional hour younger children spend getting to school, their weekday sleep time decreased by 0.69 hr, and for older children,

| 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| — | | | | | | | | | | | | | | | | | |
| .04 | — | | | | | | | | | | | | | | | | |
| −.03 | .21* | — | | | | | | | | | | | | | | | |
| −.02 | −.03 | .04 | — | | | | | | | | | | | | | | |
| .05 | −.01 | −.08* | −.11* | — | | | | | | | | | | | | | |
| −.06 | −.01 | −.04 | −.08* | .01 | — | | | | | | | | | | | | |
| .05 | −.03 | −.03 | −.06 | .01 | .05 | — | | | | | | | | | | | |
| −.04 | −.08* | .04 | .09* | −.18* | −.13* | −.08* | — | | | | | | | | | | |
| −.01 | −.01 | −.04 | .02 | −.09* | −.06 | −.01 | .02 | — | | | | | | | | | |
| −.02 | .04 | −.09* | −.11* | −.06 | −.02 | −.02 | −.13* | −.03 | — | | | | | | | | |
| .00 | .10* | −.03 | −.14* | .04 | .01 | −.01 | .01 | .03 | −.03 | — | | | | | | | |
| −.02 | .02 | −.13* | −.02 | −.11* | −.08* | −.06 | −.08* | −.05 | −.02 | −.12* | — | | | | | | |
| −.05 | .08* | .00 | −.04 | −.12* | −.04 | −.02 | .03 | −.01 | −.03 | .13* | −.02 | — | | | | | |
| .12* | .01 | .06 | .05 | −.06 | −.13* | −.02 | .02 | .02 | −.10* | .16* | −.16* | .18* | — | | | | |
| .08* | .01 | .00 | .03 | .04 | −.02 | .01 | −.02 | −.04 | −.03 | −.01 | .03 | −.02 | .05 | — | | | |
| −.07 | −.01 | .01 | .03 | .02 | .00 | .03 | −.01 | −.02 | −.01 | −.04 | .01 | −.17* | .00 | .14* | — | | |
| .06 | .02 | .01 | .00 | .04 | −.06 | .02 | .02 | −.04 | −.03 | −.04 | −.02 | −.08* | .02 | .27* | .31* | — | |
| .07 | −.02 | .00 | .04 | .08* | .01 | .02 | −.02 | −.03 | .00 | −.08* | .01 | −.18* | −.04 | .24* | .24* | .21* | — |
| −.08* | .07 | −.06 | −.07 | −.11* | .08* | −.01 | −.04 | .06 | .02 | .08* | .01 | .20* | −.19* | −.12* | −.09* | −.12* | −.18* |
| .00 | −.10* | .07 | .13* | .10* | −.05 | .03 | .01 | −.03 | −.01 | −.09* | .01 | −.22* | .17* | .13* | .12* | .06 | .23* |
| .13* | .00 | −.03 | −.08* | .02 | −.05 | −.01 | .04 | −.03 | −.01 | .02 | −.01 | .01 | .04 | −.05 | −.02 | .10* | −.06 |
| .00 | .02 | −.01 | −.02 | .01 | .03 | −.01 | .08* | −.02 | −.03 | .01 | −.03 | −.02 | .02 | −.01 | −.01 | .04 | −.04 |
| .02 | .05 | .01 | −.02 | .00 | −.02 | −.03 | −.01 | .00 | .01 | .00 | −.04 | .03 | .01 | .04 | −.03 | .01 | .01 |

sleep time decreases by a notable 1.42 hr, again because of earlier wake times. It is worth noting that without the school travel time variable in the model, our finding of fewer total hours of weekday sleep among African American adolescents compared with non-Hispanic Whites is even more pronounced (0.59 hr less sleep instead of 0.42 hr), suggesting that longer school travel times play a role in contributing to this racial/ethnic sleep discrepancy.

A number of child activity variables were significantly related to total weekday sleep time. For younger children, time spent watching television on weekdays was associated with less total sleep time, with 0.12 hr less sleep per hour of television viewed, primarily because of later bedtimes. For older children, time spent watching television was associated with delays in both bedtimes and wake times, such that there was no effect on total sleep time. Computer/video game use was also related to phase-delayed sleep schedules, without overall effects on total sleep hours. Time spent on homework was associated with significantly fewer total hours of sleep for older children (but not younger children) because of both later bedtimes and earlier wake times. Unexpectedly, time spent on religious activities on weekdays was associated with less total sleep time for both younger and older children. Time spent socializing was not significantly associated with overall sleep time on weekdays, but children who socialized more on weekdays had a phase delay to later bedtimes and later wake times, particularly among the older children. For older children, time spent on paid work on weeknights was also associated with phase delays to later bedtimes ($p < .10$) and wake times ($p < .05$) without affecting total hours of weekday sleep obtained.

The only activity variable for which more time spent on that activity predicted greater hours of sleep was time spent eating meals. On the basis of the fact that this variable is positively associated parent warmth and family rules, and negatively associated with family conflict (see Table 2), we have come to view this time-use variable as an aspect of, or at least as being related to, positive family climate and structure. Time spent eating meals predicts greater total weekday sleep time for both younger and older children; each additional hour spent eating meals is associated with a

Table 3
*Summary of Regression Analysis Predicting Weekday Sleep Behaviors by Child's Age*

