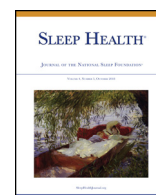




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Sleepiness as a pathway linking race and socioeconomic status with academic and cognitive outcomes in middle childhood



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ABSTRACT

Objectives: This study examined self-reported sleepiness as a pathway of effects underlying racial and socioeconomic disparities in children's academic and cognitive performance.

Design: The study design was longitudinal, and path modeling was used to test study hypotheses.

Setting: Data were collected from participants residing in semirural communities and small towns surrounding Auburn, AL.

Participants: Children (N = 282; 52% boys) participated in the study when they were 9 (M = 9.44, SD = .71) and 11 (M = 11.33, SD = .69) years old. The sample was 65% White/European American and 35% Black/African American. The majority of the children (63%) were living at or below the poverty line.

Measurements: At age 9, children reported on their daytime sleepiness over the prior 2 weeks. At age 9 and 11, children completed cognitive assessments in the laboratory, teachers reported on children's academic functioning, and schools provided state (Alabama) standardized test scores.

Results: African American children and children from lower socioeconomic status homes reported greater sleepiness. Greater sleepiness, in turn, predicted lower academic functioning, cognitive performance, and Alabama standardized test scores. Sleepiness was a significant intervening variable, but not a mediator, in these pathways. Race was a stronger predictor of sleepiness than socioeconomic status when both were entered in the same model.

Conclusions: Results highlight sleepiness as a pathway of effects linking race and socioeconomic status to academic and cognitive outcomes. Psychoeducation targeting sleepiness for African American and lower-socioeconomic status children may be beneficial for boosting achievement.

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Black/African American (AA) children and children from lower socioeconomic status (SES) families are at risk for insufficient and poor quality sleep, and elevated daytime sleepiness,^{1–3} which in turn are predictive of lower academic and cognitive performance.^{4–6} AA and lower-SES children are also at greater risk for lower academic and cognitive performance compared to white/European American (EA) and higher-SES children.^{7,8} It is plausible that sleep-wake behaviors contribute to these racial and socioeconomic disparities in children's development. Recent work with adults has demonstrated that sleep duration and quality serve as intervening or mediating variables linking race/ethnicity and SES with poor physical and mental health.^{9,10} However, prior work has not examined

sleepiness as a mediator or an intervening variable in associations between either race or SES and children's adaptation. The present study assessed the role of self-reported sleepiness as a pathway of effects underlying racial and socioeconomic disparities in children's academic and cognitive performance.

Children's experience of daytime sleepiness, which results frequently from insufficient and poor sleep quality,¹¹ has been linked with lower academic achievement and intellectual ability.⁵ Increases in daytime sleepiness have also been associated with slower trajectories of growth in cognitive performance across ages 8–10 years old.⁴ Following a 7-day protocol in which sleep was restricted to 5 hours per night, adolescents showed an increase in sleepiness that paralleled a decrease in attention, working memory, and executive functioning.¹² A meta-analysis found that measures of sleepiness had stronger negative effects on children's school performance, including grades and standardized test scores, than assessments of

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sleep quality or duration.⁶ This may be because individuals' subjective experiences of alertness differ at equivalent levels of sleep quality or duration⁶ or that sleepiness results from a combination of both insufficient and poor quality sleep for some children.¹³ Sleepiness may be of particular relevance to academic and cognitive functioning because of its effects on attention and concentration in the school setting,¹⁴ as daytime fatigue may compromise children's ability to engage with their environment.¹⁵

There are documented disparities in the duration and quality of sleep as well as daytime sleepiness between EA and AA individuals and between those living in higher- compared to lower-SES homes. Much of the literature pertains to adults,^{16–18} but there is emerging evidence that these differences in sleep begin in childhood.^{1–3} For example, in comparison to children from higher-SES backgrounds, those from lower-SES families report more sleep/wake problems² and greater daytime sleepiness.¹ Furthermore, children who felt their family's socioeconomic position was lower relative to their school and society reported greater daytime sleepiness.³

In addition to racial and socioeconomic disparities in children's sleep-wake behaviors, disparities have also been documented for academic and cognitive performance.^{7,8} Thus, it is possible that sleepiness acts as a mediating or intervening variable that underlies disparities detected in achievement outcomes. This idea is consistent with work with adults demonstrating the mediating role of poorer sleep quality in relations between SES, race, and physical and mental health outcomes.^{9,10} Among children, parent report of children's greater difficulty initiating or maintaining sleep partially mediated the relation between parents' perceptions of their family's economic situation and children's mental health, including greater symptoms of emotional and conduct problems.¹⁹

