Sleep Behavior in an Urban US Sample of School-aged Children

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Objectives: To describe sleep behavior of elementary school-aged children and to assess variations by age, sex, and ethnicity.

Design, Setting, and Participants: Cross-sectional analysis of 755 (50% female, 35% ethnic minority) children 8 to 11 years old from a community-based sample of children participating in a cohort study. Sleep and health data were obtained from a child-completed 7-day sleep journal and a caregiver-completed health/sleep questionnaire.

Main Outcome Measure: Mean nightly sleep duration; bedtime 11 PM or later.

Results: Mean (SD) sleep duration for all children was 9.63 (0.72) hours. Univariate results showed a statistically significant decrease in mean sleep duration associated with increasing age (P < .001) and male sex (P = .03). At all ages, minority boys slept significantly less than non-minority boys and girls and minority girls. The shortest covariate-adjusted mean sleep duration was observed among the oldest minority boys (9.28 [0.07] hours vs 9.43–9.85 hours in the other age, sex, and ethnicity subgroups). Forty-three percent of 10- to 11-year-old minority boys reported less than 9 hours nightly sleep vs 5% to 26% of the other age, sex, and ethnicity subgroups. After controlling for potential confounding, minority children were more likely than nonminority children to have a bedtime of 11 PM or later (odds ratio, 4.8; 95% confidence interval, 2.9–8.0).

Conclusions: A sizeable proportion of elementary schoolchildren sleep less than the recommended 9 hours. Across the age range, decreases in sleep time and, in ethnic minorities, increasingly delayed bedtimes suggest emerging sleep restriction in preadolescents. Observed ethnic differences in sleep behavior highlight the need for better understanding of the social and environmental influences encouraging these sleep patterns.


ACK OF ADEQUATE SLEEP TIME and associated daytime sleepiness are increasingly common features of US childhood. Daytime sleepiness has been widely acknowledged among US adolescents: recent research indicates that 63% to 87% of adolescents report needing more sleep than they receive. In light of this problem, promotion of healthy sleep habits and changes in school schedules and/or start times have been advocated to reduce the chronic sleep debt faced by many teenagers.

The problem of daytime sleepiness is not limited to adolescents, with 11% to 12% of elementary schoolchildren experiencing daytime sleepiness, and 18% to 21% describing fatigue during the school day. The influence of problem sleepiness on children is multidimensional and may include decreased cognitive functioning and academic performance, increased aggression and other behavioral problems, and increased vulnerability to accidents.

The elevated prevalence and negative consequences of daytime sleepiness have generated renewed interest in the normative sleep habits of school-aged children. However, fewer studies have examined sleep behavior in elementary schoolchildren compared with studies of either younger children or adolescents. Moreover, the available studies are generally limited for the following reasons: (1) a focus on middle-class, white children; (2) reliance on a single measurement of sleep (eg, maternal report of the child’s “average” sleep duration), without consideration of day-to-day variation in sleep; and (3) reliance on parental reports, despite parents’ potential lack of awareness of specific activities that surround their child’s bedtimes and wake times. Children’s reports of their own sleep

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may provide a more complete picture of children’s sleep behavior.\textsuperscript{6-24} Finally, a serious knowledge gap in school-aged children’s sleep behavior, particularly for minority ethnic groups, was identified in the recent US National Center on Sleep Disorders Research Plan.\textsuperscript{25} More comprehensive sleep behavior data in an ethnically diverse, nonclinical sample are needed to guide development of recommendations for healthy children’s sleep.

Our study overcomes the limitations noted above by (1) using child self-report data to measure sleep characteristics; (2) incorporating multiple nights (up to 7), rather than a single measurement of sleep time; (3) ensuring adequate representation of African Americans; and (4) using a community-based sample instead of a clinical sample. This study reports the distribution of sleep measures obtained from a multiday, child-completed journal in children participating in the Cleveland Children’s Sleep and Health Study, an ongoing investigation of the epidemiology of sleep patterns and sleep disordered breathing in an urban, community-based cohort of children 8 through 11 years of age, of which approximately one third are ethnic minorities. We hypothesized that sleep patterns would be relatively similar for boys and girls, but that minority children, often from homes with socioeconomic disadvantages, would sleep less and have more variation in sleep duration.