| | Hours of sleep | | | | Bedtime | | | | Wake time | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Younger | | Older | | Younger | | Older | | Younger | | Older | |
| Variable | *B* | *SE B* | *B* | *SE B* | *B* | *SE B* | *B* | *SE B* | *B* | *SE B* | *B* | *SE B* |
| Child demographics | | | | | | | | | | | | |
| Age | −0.087** | 0.023 | −0.050 | 0.039 | 0.105** | 0.021 | 0.153** | 0.029 | 0.018[a] | 0.015 | 0.104* | 0.044 |
| Male | −0.003 | 0.072 | 0.088 | 0.110 | 0.004[a] | 0.061 | −0.278** | 0.077 | 0.001 | 0.049 | −0.190† | 0.106 |
| African American | −0.046[a] | 0.114 | −0.419** | 0.160 | 0.115 | 0.088 | 0.281** | 0.104 | 0.069[a] | 0.081 | −0.138 | 0.123 |
| Hispanic | 0.003 | 0.137 | 0.044 | 0.300 | 0.153 | 0.118 | 0.121 | 0.157 | 0.156† | 0.092 | 0.165 | 0.288 |
| Asian | −0.682**[a] | 0.230 | 0.577 | 0.521 | 0.574*[a] | 0.269 | −0.015 | 0.230 | −0.107[a] | 0.145 | 0.562 | 0.343 |
| Family characteristics | | | | | | | | | | | | |
| Family income | −0.009 | 0.007 | −0.003 | 0.003 | 0.008† | 0.005 | 0.003 | 0.002 | −0.001 | 0.004 | −0.001 | 0.003 |
| Parental education | −0.002 | 0.018 | 0.003 | 0.032 | 0.005 | 0.016 | 0.035* | 0.017 | 0.003 | 0.012 | 0.038 | 0.028 |
| Married couple | 0.049 | 0.094 | −0.289† | 0.167 | 0.081 | 0.084 | 0.156 | 0.123 | 0.130* | 0.062 | −0.133 | 0.155 |
| Head's working hours | −0.001 | 0.002 | −0.004 | 0.004 | 0.003 | 0.002 | 0.005† | 0.003 | 0.001 | 0.002 | 0.000 | 0.004 |
| Spouse–cohabitor's working hours | 0.000 | 0.002 | 0.003 | 0.003 | −0.001 | 0.002 | −0.003 | 0.003 | −0.000 | 0.001 | 0.000 | 0.003 |
| Total no. of children | 0.004 | 0.037 | 0.154 | 0.105 | −0.063† | 0.034 | −0.05 | 0.040 | −0.059* | 0.027 | 0.104 | 0.092 |
| School start and end time, travel time | | | | | | | | | | | | |
| School start time | 0.325**[a] | 0.056 | 0.574** | 0.073 | 0.076† | 0.042 | 0.048 | 0.058 | 0.402**[a] | 0.050 | 0.622** | 0.065 |
| School end time | 0.076* | 0.031 | 0.104 | 0.063 | −0.035[a] | 0.029 | 0.081† | 0.047 | 0.041*[a] | 0.017 | 0.185** | 0.055 |
| Time traveling to school | −0.693**[a] | 0.147 | −1.420** | 0.197 | −0.090 | 0.121 | −0.127 | 0.140 | −0.783**[a] | 0.107 | −1.547** | 0.170 |
| Weekday activities | | | | | | | | | | | | |
| Television | −0.119**[a] | 0.028 | 0.007 | 0.040 | 0.165** | 0.024 | 0.178** | 0.026 | 0.047*[a] | 0.023 | 0.184** | 0.033 |
| Computer–video games | −0.029 | 0.047 | −0.069 | 0.047 | 0.096*[a] | 0.040 | 0.223** | 0.035 | 0.067† | 0.039 | 0.152** | 0.042 |
| Sports | −0.093 | 0.099 | 0.119 | 0.077 | 0.113 | 0.085 | 0.103 | 0.066 | 0.020[a] | 0.059 | 0.222** | 0.077 |
| Homework | −0.067 | 0.058 | −0.200** | 0.057 | −0.016 | 0.054 | 0.078* | 0.037 | −0.083* | 0.038 | −0.122* | 0.054 |
| Religious activities | −0.367** | 0.115 | −0.209* | 0.086 | 0.351**[a] | 0.095 | 0.092 | 0.082 | −0.015 | 0.071 | −0.117 | 0.093 |
| Socializing | −0.081 | 0.072 | −0.071 | 0.090 | 0.145*[a] | 0.064 | 0.306** | 0.040 | 0.065 | 0.049 | 0.235** | 0.084 |
| Meals | 0.365** | 0.077 | 0.570** | 0.145 | −0.066[a] | 0.086 | −0.317** | 0.087 | 0.298** | 0.074 | 0.253† | 0.130 |
| Work | | | 0.015 | 0.044 | | | 0.069† | 0.039 | | | 0.084* | 0.042 |
| Family functioning | | | | | | | | | | | | |
| Parental warmth | 0.091*[a] | 0.044 | −0.048 | 0.058 | −0.051 | 0.038 | 0.048 | 0.041 | 0.040 | 0.030 | 0.001 | 0.047 |
| Parental rules | 0.003[a] | 0.056 | 0.212* | 0.060 | −0.021 | 0.053 | −0.123** | 0.047 | −0.019[a] | 0.036 | 0.089 | 0.058 |
| Economic strain | −0.048 | 0.032 | 0.021 | 0.064 | 0.076*[a] | 0.030 | −0.04 | 0.037 | 0.028 | 0.021 | −0.018 | 0.050 |
| Parenting stress | −0.072 | 0.044 | −0.051 | 0.088 | 0.055 | 0.040 | 0.023 | 0.047 | −0.018 | 0.031 | −0.028 | 0.082 |
| Psychological distress | 0.017 | 0.034 | −0.075 | 0.055 | −0.009 | 0.032 | 0.009 | 0.037 | 0.009 | 0.025 | −0.066 | 0.045 |
| Family conflict | −0.056 | 0.039 | 0.032 | 0.058 | 0.032 | 0.035 | −0.003 | 0.034 | −0.024 | 0.025 | 0.029 | 0.049 |
| $R^2$ | .237 | | .263 | | .225 | | .314 | | .299 | | .356 | |

*Note.* Younger participants (5.5–11.9 years old), $n = 1{,}267$; older participants (12.0–19.1 years old), $n = 1{,}187$. Standard errors were adjusted using Huber–White methods. Models also included other race–ethnicity, child health, and internalizing and externalizing problems.
[a] Younger child differed significantly from older child at $p < .05$.
† $p < .10$. * $p < .05$. ** $p < .01$.

0.37 hr increase in total sleep time for younger children and a 0.57 hr increase in total sleep time for older children because of a combination of earlier bedtimes and later wake times.

For associations between our other family functioning variables and children's weekday sleep, we found, as predicted, that associations between parental warmth and child sleep time were moderated by child's age: Greater parental warmth was associated with significantly more weekday sleep (by 0.09 hr per standard deviation of parent warmth) for younger children but not older children. By contrast, parental rules had no association with total sleep time for younger children but were associated with significantly greater sleep for older children (0.21 hr for every standard deviation of increase in parental rules), primarily because of earlier bedtimes. Although our rules measure did contain a question on rules regarding bedtimes, the rules measure had an equally large effect with the bedtime rule item excluded. Finally, there was a significant association between family economic strain and later bedtimes for younger children, with no effect on total sleep hours.

Our full models did a reasonably good job of explaining weekday sleep behaviors. $R^2$ values ranged from 23% for younger children's bedtimes to 36% for older children's wake times.

