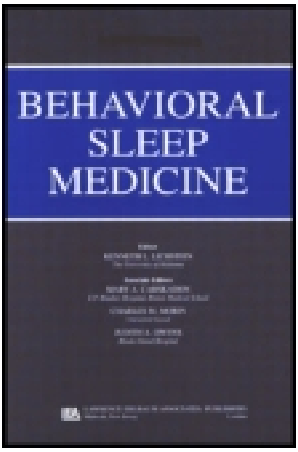

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Family Socioeconomic Status and Sleep Patterns of Young Adolescents

Christine A. Marco [a], Amy R. Wolfson [a], Michaela Sparling [b] & Andrea Azuaje [b]

[a] Department of Psychology, Rhode Island College, Providence, Rhode Island

[b] Department of Psychology, College of the Holy Cross, Worcester, Massachusetts

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Family Socioeconomic Status and Sleep Patterns of Young Adolescents

Christine A. Marco
Department of Psychology
Rhode Island College, Providence, Rhode Island

Amy R. Wolfson, Michaela Sparling, and Andrea Azuaje
Department of Psychology
College of the Holy Cross, Worcester, Massachusetts

This study examined associations among socioeconomic status (SES), SES-related variables, and sleep in young middle school adolescents. Participants included 155 seventh-graders attending two urban New England middle schools. Aspects of the SES environment included parent demographic variables (e.g., income and education), neighborhood environment, and family home environment. Students completed 1 week of actigraphy to estimate sleep patterns. Results demonstrated that the timing and consistency of school-night sleep were associated with demographic and behavioral aspects of SES, whereas weekend sleep schedules were associated with demographic, behavioral, and neighborhood aspects of SES. Finally, regularity in school-night and weekend sleep schedules were associated with demographic and neighborhood aspects of SES.

Laboratory studies on sleep in healthy adolescents have shown that, when allowed 10 hr of nighttime sleep, total sleep time averages 9.2 hr (Carskadon & Acebo, 2002; Carskadon et al., 1980). Field and survey studies indicate, however, that from as early as 11 to 14 years of age, adolescents get less sleep, report inconsistent and delayed sleep patterns, and experience significant daytime sleepiness (Drake et al., 2003; Fredricksen, Rhodes, Reddy, & Way, 2004). Environmental factors such as early school start times, after-school sports, and screen/cell phone use further interfere with adolescents' sleep schedules (Van den Bulck, 2004; Wolfson, Spaulding, Dandrow, & Baroni, 2007). The consequences of insufficient and irregular sleep include poor academic performance, depressed mood, conduct difficulties, early substance use, and other health problems to which 12- to 14-year-olds may be particularly vulnerable as they

Correspondence should be addressed to Christine A. Marco, Department of Psychology, Rhode Island College, Horace Mann Hall 311, 600 Mount Pleasant Ave., Providence, RI 02908. E-mail: cmarco@ric.edu

negotiate the early years of adolescence (Wolfson & Carskadon, 2003; Wolfson & Richards, 2011).

A limitation of past studies is their focus on adolescents from middle- to upper-middle-class family backgrounds or their failure to address socioeconomic status (SES), despite evidence of its association with sleep and with physical and mental health throughout the lifespan (Berkman & Epstein, 2008). For example, SES is associated with decreased sleep, poorer self-reported sleep quality, and more sleep complaints in adults (Grandner et al., 2010). Insomnia complaints are reported more in adults with lower levels of education, unemployment, or those living in poverty (Gellis et al., 2005). In a special issue of *Behavioral Sleep Medicine* on "Sleep and Ethnicity," one study reported that adults with lower childhood SES (measured by parental education) spend more time in Stage 2 sleep and less time in short-wave sleep (SWS), and females from lower SES families have longer sleep latencies (Tomfohr, Ancoli-Israel, & Dimsdale, 2010).

In addition, research has established an association between children's SES and sleep. After controlling for race, children from lower SES backgrounds have shorter sleep durations and more sleep difficulties than those living in higher SES families, and SES moderates the association between children's sleep and adjustment (Buckhalt, El-Sheikh, Keller, & Kelly, 2009; El-Sheikh, Kelly, Buckhalt, & Hinnant, 2010; Knutson & Lauderdale, 2009). Preschoolers from disadvantaged households are less likely to have consistent bedtime routines, possibly leading to future sleep and behavioral disparities in adolescence (Hale, Berger, LeBourgeois, & Brooks-Gunn, 2009). A study of 64 inner-city early adolescents suggested that SES-related issues—such as parents working evening and night shifts, shared sleeping spaces, and perceived threats to personal safety in the surrounding environment—potentially interfere with sleep habits (Owens, Stahl, Patton, Reddy, & Crouch, 2006). Much research to date, however, used self-report measures for estimating sleep, and did not include more objective measures to estimate sleep–wake patterns, such as actigraphy.