SAMPLE CONSTRUCTION

Details of the construction of the study cohort, including recruitment and informed consent procedures, have been described elsewhere.\textsuperscript{26-28} Briefly, the cohort consists of a stratified, random sample of 907 full-term and preterm (<37 weeks’ gestational age at birth) children born between January 1, 1988, and May 31, 1993, at 1 of 3 major Cleveland, Ohio, area hospitals. Six hundred sixty-four of these children were recruited from a previous birth cohort study of 913 children conducted to assess cognition and behavior in full-term vs preterm children at 8 through 11 years of age. Nonparticipation of this group in this protocol was because of their having moved from the area (4.7%), an inability to locate (5.6%), refusal (12.4%), and passive refusal (4.6% agreed to participate but did not complete study visits). Because the original cohort contained only 23% minorities, we additionally recruited a balanced sample of 243 full-term and preterm minority children, born at 1 of the 3 targeted hospitals during the same birth years as the original cohort.

This study was approved by the institutional review boards of all participating institutions. Written informed consent was obtained from all guardians and assent obtained from all children.

MEASUREMENTS AND PROTOCOL

The Cleveland Children’s Sleep and Health Study involves an extensive protocol that included home visits to participating families, in-home overnight cardiorespiratory studies, and assessments of behavior-functional outcomes, neuropsychological development, and the family-home environment. Data on sleep patterns were ascertained from a child-completed 7-day sleep journal. Using a structured form, each evening children recorded information just before going to bed concerning specific features of the day: for example, if they were sick that day and did not go to school. The following morning, children recorded the time they went to bed, the time they attempted to fall asleep, the number of times they woke up during the night, and the time they finally awoke. Children were individually instructed on the use of the diary, and parents were encouraged to assist as needed. Chronic health-behavioral conditions postulated to potentially influence sleep patterns were identified from data collected using the caregiver-completed Child’s Health Questionnaire–Parent Report 50 and Children’s Sleep and Health Questionnaire, a pediatric modification of a validated questionnaire\textsuperscript{30} that assesses sleep symptoms and disorders.

MAIN OUTCOME MEASURES

Sleep outcomes were calculated as the mean values over all available days of journal information (over a maximum recording period of 7 days), as well as the separate mean value calculations for weeknights (Sunday through Thursday) and weekend nights (Friday and Saturday). Sleep duration indicated the total hours slept. It was calculated as the difference between the average time the child awoke in the morning (wake time), and average time the child attempted to fall asleep (bedtime). Coefficient of variation (CV) indicated a measure of the night-to-night variation in sleep duration. It was calculated as the standard deviation of sleep duration divided by mean sleep duration, expressed as a percentage.

PREDICTORS

Predictors of primary interest include age (as either a continuous or categorical variable: age 8-8.9, age 9-9.9, age 10-11.9), sex, and ethnicity (minority vs nonminority status). Children were classified as being of nonminority ethnicity if described as white or European American by their parent(s); all other children (eg, black or African American, Asian, Native American, Hispanic, and biracial) were categorized as of minority ethnicity.

COVARIATES

Vacation was defined as “yes” if (1) journal entries were made over the summer or winter break or (2) the child reported being out of school at least 4 of 5 weekdays and was not sick (eg, a nonholiday family vacation). Children with chronic health problems, behavioral problems, or potential sleep disorders were identified based on parental reports of serious health conditions (eg, epilepsy, diabetes mellitus, cerebral palsy), congenital syndromes (eg, Turner syndrome), behavioral problems (eg, attention-deficit disorder–attention-deficit/hyperactivity disorder, Tourette syndrome), excessive daytime sleepiness (eg, child “sometimes,” “frequent,” or “always” falling asleep at school, while eating, while playing, or while talking), habitual snoring (snoring loudly at least 3 times per week), or if the child had sleep apnea on cardiopulmonary monitoring performed as part of the larger protocol (ie, apnea hypopnea index $\geq 5$ events per hour or obstructive apnea index $\geq 1$ events per hour). The caregiver’s educational level was classified as less than high school vs high school diploma or higher; education was assumed to be the latter for 16 individuals with missing educational data. Children were categorized as preterm if they were born at less than 37 weeks’ gestational age.