### *Regression Analyses Predicting Weekend Sleep Behaviors*

Table 4 presents the results of regression analyses for factors predicting children's weekend sleep behaviors by age group. In contrast to our findings for weekday total sleep time, child age was not associated with total weekend sleep hours within either age group. There were, however, age-related shifts to both later bedtimes and later wake times by approximately 5 to 6 min per year of age among the younger children and about 12 min per year of age among the older children/adolescents. Adolescent boys reported more total hours of sleep (by 0.38 hr) on weekends than did adolescent girls, mostly because they went to bed 0.28 hr earlier. Older African American children again slept significantly less than non-Hispanic White children (by 0.47 hr) because of a combination of later bedtimes and earlier wake times. As with weekday sleep, this effect was significant even when time spent napping was included in the model as part of total sleep or as a control variable. Younger Hispanic children slept 0.39 hr less and older Hispanic children slept 0.49 hr less than non-Hispanic White children on weekends.

Several family demographic factors had significant associations with weekend bedtimes and wake times. Only parent education, however, was significantly related to total hours of sleep. Every additional year of parental education was associated with 0.07 hr less weekend sleep for younger children because of earlier wake times. Higher parent education predicted later bedtimes for older children but had no effect on total sleep time. There was also a trend for less total sleep among older children living in married couple households (by 0.37 hr, $p < .10$). The presence of a greater number of children in the family predicted significantly earlier weekend bedtimes for both younger and older children, with no effect on overall sleep hours.

We anticipated that weekday school start and travel times might continue to influence the weekend sleep–wake schedule because of either biological or social entrainment of schedules. There was some evidence this was the case—for every hour later weekday school start time, younger children's weekend bedtimes and wake times were 0.11 hr and 0.12 hr later, respectively. For every hour weekday travel time to school, younger children's weekend wake times were 0.36 hr earlier.

Many activity variables were associated with hours of sleep time on the weekends. Each hour spent watching television was associated with less sleep time for both younger (by 0.15 hr) and older children (by 0.16 hr), primarily because of later bedtimes. Time spent on the computer or playing video games also predicted less sleep for both younger (by 0.16 hr) and older children (by 0.23 hr) because of later bedtimes. For each additional hour young children spent on sports, total sleep time declined by 0.15 hr, mainly because of earlier wake times. As with weekdays, time spent engaged in religious activities was negatively associated with total sleep on weekends for both younger (by 0.07 hr) and older children (by 0.19 hr) because of significantly earlier wake times. Socializing was associated with decreased sleep times for both younger and older children, primarily because of later bedtimes. Time spent eating meals was not associated with overall sleep time on weekends but was associated with earlier bedtimes for younger children and earlier wake times for older children. Working on the weekend was associated with less total sleep time for older children, due mostly to earlier wake times, with each hour of paid work's accounting for 0.25 hr less sleep. Homework is the only activity variable that did not influence weekend sleep schedules.

Finally, none of our family process measures were significantly associated with overall sleep time on weekends, although increased family conflict was associated with later bedtimes at the trend level for young children, and economic strain significantly predicted later weekend wake times for younger children. The total variance accounted for in the weekend models was substantially lower than in the weekday models, possibly because school start times and travel times had such a large impact on weekday children's sleep behaviors. For the weekend models, the $R^2$ values ranged from 12% for younger children's wake times to 26% for older children's bedtimes.

For both our weekday and weekend models, we were curious as to whether the associations between our family functioning variables and child sleep might be mediated by child activities, with the family process effects being notably stronger without the presence of the child activity variables in the model. There was little evidence that this was the case. Rather, the family functioning and child activity variables made relatively independent contributions.

Table 4
*Summary of Regression Analysis Predicting Weekend Sleep Behaviors by Child's Age*