Although SES is traditionally defined as a combination of income, education, and occupational demographics, it is a complex construct having economic, social, environmental, and behavioral components, several of which have been associated with sleep outcomes. Research shows that sleep is associated with various aspects of SES such as income, education, and occupational demographics (Hale, 2005); neighborhood noise and lighting (Hill, Burdette, & Hale, 2009); and a lack of routine and structure in daily life (Evans, Gonnella, Marcynyszyn, Gentile, & Salpekar, 2005). Furthermore, studies suggest that children from lower SES households watch more television (Stamatakis, Hillsdon, Mishra, Hamer, & Marmot, 2009), which is known to contribute to poorer sleep behaviors (Van den Bulck, 2004).

Despite accumulating evidence relating sleep with SES and its various components, little is known about their relative contributions to sleep outcomes. This study utilized existing data to examine associations among aspects of SES and young adolescents' sleep outcomes. The specific aspects of SES included demographic characteristics, measures of the neighborhood environment in which the young adolescents lived, and measures of the household environment that were collected as part of a baseline assessment of young adolescents participating in a sleep intervention study. The sleep outcomes of interest were the timing, duration, and consistency of sleep as measured by actigraphy. It was predicted that lower SES would be associated with more delayed, shorter, and less consistent sleep patterns, although their relative contributions were not specified *a priori*.

METHOD

Participants

Participants included 62 male and 93 female seventh-grade students ($M = 12.6 \pm 0.6$ years of age) from two urban, New England middle schools with start times of 8:37 a.m. The students had a generally healthy height-to-weight ratio (mean BMI $= 21.5 \pm 5.2$), and most were in the middle (38.7%) or late/post (39.3%) stage of pubertal development. Although the majority (70.3%) of students had no chronic medical conditions, some had asthma ($n = 25$), cardiovascular-related conditions ($n = 4$), a history of head trauma ($n = 2$), or diabetes ($n = 1$). Likewise, the majority (86.5%) had no psychiatric/psychological conditions, but some had learning-related problems ($n = 11$), ADHD ($n = 7$), depression ($n = 4$), or substance abuse ($n = 1$), as reported by the parents. On average, 3.8 ± 1.5 children resided in the households, and 41.1% of participants reported that they shared a bedroom, although 92.3% reported sleeping in their own bed. Some participants reported having a television in the bedroom ($n = 49$), a computer ($n = 2$), or both ($n = 15$).

Thirty-three percent of the young adolescents were from families with incomes below $30,000, which is representative of the city where the data were collected (Chau, Thampi, & Wight, 2010). The young adolescents' ethnicities were reported as primarily Caucasian (47.1%), Hispanic (24.5%), African American (9.0%), Asian, (7.1%). Native American (2.6%), and "other" (3.9%; with 5.8% being missing data). The distribution of ethnicities was representative of the Worcester City School system (Massachusetts Department, 2009). Demographic characteristics of the households are presented in Table 1.

Study Design

The Young Adolescent Sleep-Smart study is a longitudinal, preventive-intervention study designed to understand and improve the sleep patterns and daytime functioning of students from two urban middle schools. The study consisted of baseline and post-intervention actigraphy assessments in seventh grade plus two follow-up assessments in eight grade of a preventive-intervention and a comparison group of students. This article analyzes baseline data only.

Measures

Demographic indicators of SES. These variables were obtained from a background information questionnaire completed by the parents. First, *income* was measured with a checklist of dollar ranges reflecting $10,000 increments, and parents marked the option that included their total household income. Due to low frequency of responses in some options, responses were coded into three ordinal levels: lower income (< $30,000), middle income ($30,000–$60,000), and higher income (> $60,000). Second, *education level* of the heads of the household was measured with a checklist of options, which, due to low frequencies for some responses, was classified as follows: no (male/female) head of household, high school diploma or less, some college or trade school, college graduate, or attended or completed graduate school. Third, *employment status* of the adult heads of the household was classified as follows: none, part-time only, or at least one adult working full time. The distinction between part-time only and

TABLE 1
Characteristics of Households in the Sample

Variable	*n*	%
Income		
< $30,000	52	33.5
$30,000–60,000	41	26.5
$60,000+	48	31.0
Missing	14	9.0
Education: Male head of household		
No male head of household	15	9.7
High school or less	60	38.7
Trade/some college	25	16.1
College graduate	17	11.0
Grad school/degree	17	11.0
Missing	21	13.5
Education: Female head of household		
No female head of household	2	1.3
High school or less	61	39.4
Trade/some college	27	17.4
College graduate	27	17.4
Grad school/degree	20	12.9
Missing	18	11.6
Parenting status		
Single parent	42	27.1
Dual parent	102	65.8
Missing	11	7.1
Employment status		
No employed adults	18	11.6
Part time only	6	3.9
One or more full time	124	80.0
Missing	7	4.5

full-time employment was made because it was likely that participants having only part-time employment would not have health insurance and other such benefits as afforded those in higher SES strata.