EXCLUSION CRITERIA

To enhance reliability, analyses were restricted to journal data that included both bedtime and wake time for at least 2 week-
To analyze sleep patterns, logistic regression was used to estimate the odds of going to bed after 11 PM for the four ethnicity-sex subgroups, controlling for age and potential confounders. Post hoc tests were used to compare means for weekday and weekend sleep outcomes. Multivariable linear regression was used to control for the potential confounders: preterm status, ethnicity, and sex.32

**RESULTS**

The analytic sample consisted of 755 children, mean age 9.5 years (age range, 8-11 years), with nearly equal proportions of girls and boys (Table 1). Thirty-five percent of the sample was categorized as being of minority ethnicity. Most minority children (88%) were African American. Consistent with the cohort design, 46% were preterm children. Most primary caregivers (94%) reported completing at least high school. Habitual snoring, defined as loud snoring at least once per week, was reported for 14.8% of children. Thirty children (3.9%) had obstructive sleep apnea, identified by overnight cardiorespiratory monitoring performed as part of the larger research protocol.

Comparisons of the 132 children excluded from the analysis owing to insufficient sleep journal data and the 755 children who were included in the final analytic sample show that both groups were of similar age and body mass index (calculated as weight in kilograms divided by the square of height in meters) and had similar proportions for sex, term status, caregiver educational level, and obesity. However, 70% of the excluded children were minorities (P < .001). Comparisons of the 231 children whose caregiver reported chronic health conditions and/or sleep problems vs the 524 children without such a problem revealed no significant differences in any of the sleep outcomes. Therefore, subsequent analyses were not stratified by health status.

**SLEEP DURATION: VARIATION BY AGE, SEX, AND ETHNICITY**

Univariate results showed a significant effect of age group (P < .001), whereby mean (SD) sleep duration of 10-11-year-olds (9.44 [0.81] hours) was 18 minutes shorter than that of 8-year-olds (9.74 [0.68] hours) and 13 minutes shorter than that of 9-year-olds (9.65 [0.68] hours). On average, boys had approximately 7 minutes shorter sleep duration than girls (9.57 [0.71] vs 9.68 [0.72] hours, P = .03). Also, minority children tended to sleep about 6 minutes less, on average, than nonminority children (9.56 [0.86] vs 9.66 [0.63] hours, P = .07). Former preterm children tended to sleep 6 minutes longer than full-term children (9.68 [0.66] vs 9.58 [0.76] hours, P < .05).

The distributions of sleep measures for the analytic sample and for age-sex-ethnicity subgroups are given in Table 2. The average bedtime for all days for the entire sample was 10:05 PM and wake time was 7:42 AM, resulting in an average of 9.63 hours of sleep per night. Minority boys and girls aged 10 to 11 years reported the latest mean bedtime (10:33 and 10:37 PM, respectively) and also had the most night-to-night variation in sleep duration (CV = 11.3% and 10.8%, respectively). The 10-11-year-old minority boys reported the shortest mean sleep duration (9.12 [0.78] hours), with mean sleep duration ranging from 19 to 43 minutes more for the other subgroups. Mean sleep durations for weekdays (9.62 [0.77] hours) and weekends (9.65 [1.03] hours) were similar (P = .41). Examination of the mean duration and variation of weekend sleep revealed similar trends com-