| | Hours of sleep | | | | Bedtime | | | | Wake time | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Younger | | Older | | Younger | | Older | | Younger | | Older | |
| Variable | *B* | *SE B* | *B* | *SE B* | *B* | *SE B* | *B* | *SE B* | *B* | *SE B* | *B* | *SE B* |
| Child demographics | | | | | | | | | | | | |
| Age | −0.030 | 0.028 | −0.004 | 0.043 | 0.113$^{**a}$ | 0.021 | 0.195$^{**}$ | 0.028 | 0.083$^{**a}$ | 0.024 | 0.192$^{**}$ | 0.038 |
| Male | 0.018$^{a}$ | 0.096 | 0.381$^{*}$ | 0.159 | −0.098 | 0.076 | −0.288$^{**}$ | 0.104 | −0.080 | 0.079 | 0.093 | 0.134 |
| African American | 0.161 | 0.165 | −0.473$^{*}$ | 0.230 | 0.172 | 0.125 | 0.324$^{\dagger}$ | 0.171 | 0.333$^{**}$ | 0.122 | −0.148 | 0.189 |
| Hispanic | −0.394$^{*}$ | 0.180 | −0.488$^{\dagger}$ | 0.288 | 0.141 | 0.153 | 0.386$^{\dagger}$ | 0.208 | −0.253$^{\dagger}$ | 0.148 | −0.102 | 0.271 |
| Asian | 0.369 | 0.361 | 0.156 | 0.422 | 0.282 | 0.262 | −0.133 | 0.334 | 0.651$^{*a}$ | 0.294 | 0.023 | 0.329 |
| Family characteristics | | | | | | | | | | | | |
| Family income | −0.005 | 0.009 | 0.008$^{\dagger}$ | 0.004 | −0.004 | 0.009 | 0.005 | 0.004 | −0.009$^{a}$ | 0.007 | 0.013$^{*}$ | 0.006 |
| Parental education | −0.072$^{**}$ | 0.026 | −0.037 | 0.034 | 0.004 | 0.020 | 0.045$^{*}$ | 0.022 | −0.068$^{**}$ | 0.022 | 0.009 | 0.033 |
| Married couple | −0.056 | 0.154 | −0.370$^{\dagger}$ | 0.200 | 0.128 | 0.111 | 0.234 | 0.149 | 0.071 | 0.108 | −0.135 | 0.155 |
| Head's working hours | −0.005 | 0.004 | −0.008 | 0.005 | 0.005$^{\dagger}$ | 0.003 | 0.002 | 0.004 | 0.000 | 0.003 | −0.006 | 0.005 |
| Spouse–cohabitor's working hours | 0.002 | 0.003 | 0.006 | 0.004 | −0.001 | 0.002 | −0.003 | 0.003 | 0.001 | 0.002 | 0.002 | 0.003 |
| Total no. of children | 0.024 | 0.060 | 0.155 | 0.098 | −0.117$^{**}$ | 0.043 | −0.144$^{**}$ | 0.052 | −0.093$^{\dagger}$ | 0.049 | 0.011 | 0.075 |
| School start and end time, travel time | | | | | | | | | | | | |
| School start time | 0.007 | 0.066 | 0.048 | 0.105 | 0.114$^{*}$ | 0.057 | 0.073 | 0.080 | 0.121$^{*}$ | 0.056 | 0.121 | 0.108 |
| School end time | 0.069 | 0.045 | 0.061 | 0.082 | −0.029 | 0.039 | 0.007 | 0.059 | 0.040 | 0.041 | 0.068 | 0.077 |
| Time traveling to school | −0.170 | 0.185 | 0.157 | 0.242 | −0.190 | 0.163 | −0.264 | 0.171 | −0.359$^{*}$ | 0.151 | −0.107 | 0.224 |
| Weekend activities | | | | | | | | | | | | |
| Television | −0.147$^{**}$ | 0.029 | −0.162$^{**}$ | 0.045 | 0.125$^{**}$ | 0.025 | 0.139$^{**}$ | 0.027 | −0.022 | 0.024 | −0.023 | 0.033 |
| Computer–video games | −0.160$^{**}$ | 0.044 | −0.231$^{**}$ | 0.042 | 0.131$^{**a}$ | 0.036 | 0.241$^{**}$ | 0.038 | −0.030 | 0.031 | 0.011 | 0.029 |
| Sports | −0.153$^{**}$ | 0.044 | −0.077 | 0.073 | 0.058$^{\dagger}$ | 0.030 | 0.019 | 0.068 | −0.095$^{*}$ | 0.040 | −0.059 | 0.085 |
| Homework | 0.113 | 0.183 | −0.104 | 0.072 | −0.055 | 0.130 | 0.063 | 0.051 | 0.058 | 0.126 | −0.041 | 0.057 |
| Religious activities | −0.066$^{\dagger a}$ | 0.034 | 0.194$^{**}$ | 0.047 | −0.040 | 0.026 | −0.059 | 0.041 | −0.105$^{**a}$ | 0.031 | −0.253$^{**}$ | 0.043 |
| Socializing | −0.131$^{**}$ | 0.032 | −0.207$^{**}$ | 0.042 | 0.114$^{**a}$ | 0.031 | 0.198$^{**}$ | 0.030 | −0.018 | 0.025 | −0.009 | 0.038 |
| Meals | 0.163$^{a}$ | 0.103 | −0.149 | 0.121 | −0.210$^{**}$ | 0.072 | −0.155$^{\dagger}$ | 0.080 | −0.047$^{a}$ | 0.080 | −0.304$^{**}$ | 0.106 |
| Work | | | −0.251$^{**}$ | 0.044 | | | 0.046 | 0.037 | | | −0.204$^{**}$ | 0.041 |
| Family functioning | | | | | | | | | | | | |
| Parental warmth | 0.006 | 0.066 | −0.075 | 0.084 | −0.001 | 0.051 | 0.019 | 0.056 | 0.005 | 0.051 | −0.056 | 0.070 |
| Parental rules | 0.100 | 0.081 | −0.010 | 0.077 | 0.002 | 0.060 | 0.003 | 0.055 | 0.102$^{\dagger}$ | 0.057 | −0.008 | 0.067 |
| Economic strain | 0.047 | 0.050 | −0.026 | 0.079 | 0.050 | 0.038 | 0.078 | 0.056 | 0.097$^{**}$ | 0.037 | 0.052 | 0.063 |
| Parenting stress | 0.014 | 0.066 | 0.006 | 0.093 | −0.028 | 0.056 | 0.017 | 0.068 | −0.013 | 0.053 | 0.023 | 0.075 |
| Psychological distress | −0.038 | 0.050 | 0.010 | 0.072 | −0.032 | 0.042 | −0.040 | 0.049 | −0.070$^{\dagger}$ | 0.037 | −0.030 | 0.056 |
| Family conflict | −0.022 | 0.050 | 0.008 | 0.066 | 0.067$^{\dagger}$ | 0.036 | 0.015 | 0.047 | 0.045 | 0.041 | 0.023 | 0.057 |
| $R^2$ | .125 | | .138 | | .196 | | .256 | | .119 | | .138 | |

*Note.* Younger participants (5.5–11.9 years old), $n = 1{,}267$; older participants (12.0–19.1 years old), $n = 1{,}187$. Standard errors were adjusted using Huber–White methods. Models also included other race–ethnicity, child health, and internalizing and externalizing problems.
[a] Younger child differed significantly from older child at $p < .05$.
$^{\dagger}p < .10$. $^{*}p < .05$. $^{**}p < .01$.

### *Mediators of the Association Between Age and Sleep Across the Full Age Span*

In a final set of analyses, we examined the extent to which each of our sets of variables (demographic, school schedule, family functioning, and activity), as well as specific variables within each set, accounted for age-related changes in sleep across the entire age span.

*Age and weekday sleep hours.* As would be expected, across the full range, age had a strong linear effect on hours of weekday sleep, accounting for 18% of the variance in weekday sleep hours, with children receiving 0.178 hr less sleep for every year of age. When the demographic and child health controls were added to the model after age, the coefficient for the effect of age on weekday sleep was reduced by 3%, to 0.172 hr less sleep per year of age. The school scheduling variables, family functioning variables, and activity variables, when entered as separate blocks, reduced the size of the age-to-weekday-sleep coefficient by 9%, 12%, and 15%, respectively. When all blocks of variables were added simultaneously, the coefficient for the effect of age on weekday sleep was reduced by 37%, to 0.112 hr less sleep per year of age.

In identifying potential specific mediators of the association between age and total weekday sleep hours, we focused on those school schedule, family functioning, and weekday activity variables that were significantly associated with both child age and weekday sleep in univariate correlations (Baron & Kenny, 1986). Several variables met this criterion, including school start times, weekday homework, weekday time spent on meals, parent warmth, and household rules. As can be seen in Table 2, with increasing age, school start times were earlier, more time was spent on weekday homework, less time was spent on weekday meals, and children encountered lower levels of parent warmth and fewer household rules, and each of these variables in turn predicted fewer hours of weekday sleep. Formal tests of mediation (Preacher & Hayes, 2004) revealed that each of these variables, except parental warmth, was a significant partial mediator of the association between age and weekday sleep hours. Earlier school start times, greater hours of homework, less time on meals, and fewer parental rules each helped to account for the fact that children were getting less weekday sleep as they grew older, with the association between age and weekday sleep being reduced by 9% (for school start times), 3% (for homework), 8% (for time on meals) and 13% (for parental rules) when each of these variables was entered separately into the model after child age and race/ethnicity.