Current study

The current study examined sleepiness as a potential mechanism (mediator or intervening variable) in the associations among both race (EA and AA children) and SES and children's academic and cognitive outcomes. To our knowledge, no published study has examined sleepiness in this context. We hypothesized that AA and lower-SES children would report greater daytime sleepiness, which in turn would predict lower academic and cognitive performance. We assessed these associations longitudinally through examination of sleepiness at age 9 and the outcome variables 2 years later at age 11. We controlled for autoregressive effects (ie, academic and cognitive performance at age 9), which allowed us to examine *change* in academic and cognitive performance over 2 years. Additionally, because there may be unique mechanisms of effects for race and SES, we examined models for each predictor separately as well as simultaneously.

Methods

Participants

Children were part of a longitudinal study of sleep, health, and adjustment across middle to late childhood (Auburn University Sleep Study). Data for the present investigation were drawn from 2 study waves 2 years apart. At the first wave, 282 children (52% boys) and their families were recruited from local elementary schools. Based on mothers' report, children did not have a diagnosis of a clinical sleep disorder. Children's mean age was 9.44 years ($SD = .71$) at the first assessment and 11.33 years ($SD = .69$) at the subsequent assessment. The sample was 65% EA and 35% AA, which reflect the racial/ethnic representation of the community. Family income-to-needs ratio (annual family income divided by the poverty threshold with respect to family size²⁰) indicated that the majority of

participants (63%) were living at or below the poverty line (ratio ≤ 2), 28% were lower middle class (ratio between 2 and 3), and 9% were middle class (ratio ≥ 3). Two years later, families partook in another study wave; 80% of the original sample was retained. There were no differences between those who remained vs dropped from the study with regard to family demographics or study variables.

Procedure

The study was approved by the institution's review board. Parents provided consent to participate, and children provided assent. At age 9, children participated in a laboratory visit during which they reported on their sleepiness and completed cognitive assessments. The same cognitive assessments were repeated at age 11. Teachers reported on children's classroom performance, and schools provided scores on standardized tests at both study waves.

Measures

Sleep parameters

The main sleep variable of interest in the present study was children's sleepiness. Although not the focus of the study, sleep duration and quality at age 9 were also assessed and statistically controlled in all analyses to examine the unique effects of sleepiness separate from these sleep parameters.

Sleepiness. Children completed the Sleep Habits Survey²¹ via interview. This questionnaire is well established in samples of school-age children.⁵ The Sleepiness scale (9 items; 1 item regarding driving was deleted) assesses whether the child has fallen asleep, struggled to stay awake, or both during a variety of daily life situations in the past 2 weeks, such as traveling or attending a class at school ($\alpha = .70$).

Sleep quality. The sleep/wake problems scale (10 items) of the Sleep Habits Survey was used to measure sleep quality, which was entered as a covariate in all analyses. Example items include whether the child has slept in past noon or had an extremely hard time falling asleep. Children answer on a 5-point scale ranging from "Everyday" to "Never" ($\alpha = .63$).

Sleep duration. Children's nighttime sleep duration was measured using Motionlogger Octagonal Basic actigraphs (Ambulatory Monitoring, Inc, Ardsley, NY). An actigraph assesses sleep via an accelerometer that indicates when there is movement. Intervals when the child was awake or sleeping were then calculated in 1-minute epochs. *Sleep duration* was defined as the number of epochs scored as sleep between sleep onset and final morning awakening. Children were instructed to wear the actigraph on their nondominant wrist for 7 nights. Actigraphy data were only analyzed for participants with 5 or more nights of actigraphy information (87% of the sample). If the child took medicine for an acute illness on a particular night (eg, cough syrup), the data for that night were not included in analyses. There was good night-to-night stability in sleep duration ($\alpha = .85$).

Academic and cognitive performance

Towards a more comprehensive examination of these constructs, we used 3 different assessments including teacher reports, individually-administered cognitive measures, and school records of performance on standardized tests.

Academic functioning. Teachers' report of children's academic functioning was obtained from the Student Behavior Survey.²² This questionnaire has established reliability and validity²² and includes questions regarding children's academic performance (8 items) and habits (13 items). Academic performance items concern children's

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