### Table 1. Sample Characteristics of 755 Participants*

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Child’s age, mean (SD), y</td>
<td>9.5 (0.8)</td>
</tr>
<tr>
<td>Female sex</td>
<td>375 (49.7)</td>
</tr>
<tr>
<td>Minority ethnicity†</td>
<td>267 (35.4)</td>
</tr>
<tr>
<td>Caregiver’s educational level, high school diploma or higher†</td>
<td>696 (94.1)</td>
</tr>
<tr>
<td>Preterm status (&lt;37 weeks’ gestational age)</td>
<td>346 (45.8)</td>
</tr>
<tr>
<td>Chronic health and/or sleep problems</td>
<td>231 (30.6)</td>
</tr>
<tr>
<td>Loud snoring at least once per week</td>
<td>111 (14.8)</td>
</tr>
<tr>
<td>BMI percentile, mean (SD)</td>
<td>57.6 (31.3)</td>
</tr>
<tr>
<td>Obesity (BMI percentile &gt; 95th)</td>
<td>115 (15.3)</td>
</tr>
</tbody>
</table>

Abbreviation: BMI, body mass index (calculated as weight in kilograms divided by the square of height in meters).

*Data are given as the number (percentage) of participants unless otherwise indicated.

†Described by primary caregiver as African American (n = 236), biracial (n = 16), Hispanic (n = 10), Native American (n = 3), or Asian (n = 2).

‡Including the following: congenital syndromes (n = 4), hydrocephalus (n = 5), seizure disorder (n = 8), fetal alcohol syndrome (n = 3), sickle cell anemia (n = 4), diabetes mellitus (n = 8), cerebral palsy (n = 15), scoliosis (n = 1), body growth rate disorder (n = 1), attention-deficit disorder—attention-deficit/hyperactivity disorder (n = 82), Asperger syndrome (n = 1), and Tourette syndrome (n = 2). Chronic health and sleep problem categories are nonmutually exclusive.

§Including obstructive sleep apnea (n = 30); loud snoring, frequent awakenings, or leg jerking 3 times or more per week (n = 87); excessive sleepiness during daily activities such as playing, talking, eating (n = 52).

*Based on National Heart, Lung, and Blood Institute guidelines for age and sex.32
pared with data for all recorded days: mean sleep duration on weekends decreased about 11 minutes with increasing age (9.76 [0.94] hours at age 8 years to 9.57 [1.04] hours at ages 10-11 years). Similarly, minority boys 10 through 11 years of age reported the shortest mean weekend sleep duration (9.25 [1.32] hours) and, along with 8-year-old minority girls, reported the largest nightly variation in weekend sleep (CV=10.7% and 11.3%, respectively).

Analyses excluding all children who completed journals during summer break or family vacations also revealed that 10- to 11-year-old minority boys reported the shortest mean sleep duration for all days (9.05 [0.79] hours) and for weekends (9.00 [1.3] hours), as well as the largest night-to-night variation in sleep over all days (CV=9.9%). Average sleep duration over all days for the other subgroups was 22 to 43 minutes longer.

A linear model with age group, sex, ethnicity, and all 2- and 3-way interactions was fit to compare the effects of sex and ethnicity within each age group on mean sleep duration for all days (Table 2). The results show that there were no ethnicity-sex subgroup differences at age 8. However, among the 9-year-olds, minority boys reported significantly shorter sleep durations than minority girls (P=0.05) and tended to sleep less than both nonminority girls (P=0.01) and boys (P=0.10). At ages 10 through 11, minority boys reported significantly shorter sleep duration than minority girls (P=0.01) and nonminority girls (P=0.02) and boys (P=0.05). There were no significant differences in mean sleep duration among minority girls, nonminority girls, and nonminority boys for any of the 3 age groups.

To further explore the effects of age, sex, and ethnicity on mean sleep duration, another linear model was used to estimate mean sleep duration (SE) for all days, adjusting for potential confounders (including vacation status, chronic health conditions, and others) (Table 3). The results show a similar pattern as the unadjusted analyses; that is, the oldest minority boys had the shortest adjusted mean sleep durations (9.28 [0.07] hours). The adjusted mean sleep duration was 9 to 34 minutes greater for the other age-sex-ethnicity subgroups. Post hoc tests revealed that across all ages, minority boys slept significantly less compared with nonminority boys (P<0.001) and girls (P<0.001), and minority girls (P=0.004). Similar to the unadjusted analyses, the mean sleep times for the latter 3 ethnicity-sex subgroups were not significantly different.