*Age and weekend sleep hours.* Age was less strongly related to weekend sleep across the full age span, accounting for only 3% of the variation in weekend sleep hours, with weekend sleep hours decreasing by 0.079 hr for every year of age. Adding the block of demographic and child health variables did not reduce the association between age and weekend sleep hours.

The school scheduling variables, family functioning variables, and activity variables, when entered as separate blocks, reduced the size of the age-to-weekend-sleep coefficient by 1%, 11%, and 49%, respectively. The full set of variables, entered together, also reduced the age-to-weekend-sleep coefficient by 49%, to 0.04 hr less sleep per year of age.

In terms of specific mediators for the association between age and weekend sleep hours, only two variables were significant mediators, according to tests of the significance of the indirect path (Preacher & Hayes, 2004). These included time spent working (paid employment) and time spent using the computer on weekends, each of which significantly increased with age ($r = .24$ for work; $r = .10$ for computer use) and was associated with significantly fewer weekend sleep hours ($r = –.10$ for work; $r = –.13$ for computer use). Each of these variables, entered independently, reduced the age-to-weekend-sleep coefficient by 14%, to 0.07 hr less sleep per year of age.

## Discussion

The results of our study confirm prior findings regarding influences on children's sleep (see Carskadon, 2002) but also add to the literature in several ways. First, the large sample size and nationally representative nature of the data allowed us to examine associations between factors such as socioeconomic status and race/ethnicity and children's sleep and to increase the generalizability of the results. Second, our simultaneous examination of family process variables along with demographic variables, school schedule variables, and child activities allowed us to present the unique effects of each variable, such that each effect is not easily attributable to confounding with other variables. Third, separate models allowed us to compare the extent to which processes were similar for weekday and weekend sleep, and for younger versus older children, while our final model examined influences on sleep across the full age span. Finally, a time-diary approach to reporting sleep and activities was used, which is less subject to reporting bias than global or stylized self-report measures of time use (Juster et al., 2003).

Several caveats regarding our study should, however, be noted. First, given the cross-sectional nature of our data, the directionality of our findings is clearly subject to debate—it is certainly possible that the timing and quality of children's sleep influences children's activity choices and the quality of their family life. Indeed, children who are not sleepy at night would be likely to fill such sleepless hours with activities, and insufficient sleep can cause behavioral and mood changes that may have an impact on behavior and on family processes. Reverse causality explanations are, however, less likely for the impact of school travel times on children's sleep hours (particularly for younger children, who are unlikely to be responsible for their own transport to and from school) and certainly for associations between race/ethnicity and sleep. Second, although our study measured the influence of many broad social-ecological variables on children's sleep patterns, we did not have measures of children's proximal sleep ecology, such as their sleeping arrangements (sleeping alone or sharing beds with siblings, parents, pets, or other bed partners; Worthman & Melby,

2002). Third, our study focused on sleep timing, rather than sleep efficiency and quality, which are important factors in determining the impact of children's sleep on their functioning and health (Dahl, 1996; Sadeh, Gruber, & Raviv, 2002). Fourth, any form of self-reported sleep timing is likely to be less accurate than an objective approach to measurement of sleep timing, such as actigraphy (Sadeh, Raviv, & Gruber, 2000). The fact that our average sleep hours are longer than those typically found with actigraphy in children (Sadeh et al., 2003) and adolescents (Hansen, Janssen, Schiff, Zee, & Dubocovich, 2005) suggests that our measure may capture some time in bed during which children are not sleeping.

These caveats aside, our results demonstrate that children's sleep behaviors are associated with a combination of demographic variables (particularly race/ethnicity), school schedule variables, child activity choices, and family functioning variables. Although we identified a few mediational processes, for the most part variables within each of these domains had independent effects on child sleep. With respect to our family functioning variables, which were of central interest, parental warmth and parental rules were the strongest predictors, with the effects of these variables being moderated by child age. As predicted, warmth was found to play a stronger role for younger children, whereas rules were more important for older children. In general, family variables were better predictors of weekday, as opposed to weekend, sleep behaviors. With this overview, we briefly discuss results within each domain, with an eye to what they tell about the role that the family is playing, and not playing, in determining children's sleep behaviors.

### *School Schedule Variables*

Among our findings, the largest effect sizes were for the impact of school start times and especially the effect of travel time to school on total hours of weekday sleep. Whereas prior studies have emphasized the importance of school start times for child and adolescent sleep and well-being (Carskadon, 2002; Hansen et al., 2005; Wolfson & Carskadon, 1998), to our knowledge, none have reported the effects of travel times to and from school. Experts on adolescent sleep have lobbied for changes to later school start times to increase the hours of sleep adolescents receive; our new results suggest that policymakers also need to consider travel time to school as an important factor contributing to sleep debt.

The impact of school schedule variables on total weekday sleep was driven by changes in wake times, with no significant effects on bedtimes being found, suggesting that children and adolescents are not adjusting their bedtimes in response to their need for earlier wake times and that parents are not enforcing such adjustments. For adolescents, this is consistent with prior literature suggesting that biological shifts in sleep schedules make it difficult for them to shift to earlier bedtimes (Wolfson & Carskadon, 1998). The fact that younger children also showed no significant adaptation of bedtimes in response to schooling schedules suggests that later bedtime preferences also have social determinants. It also suggests that parents are not sufficiently cognizant of the importance of or are not effective in helping their younger children and adolescents adjust their bedtimes to take into account school scheduling and travel time demands.