### Table 2. Unadjusted Means for Sleep Variables for All Recorded Days and Weekends by Sex-Ethnicity Subgroups

<table>
<thead>
<tr>
<th>Ethnicity and Sex</th>
<th>No. of Participants</th>
<th>Bedtime All Days, PM</th>
<th>Wake Time All Days, AM</th>
<th>Sleep Duration All Days, h</th>
<th>CV All Days†</th>
<th>Sleep Duration Weekends, h</th>
<th>CV Weekends†</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>8-Year-olds</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nonminority girls</td>
<td>85</td>
<td>9:52 (0.69)</td>
<td>7:41 (0.73)</td>
<td>9.82 (0.55)</td>
<td>7.4 (4.0)</td>
<td>9.84 (0.82)</td>
<td>7.4 (8.6)</td>
</tr>
<tr>
<td>Nonminority boys</td>
<td>87</td>
<td>9:58 (0.78)</td>
<td>7:42 (0.88)</td>
<td>9.73 (0.63)</td>
<td>7.6 (3.7)</td>
<td>9.58 (0.93)</td>
<td>8.2 (6.1)</td>
</tr>
<tr>
<td>Minority girls</td>
<td>45</td>
<td>10:10 (0.86)</td>
<td>7:50 (1.07)</td>
<td>9.67 (0.95)</td>
<td>9.7 (6.8)</td>
<td>9.85 (1.16)</td>
<td>11.3 (15.6)</td>
</tr>
<tr>
<td>Minority boys</td>
<td>45</td>
<td>10:11 (0.95)</td>
<td>7:50 (1.07)</td>
<td>9.66 (0.66)</td>
<td>8.5 (4.7)</td>
<td>9.82 (0.90)</td>
<td>6.0 (5.0)</td>
</tr>
<tr>
<td><strong>9-Year-olds</strong></td>
<td>282</td>
<td>10:00 (0.80)</td>
<td>7:45 (0.90)</td>
<td>9.74 (0.68)</td>
<td>8.1 (4.7)</td>
<td>9.76 (0.94)</td>
<td>8.1 (9.1)</td>
</tr>
<tr>
<td>Nonminority girls</td>
<td>101</td>
<td>9:55 (0.70)</td>
<td>7:35 (0.81)</td>
<td>9.67 (0.60)</td>
<td>8.6 (5.1)</td>
<td>9.63 (1.17)</td>
<td>8.7 (9.1)</td>
</tr>
<tr>
<td>Nonminority boys</td>
<td>105</td>
<td>9:53 (0.63)</td>
<td>7:31 (0.76)</td>
<td>9.64 (0.58)</td>
<td>7.6 (4.2)</td>
<td>9.53 (0.93)</td>
<td>7.5 (6.5)</td>
</tr>
<tr>
<td>Minority girls</td>
<td>51</td>
<td>10:09 (0.81)</td>
<td>7:59 (0.93)</td>
<td>9.83 (0.76)</td>
<td>8.9 (5.6)</td>
<td>9.71 (1.03)</td>
<td>10.2 (11.4)</td>
</tr>
<tr>
<td>Minority boys</td>
<td>53</td>
<td>10:20 (0.97)</td>
<td>7:46 (0.98)</td>
<td>9.44 (0.86)</td>
<td>9.6 (6.7)</td>
<td>9.59 (1.26)</td>
<td>7.8 (8.2)</td>
</tr>
<tr>
<td><strong>10- to 11-Year-olds</strong></td>
<td>310</td>
<td>10:01 (0.76)</td>
<td>7:40 (0.86)</td>
<td>9.65 (0.68)</td>
<td>8.3 (5.3)</td>
<td>9.60 (1.09)</td>
<td>8.4 (8.6)</td>
</tr>
<tr>
<td>Nonminority girls</td>
<td>57</td>
<td>10:06 (0.81)</td>
<td>7:35 (0.77)</td>
<td>9.48 (0.67)</td>
<td>8.9 (6.0)</td>
<td>9.61 (0.81)</td>
<td>7.1 (7.9)</td>
</tr>
<tr>
<td>Nonminority boys</td>
<td>53</td>
<td>10:06 (0.53)</td>
<td>7:39 (0.78)</td>
<td>9.55 (0.78)</td>
<td>8.1 (4.7)</td>
<td>9.66 (1.12)</td>
<td>7.4 (8.5)</td>
</tr>
<tr>
<td>Minority girls</td>
<td>36</td>
<td>10:37 (1.10)</td>
<td>8:09 (0.91)</td>
<td>9.53 (0.10)</td>
<td>10.8 (7.3)</td>
<td>9.72 (0.87)</td>
<td>9.8 (7.6)</td>
</tr>
<tr>
<td>Minority boys</td>
<td>37</td>
<td>10:33 (0.93)</td>
<td>7:40 (0.96)</td>
<td>9.12 (0.78)</td>
<td>11.3 (5.5)</td>
<td>9.25 (1.32)</td>
<td>10.7 (9.9)</td>
</tr>
<tr>
<td><strong>All 10- to 11-Year-Old Children</strong></td>
<td>183</td>
<td>10:18 (0.86)</td>
<td>7:44 (0.86)</td>
<td>9.44 (0.81)</td>
<td>9.5 (5.9)</td>
<td>9.57 (1.04)</td>
<td>8.5 (8.5)</td>
</tr>
<tr>
<td>All Children</td>
<td>755</td>
<td>10:05 (0.81)</td>
<td>7:42 (0.87)</td>
<td>9.63 (0.72)</td>
<td>8.6 (5.3)</td>
<td>9.65 (1.03)</td>
<td>8.3 (8.7)</td>
</tr>
</tbody>
</table>

Abbreviation: CV, coefficient of variation.

*Data are given as the mean (SD).
†Values are expressed as percentages.

### Table 3. Adjusted Mean Sleep Duration Over All Recorded Days for 755 Participants

<table>
<thead>
<tr>
<th>Ethnicity and Sex</th>
<th>8.5 Years Old</th>
<th>9.5 Years Old</th>
<th>10.5 Years Old</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nonminority girls</td>
<td>9.85 (0.06)</td>
<td>9.69 (0.04)</td>
<td>9.55 (0.06)</td>
</tr>
<tr>
<td>Nonminority boys</td>
<td>9.82 (0.06)</td>
<td>9.67 (0.05)</td>
<td>9.52 (0.06)</td>
</tr>
<tr>
<td>Minority girls</td>
<td>9.83 (0.07)</td>
<td>9.68 (0.06)</td>
<td>9.53 (0.07)</td>
</tr>
<tr>
<td>Minority boys</td>
<td>9.85 (0.07)</td>
<td>9.43 (0.08)</td>
<td>9.28 (0.07)</td>
</tr>
</tbody>
</table>

*Values are given as the mean (SE) [95% confidence interval]. Predictors included the following: square root of age, sex, ethnicity, preterm status, chronic health problems, vacation status, caregiver’s educational level, the interaction of the square root of age and preterm status, and the interaction of ethnicity and sex.
“NIGHT OWLS” (BEDTIME ≥11 PM) AND “SHORT” SLEEPERS (<9 HOURS OF SLEEP)

Table 4 further addresses the variation in sleep patterns among the age-sex-ethnicity subgroups by categorizing bedtime, sleep duration, and night-to-night CV of sleep duration for each age, sex, and ethnicity subgroup. Increasingly later bedtimes with older ages were more evident for minority than nonminority children, with no consistent sex differences across age and ethnicity subgroups. Overall, 16% of the sample reported sleeping an average of less than 9 hours per night. However, 43% of 10- to 11-year-old minority boys reported less than 9 hours of sleep on average (the lower limit of the recommended amount of nightly sleep for this age group25) vs 5% to 26% of the other age-sex-ethnicity subgroups. Almost 11% of older minority boys reported fewer than 8 hours of sleep, compared with approximately 0% to 2% of nonminority children. Nearly 10% of the analytic sample had a CV greater than 15%, and 3% had a CV greater than 20%. The highest proportions of children with CVs greater than 15% were found among 9-year-old minority boys and 10- to 11-year-old minority boys (19% and 22%, respectively).