### *Demographic Variables*

Another noteworthy finding was the fact that older African American children slept significantly fewer hours than other participants on both weekdays and weekends. For weekday sleep, this effect was partially due to longer times spent traveling to and from school, which were in turn related to earlier wake times. It cannot be determined from the current data whether this was due to differing choices regarding where to send African American children to school or to high schools being more dispersed or travel methods less efficient in the neighborhoods in which they reside. Beyond earlier wake times, later bedtimes further contributed to older African American youth's receiving less total sleep. The finding of less total sleep for African American adolescents was significant controlling for a wide variety of demographic, activity, and family functioning variables, and it still remained if hours of naptime were included in the sleep hours index, in contrast to prior findings in which longer naptimes compensated for shorter hours of nighttime sleep in African American children (Crosby et al., 2005). Research on the impact of shortened sleep suggests that the pattern of fewer sleep hours for African American adolescents could have potentially serious health consequences—shortened sleep contributes to physiological changes associated with greater risk for obesity, diabetes, and hypertension (Spiegel, Leproult, & Van Cauter, 2003, 2005). One prior study finding shorter sleep hours in African American children (McLaughlin Crabtree et al., 2005) also found these children to have higher levels of daytime sleepiness at home and at school, a pattern that has potentially serious educational consequences.

The other race/ethnicity effects that were found, including younger Asian children receiving less weekday sleep and younger Hispanic children reporting less weekend sleep, may be of less concern for health outcomes because they are not pervasive across both weekday and weekend sleep. On the other hand, greater variability in sleep scheduling is, in and of itself, thought to be detrimental to child well-being (Acebo & Carskadon, 2002).

Contrary to our expectations, parent education and income variables were only sporadically associated with child sleep, and where they were present, effects were in the direction of later bedtimes or less sleep in families with higher education and income. Thus, according to our data, sleep processes are more likely to help account for racial/ethnic disparities in health outcomes than they are to account for the socioeconomic gradient in health.

### *Children's Activities*

Most of our activity variables were important contributors to sleep hours and timing, with activities playing a

particularly important role in the determination of weekend sleep behaviors. For weekday sleep, time watching television (for younger children) and time spent on homework (for older children) contributed to fewer total sleep hours, although effect sizes were relatively small. Computer use/videogame playing was related to later weekday bedtimes for all children but did not influence overall weekday sleep hours. For weekend sleep, television viewing, time spent on the computer or video games, time spent socializing, time spent on sports (for younger children), and time spent working (for older children) all predicted fewer sleep hours. A surprising finding was that involvement in religious activities predicted fewer total hours of sleep on both weekdays and weekends. Although weekday religious activity involvement was associated with later bedtimes for younger children, the effect of religious activities on children's weekend sleep was due to earlier wake times, suggesting that children's weekend bedtimes are not being sufficiently adjusted (by children or parents) to account for involvement in religious activities during the weekend morning hours.

In contrast to the other activities mentioned, greater time spent at meals was associated with greater sleep on weekdays. Greater time at meals may be a proxy for shared family time or for a high level of structure in the home, as it seems likely that longer mealtimes are associated with more sit-down meals in which the family eats together. Longer meals, particularly if shared, may also be taking on an important social function for children and their families, serving communicative, symbolic, and affective functions within the family. Indeed, mealtimes are among the most important and commonly studied of family rituals (Fiese et al., 2002). Mealtime is, however, more than just a proxy for parent warmth; in our study, time spent on meals predicted children's sleep behavior above and beyond the effects of parent warmth. This finding is in accord with prior research showing that family meals are predictors of positive adolescent outcomes independent of family connectedness (Eisenberg, Olson, Neumark-Sztainer, Story, & Bearinger, 2004).

Although it could be argued that greater time spent doing any activity is likely to relate to fewer hours of sleep because the child has only a finite number of hours in a day, the fact that some activities, such as more time spent at meals, relate to greater hours of sleep refutes this as the sole explanation of our activity variable effects.

### *Family Functioning Variables*

As noted earlier, our expectations that parental warmth would play a more important role in predicting younger children's sleep and family rules would be more important for older children's sleep behaviors were confirmed. Parental warmth was related to greater hours of sleep for younger children. We hypothesize that warmth aids young children's sleep through increased feelings of comfort and security, an important ingredient for falling asleep; perhaps parents are more likely to engage in comforting bedtime routines with children on weekdays. Our family rules variable was related to earlier bedtimes and greater total hours of sleep on weekdays for older children; we assume this association was due in part to stricter enforcement of rules regarding bedtimes on weeknights. Of interest, however, our family rules measure had an equal effect size with the bedtime rule item excluded, suggesting the rules effect is not just a matter of stricter bedtime enforcement but something more general about parental expectations, structure, or monitoring. Surprisingly, parent psychological distress had no significant associations with children's sleep timing—only a single trend for earlier weekend wake times for younger children. This stands in contrast to prior research showing strong associations between parent emotional well-being and child sleep timing (Seifer et al., 1996). Our measure of family conflict also showed no significant associations with children's sleep behaviors, showing just a trend toward later bedtimes for younger children on weekends. Our conflict measure, however, was based on only a few parent-report items, and prior studies have noted that child report of conflict is a stronger predictor of child sleep patterns (El-Sheikh et al., 2006).

In general, although the effects sizes were not large, family process variables related to children's sleep in the expected direction—positive parenting behaviors, such as higher levels of control and warmth, were related to more desirable child sleep behaviors. It is interesting that the family functioning variables appear to have had a larger impact on weekday rather than weekend sleep, both in terms of the proportion of variance they explained and the number of significant effects, whereas the child activity effects were more pervasive on weekends than weekdays. One possible interpretation of this is that parents "ease up" and give children greater say over their activity choices and sleep behaviors on weekends, such that those activities in turn become stronger determinants of children's weekend sleep hours. This is in line with prior research on children's perceptions of influences on their weekday and weekend sleep (Carskadon, 2002). Further research should examine whether there are benefits related to the development of child autonomy associated with allowing greater child control over weekend sleep decisions. If not, because of prior evidence that large weekday–weekend sleep differentials are problematic (Acebo & Carskadon, 2002), parents should consider becoming more involved in the regulation of both weekday and weekend sleep to ensure greater regularity of child sleep schedules.

A further place where greater parental intervention might be warranted is in helping to reduce the age-related decline in total sleep hours from childhood to adolescence. Reductions in family rules and time spent on meals were significant mediators of the negative association between child age and total weekday sleep. On the basis of these results, one could recommend that parents maintain stricter rules and structured family mealtimes later into the adolescent years in an attempt to preserve longer sleep hours for youth. Given that adolescents who do encounter stricter rules have greater weekday sleep hours, it seems reasonable that this would have a positive effect. Such parental interventions would, however, run up against realities that parents have less control over, including the biological phase shifts in

sleep timing preferences that occur in adolescence (Carskadon et al., 1993), as well as school-schedule related variables. In the current study, earlier school start times and increasing time spent on homework were both found to be significant mediators of the age-to-weekday-sleep association; parental intervention to alter these constraints on adolescent time is a difficult task. On weekends however, when these school-related demands lessen, hours spent on paid employment and adolescent computer use are the significant mediators of age-related changes in weekend sleep—these activities, particularly the latter, seem more plausibly subject to parent intervention. Clearly, American children's sleep behaviors are multiply determined, with demographic and cultural variables, school demands and constraints, child activity preferences, and family factors such as parental warmth and rules all making important contributions to children's sleep timing and quantity.