A logistic regression model was used to estimate the odds of going to bed at 11 PM or later, controlling for potential confounders (eg, preterm status, caregiver’s educational level, and vacation status). The final model included age, sex, ethnicity, and vacation. Results showed that minority children had 4.8 times the odds (95% CI, 2.9-8.0) of going to bed at 11 PM or later compared with nonminority children. There was a significant interaction between age and sex such that at age 8.5 years, boys had significantly higher odds of going to bed at 11 PM or later compared with girls (OR, 2.6; 95% CI, 1.1-6.1). The odds of going to bed at 11 PM or later were similar for boys and girls at age 9.5 years (OR, 1.3; 95% CI, 0.8-2.1) and age 10.5 years (OR, 0.6; 95% CI, 0.3-1.4).

This urban US pediatric population reported sleeping, on average, 9 to 10 hours per night. This finding, using 3- to 7-day child-completed sleep journal information, confirmed results of previous investigations of the sleep behavior of school-aged children in the United States and Western Europe that have been based on parental reporting. Our findings also extend previous research, identifying significant ethnic differences in sleep behavior: ethnic minority children were more likely to go to bed after 11 PM, and approximately 43% of 10- to 11-year-old minority boys reported less than 9 hours of sleep. One study has previously reported decreased sleep duration in 5- to 12-year-old minority vs majority US children. However, to the best of our knowledge, our study is the first to report ethnic/cultural differences of sleep patterns in US elementary schoolchildren after controlling for potential confounders. Furthermore, differences between minority boys and girls have not been described previously. Our findings are consistent with those of a national survey of the sleep habits of nearly 10000 British children 5 to 11 years of age, which found that Afro-Caribbean and Asian minority children had shorter adjusted sleep durations over a 7-day week than did white children. To our knowledge, our findings are also the first to include a measure of average nightly variation in sleep duration based on children’s reports. Night-to-night variability (coefficient of variation) for all days ranged from 7% to 11%. However, variability was higher among minority and older children, and more than 20% of the 10- to 11-year-old minority boys had a CV greater than 15%.

There is growing recognition of the need to understand sleep behaviors in children and their influence on sleepiness and daytime functioning. Daytime sleepiness, often a consequence of restricted sleep, has been
associated with poorer academic achievement and pediatric behavioral problems. The most marked reductions in sleep duration and the highest prevalence of sleepiness are thought to occur in adolescents, a group in whom effective behavioral interventions are often challenging to implement. Identifying the antecedent factors that influence adolescent sleep behaviors may help develop early intervention strategies for improving the sleep habits of this group. Even in the narrow age range of this study (i.e., preadolescents), we identified a significant decrease in sleep duration as age increased from 8 to 11 years. Our studies of preadolescent children identified that a shift toward later bedtime and shorter sleep duration also are most evident in minority children, with minority boys showing the shortest sleep durations and greatest night-to-night variation in sleep compared with other sex-ethnicity subgroups.

The mean sleep duration estimates for minority and nonminority children, as well as for a subsample of the entire sample without children with underlying chronic health conditions, behavioral problems, or symptoms of excessive sleepiness or sleep disorders, are consistent with the current national recommendations for sleep duration for school-aged children established by the US National Center on Sleep Disorders Research Plan and promulgated by the public health message in the National Institutes of Health's Garfield Star Sleeper Campaign. Although our data provide information on the range of sleep behavior needed to establish normative sleep standards and an evidence base for current recommendations, they do not, however, address the amount of sleep actually needed to maximize functioning and minimize sleep-related problems. Longitudinal or intervention studies are required to address this issue.

The observed differences in sleep duration among study subgroups, while relatively small (the largest adjusted difference in sleep duration was 30 minutes), may be physiologically significant: they are similar in magnitude to the modest (≥30-minute) changes in sleep duration recently shown to improve (in the case of extension) or worsen (in the case of restriction) schoolchildren's neurobehavioral functioning. Because there is no plausible reason to think that some sex-ethnicity subgroups require less sleep than others, efforts to increase the amount of nightly sleep of lesser-sleeping groups just to the level of their longer-sleeping peers could potentially improve their neurobehavioral functioning. Similarly, children with increased variation in sleep duration over the course of a week may be particularly important individuals to target for interventions geared to maximize regular sleep routines and thereby improve sleep hygiene.

This study was not designed to identify the specific behavioral and environmental determinants of sleep behavior. However, our identification of differences in sleep behaviors in preadolescent minority boys, a vulnerable population subgroup often subjected to a number of adverse socioeconomic influences, suggests the potential importance of a variety of sociocultural and environmental factors that may influence bedtimes and sleep duration. Further research is needed to understand the roles of the home environment (e.g., family functioning, routines, physical characteristics), neighborhood environment (e.g., noise from commercial/industrial activity, predominant housing type), and peer-related factors that may contribute to the shorter and more variable sleep times of this group.

In considering the generalizability of the findings, it is important to recognize that the cohort was initially constructed to overrepresent preterm children. However, preliminary analyses suggested comparable sleep behaviors in term and preterm children, and therefore the appropriateness of combining those groups. Analyses also controlled for term status when estimating adjusted sleep time.

Limitations of the analysis should also be noted. First, a significantly greater proportion of minority than nonminority children were excluded from analyses because of incomplete sleep journal data. If children with incomplete journal data were more likely to have variable sleep patterns than children with complete data, our reported ethnic differences in sleep habits may be underestimated. Second, only a limited number (n=31) of minority subgroups other than African Americans (e.g., Asian, Native American, Hispanic) were represented in this cohort, precluding analyses by specific ethnic minority subgroups. Third, because a large proportion of children were recruited from an earlier cohort study, selection biases might have affected participation. However, the overall participation rate for subjects recruited from the original cohort was moderately high (71%). Moreover, subsequent comparisons of participants vs nonparticipants from the original cohort have revealed no statistically significant differences by sex, ethnicity, or preterm status. A fourth study limitation involved the dependence of self-reported data on sleep patterns without objective confirmation of sleep. However, other research has demonstrated agreement between self-report measures and an objective measure (actigraphy), at least among adolescents. Although self-reported sleep times may not provide completely accurate information compared with objective measurements of sleep, information collected over several days is likely to be more accurate than a single reported measure, as has been used in many studies, and the trends across groups should be informative. The study was also limited by the presence of only 1 indicator of socioeconomic status (maternal education), defined as a dichotomous variable, which did not fully describe the variation of socioeconomic status present in the sample. Inclusion of additional measures of socioeconomic status (e.g., occupation, family income) would improve assessment of the relationships between sleep patterns and correlates of ethnic minority status.

Use of self-completed pediatric 7-day sleep journals provided average estimates for sleep duration consistent with current national recommendations for school-aged children. However, overall, 16% of children reported sleeping less than the recommended 9 hours, including 43% of older minority boys. Across the age range of 8 to 11 years, significant decreases in sleep time, and, in ethnic minorities, increasingly delayed bedtimes, were ob-

CONCLUSIONS

Use of self-completed pediatric 7-day sleep journals provided average estimates for sleep duration consistent with current national recommendations for school-aged children. However, overall, 16% of children reported sleeping less than the recommended 9 hours, including 43% of older minority boys. Across the age range of 8 to 11 years, significant decreases in sleep time, and, in ethnic minorities, increasingly delayed bedtimes, were ob-
Sleep behavior of US elementary schoolchildren, particularly among ethnic minorities, is not well documented. Our study provides normative sleep data for this age group in 1 urban community and, to our knowledge, is the first to report ethnic differences in bedtime and sleep duration among school-aged children after controlling for potential confounding.

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