## References


Acebo, C., & Carskadon, M. A. (2002). Influence of irregular sleep patterns on waking behavior. In M. A. Carskadon (Ed.), *Adolescent sleep patterns: Biological, social and psychological influences* (pp. 220–235). New York: Cambridge University Press.

Agras, W. S., Hammer, L. D., McNicholas, F., & Kraemer, H. C. (2004). Risk factors for childhood overweight: A prospective study from birth to 9.5 years. *Journal of Pediatrics, 145,* 20–25.

Alwin, D. (1990). Historical changes in parental orientations to children. *Sociological Studies of Child Development, 3,* 65–86.

Baron, R. M., & Kenny, D. A. (1986). The moderator–mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology, 55,* 1173–1182.

Bates, J. E., Viken, R. J., Alexander, D. B., Beyers, J., & Stockton, L. (2002). Sleep and adjustment in preschool children: Sleep diary reports by mothers relate to behavior reports by teachers. *Child Development, 73,* 62–74.

Cajochen, C., Zeitzer, J., Czeisler, C., & Dijk, D. J. (2000). Dose-response relationship for light intensity and ocular and electroencephalographic correlates of human alertness. *Behavioural Brain Research, 115,* 75–83.

Caldwell, B., & Bradley, R. (1984). *Home Observation for Measurement of the Environment.* Little Rock: University of Arkansas at Little Rock.

Carskadon, M. A. (1999). When worlds collide: Adolescent need for sleep versus societal demands. *Phi Delta Kappan, 80,* 348–353.

Carskadon, M. A. (2002). Factors influencing sleep patterns of adolescents. In M. A. Carskadon (Ed.), *Adolescent sleep patterns: Biological, social and psychological influences* (pp. 5–25). New York: Cambridge University Press.

Carskadon, M. A., Acebo, C., & Jenni, O. G. (2004). Regulation of adolescent sleep: Implications for behavior. *Annals of the New York Academy of Sciences, 1021,* 276–291.

Carskadon, M. A., Vieira, C., & Acebo, C. (1993). Association between puberty and delayed phase preference. *Sleep, 16,* 258–262.

Carskadon, M. A., Wolfson, A. R., Acebo, C., Tzischinsky, O., & Seifer, R. (1998). Adolescent sleep patterns, circadian timing, and sleepiness at a transition to early school days. *Sleep, 21,* 871–881.

Conger, R., & Elder, G. H., Jr. (1994). *Families in troubled times: Adapting to changes in rural America.* New York: Aldine de Gruyter.

Crosby, B., LeBourgeois, M. K., & Harsh, J. (2005). Racial differences in reported napping and nocturnal sleep in 2- to 8-year-old children. *Pediatrics, 115,* 225–232.

Dahl, R. E. (1996). The regulation of sleep and arousal: Development and psychopathology. *Development and Psychopathology, 8,* 3–27.

Dahl, R. E. (2005). The regulation of sleep–arousal, affect, and attention in adolescence: Some questions and speculations. In M. A. Carskadon (Ed.), *Adolescent sleep patterns: Biological, social and psychological influences* (pp. 269–284). New York: Cambridge University Press.

Dahl, R. E., & Carskadon, M. A. (1995). Sleep and its disorders in adolescence. In R. Ferber & M. H. Kryger (Eds.), *Principles and practice of sleep medicine in the child* (pp. 19–27). Philadelphia: Saunders.

Dahl, R. E., & Lewin, D. S. (2002). Pathways to adolescent health: Sleep regulation and behavior. *Journal of Adolescence Health, 31,* 175–184.

Eisenberg, M. E., Olson, R. E., Neumark-Sztainer, D., Story, M., & Bearinger, L. H. (2004). Correlations between family meals and psychosocial well-being among adolescents. *Archives of Pediatric Adolescent Medicine, 158,* 792–796.

El-Sheikh, M., Buckhalt, J. A., Mize, J., & Acebo, C. (2006). Marital conflict and disruption of children's sleep. *Child Development, 77,* 31–43.

Fiese, B. H., Tomcho, T. J., Douglas, M., Josephs, K., Poltrock, S., & Baker, T. (2002). A review of 50 years of research on naturally occurring family routines and rituals: Cause for celebration? *Journal of Family Psychology, 16,* 381–390.

Fredriksen, K., Rhodes, J., Reddy, R., & Way, N. (2004). Sleepless in Chicago: Tracking the effects of adolescent sleep loss during the middle school years. *Child Development, 75,* 84–95.

Fuligni, A. J., & Hardway, C. (2006). Daily variations in adolescents' sleep, activities, and psychological well-being. *Journal of Research on Adolescence, 16,* 353–378.

Gupta, N. J., Mueller, W. H., Chan, W., & Meininger, J. C. (2002). Is obesity associated with poor sleep quality in adolescents? *American Journal of Human Biology, 14,* 762–768.

Hansen, M., Janssen, I., Schiff, A., Zee, P., & Dubocovich, M. L. (2005). The impact of school daily schedule on adolescent sleep. *Pediatrics, 115,* 1555–1561.

Higuchi, S., Motohashi, Y., Liu, Y., & Maeda, A. (2005). Effects of playing a computer game using a bright display on presleep physiological variables, sleep latency, slow wave sleep and REM sleep. *Journal of Sleep Research, 14,* 267–273.

Hofferth, S., & Sandberg, J. (2001). Changes in children's time with parent, U.S., 1981–1997. *Demography, 38,* 423–436.

Juster, F. T., Ono, H., & Stafford, F. P. (2003). An assessment of alternative measures of time use. *Sociological Methodology, 33,* 19–54.

Kessler, R. C., Barker, P. R., Colpe, L. J., Epstein, J. F., Gfroerer, J. C., Hiripi, E., et al. (2003). Screening for serious mental illness in the general population. *Archives of General Psychiatry, 60,* 184–189.

Locard, E., Mamelle, N., Billette, A., Miginiac, M., Munoz, F., & Rey, S. (1992). Risk factors of obesity in a five year old population: Parental versus environmental factors. *International Journal of Obesity and Related Metabolic Disorders, 16,* 721–729.

McLaughlin Crabtree, V., Beal Korhonen, J., Montgomery-Downs, H. E., Faye Jones, V., O'Brien, L. M., & Gozal, D. (2005). Cultural influences on the bedtime behaviors of young children. *Sleep Medicine, 6,* 319–324.

Meijer, A. M., Habekothe, R. T., & Van den Wittenboer, G. L. H. (2001). Mental health, parental rules and sleep in pre-adolescents. *Journal of Sleep Research, 10,* 297–302.

Moore, K. A., Zaslow, M. H., Coiro, M. J., Miller, S. M., & Magenheim, E. B. (1995). *The JOBS evaluation: How well are they faring? AFDC Families with Preschool-Aged Children in Atlanta at the outset of the JOBS Evaluation.* Washington, DC: U.S. Department of Health and Human Services.

Moore, P. J., Adler, N. E., Williams, D. R., & Jackson, J. S. (2002). Socioeconomic status and health: The role of sleep. *Psychosomatic Medicine, 64,* 337–344.

Morrell, J. M. B. (1999). The role of maternal cognitions in infant sleep problems as assessed by a new instrument, the Maternal Cognitions about Infant Sleep Questionnaire. *Journal of Child Psychology and Psychiatry and Allied Disciplines, 40,* 247–258.

Owens, J., Maxim, R., McGuinn, M., Nobile, C., Msall, M., & Alario, A. (1999). Television-viewing habits and sleep disturbance in school children. *Pediatrics, 104,* 551–557.

Owens-Stively, J., Frank, N., Smith, A., Hagino, O., Spirito, A., Arrigan, M., et al. (1997). Child temperament, parenting discipline style, and daytime behavior in childhood sleep disorders. *Journal of Developmental and Behavioral Pediatrics, 18,* 314–321.

Peterson, J. L., & Zill, N. (1986). Marital disruption, parent–child relationships, and behavioral problems in children. *Journal of Marriage and the Family, 48,* 295–307.

Preacher, K. J., & Hayes, A. F. (2004). SPSS and SAS procedures for estimating indirect effects in simple mediation models. *Behavior Research Methods, Instruments, & Computers, 36,* 717–731.

Reilly, J. J., Armstrong, J., Dorosty, A. R., Emmett, P. M., Ness, A., Rogers, I., et al. (2005). Early life risk factors for obesity in childhood: A cohort study. *British Medical Journal, 330,* 1357–1362.

Rona, R. J., Li, L., Gulliford, M. C., & Chinn, S. (1998). Disturbed sleep: Effects of sociocultural factors and illness. *Archives of Disease in Childhood, 78,* 20–25.

Sadeh, A., & Anders, T. (1993). Infant sleep problems: Origins, assessment, intervention. *Infant Mental Health Journal, 14,* 17–34.

Sadeh, A., Gruber, R., & Raviv, A. (2002). Sleep, neurobehavioral functioning and behavior problems in school-age children. *Child Development, 73,* 405–417.

Sadeh, A., Gruber, R., & Raviv, A. (2003). The effects of sleep restriction and extension on school-age children: What a difference an hour makes. *Child Development, 74,* 444–455.

Sadeh, A., Raviv, A., & Gruber, R. (2000). Sleep patterns and sleep disruptions in school-age children. *Developmental Psychology, 36,* 291–301.

Seifer, R., Sameroff, A. J., Dickstein, S., & Hayden, L. C. (1996). Parental psychopathology and sleep variation in children. *Child and Adolescent Psychiatric Clinics of North America, 5,* 715–727.

Sekine, M., Yamagami, T., Hamanishi, S., Handa, K., Tomohiro, S., & Nanri, S. (2002). Parental obesity, lifestyle factors and obesity in preschool children: Results of the Toyama Birth Cohort Study. *Journal of Epidemiology, 12,* 33–39.

Snell, E. K., Adam, E. K., & Duncan, G. (2007). Sleep and the body mass index and overweight status of children and adolescents. *Child Development, 78,* 309–323.

Spiegel, K., Leproult, R., & Van Cauter, E. (2003). Impact of sleep debt on physiological rhythms. *Revue Neurologique, 159, 11*–20.

Spiegel, K., Leproult, R., & Van Cauter, E. (2005). Metabolic and endocrine changes associated with sleep deprivation. In C. A. Kushida (Ed.), *Sleep deprivation: Vol. 1. Basic science, physiology and behavior.* New York: Dekker.

Spilsbury, J. C., Storfer-Isser, A., Drotar, D., Rosen, C. L., Kirchner, L. H., Benham, H., & Redline, S. (2004). Sleep behavior in an urban US sample of school-aged children. *Archives of Pediatric and Adolescent Medicine, 158,* 988–994.

Stein, M. A., Mendelsohn, J., Obermeyer, W. H., Amromin, J., & Benca, R. (2001). Sleep behavior and problems in school-aged children. *Pediatrics, 107,* 60–69.

Sweet, J., Bumpass, L., & Call, V. (1988). *The design and content of the National Survey of Families and Households* (NSFH Working Paper No. 1). Madison: University of Wisconsin, Center for Demography and Ecology.

Tynjala, J., Kannas, L., Levalahti, E., & Valimaa, R. (1999). Perceived sleep quality and its precursors in adolescents. *Health Promotion International, 14,* 155–166.

Van Cauter, E., & Spiegel, K. (1999). Sleep as a mediator of the relationship between socioeconomic status and health: A hypothesis. *Annals of the New York Academy of Sciences, 896,* 254–261.

Van den Bulck, J. (2000). Is television bad for your health? Behavior and body image of the adolescent "couch potato." *Journal of Youth and Adolescence, 29,* 273–288.

Van den Bulck, J. (2004). Television-viewing, computer game playing and Internet use and self reported time to bed and time out of bed in secondary school children. *Sleep, 27,* 101–104.

Wolfson, A. R., & Carskadon, M. A. (1998). Sleep schedules and daytime functioning in adolescents. *Child Development, 69,* 875–887.

Worthman, C., & Melby, M. K. (2002). Toward a comparative developmental ecology of human sleep. In M. A. Carskadon (Ed.), *Adolescent sleep patterns: Biological, social and psychological influences* (pp. 69–117). New York: Cambridge University Press.

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