Neighborhood environment. The Mendes de Leon Systematic Neighborhood Survey (Cagney et al., 2009) rates the neighborhoods in which the participants live via observer ratings of such characteristics as the type of housing, quality of public space, street type, and other similar neighborhood characteristics. Interrater coding reliabilities were established using 20% of all participant addresses, and ranged from .70 to .97. The remaining addresses were then evaluated using research assistant pairs, who were blind to the children's sleep measures. The items used to represent the neighborhood included the proportion of single family homes, condition of the block, condition of public spaces, type of street, and amount of traffic.

Household environment. Assessment of the household environment included items from the parents' questionnaires (total number of people living in the household and presence of a television or computer in the bedroom) and sleep hygiene behaviors as assessed with the Adolescent Sleep Hygiene Scale (ASHS; LeBourgeois, Giannotti, Cortesi, Wolfson, & Harsh, 2005). The ASHS, a 33-item self-report research instrument, assesses sleep hygiene practices in 12- to 18-year-olds along the following dimensions: physiological (e.g., physical discomfort), cognitive/emotional (e.g., thoughts and emotions before sleep), sleep environment (e.g., lighting and television), bedtime routine, daytime sleep, and sleep stability (e.g., schedule regularity). Coefficient alphas for the nine scales ranged from .58 to .77, similar to those established by LeBourgeois et al.

Sleep. Sleep patterns were estimated with actigraphs and a sleep-wake diary for 1 week. The actigraph is a device the size of a digital wrist watch (1.75″ × 1.3″ × 38″ and weighing 2 oz.) worn on the non-dominant wrist (Mini-motionlogger, AMI, Ardsley, NY). The accelerometer sensor interfaces with solid-state memory, initialized by a software program and requiring no further manipulation. It is initialized for 1-min epochs, zero-crossing mode. Actigraph data were scored using the validated algorithm of the Action-W2 software (AMI, Ardsley, NY) and the scoring criteria established by Acebo, Sadeh, and colleagues (Acebo et al., 1999; Sadeh, Sharkey, & Carskadon, 1994). The algorithm produces the time of sleep onset (time of first 3 consecutive minutes of sleep), sleep offset (time of last 5 consecutive minutes of sleep), total sleep period (time from onset to offset), and minutes asleep (total sleep period minus the number of minutes that movement was detected and estimated by the actigraph to be indicative of arousal from sleep). Four scorable school nights and two scorable weekend nights were required for the data to be included in the analyses. The daily sleep records were aggregated to summarize the pattern and consistency of adolescents' sleep on school nights and weekend nights. First, the estimated mean *patterns* of sleep on school nights and on weekend nights included the mean sleep onset, sleep offset, sleep period, and minutes asleep. Second, to examine the *consistency* of sleep, the standard deviation for each sleep outcome was calculated across all school nights, and then separately across all weekend nights. Lower standard deviations indicate more consistent sleep patterns. Finally, to understand the *regularity* of sleep across school nights and weekends, two variables were calculated from the actigraphy data (Wolfson et al., 2003): *Sleep onset delay* reflected discrepancies in school-night versus weekend-night sleep onset times (i.e., the absolute value of the difference between weekend-night and school-night sleep onset), and the *oversleep* estimate reflected discrepancies in school-night versus weekend-night sleep period (i.e., the absolute value of the difference between weekend-night and school-night sleep period). For both variables, higher scores indicated greater discrepancies between school-night and weekend-night sleep patterns.

Covariates for sleep variables. Factors that may influence young adolescent sleep include gender, pubertal status, race, and the presence of psychological or physical illness, each of which was measured by either the child's or parent's baseline background information questionnaire. Pubertal status was measured with the child's self-ratings on the Pubertal Development Scale (Carskadon & Acebo, 1993; Peterson, Crockett, Richards, & Boxer, 1988), which yields both a categorical classification of pubertal status (e.g., prepubertal, early pubertal, etc.) and an interval score representing pubertal development. Higher scores indicate more complete pubertal development. The child also provided information regarding his or her race/ethnicity. On the background information questionnaire, the parent noted the presence of physical conditions with a checklist that included diabetes, blood pressure, heart, kidney, asthma, epilepsy, immune disorders, or a history of head trauma. The existence of psychological conditions was assessed with a checklist that included anorexia, bulimia, depression, ADHD, substance abuse, and learning difficulties. From these checklists, two covariates were calculated to indicate (a) the number of medical conditions and (b) the number of psychological conditions.

Procedures

Prior to commencing data collection, permission to conduct the study was obtained from the school superintendent and both school principals, and the study was approved by the institution's Human Participants Committee. A letter and a permission form were sent to parents/guardians, and only students whose parents gave written permission participated. The young adolescents also provided written assent.

Research assistants administered the questionnaires at the schools, and gave each participant an actigraph to wear and a diary to complete for 1 week. The diary was a record of the student's bed and wake times each day, and was used to help score the actigraph-estimated sleep; it is not otherwise used in these data analyses. Research assistants conducted midweek calls to the participant's home to confirm that the diary was being filled out correctly and that the actigraphs were functioning properly. At the end of the week, research assistants returned to the schools to collect and download the actigraphs. Discrepancies between diary and actigraph were resolved using standard procedures (Acebo et al., 1999; Wolfson et al., 2003). Some participants ($n = 34$) were run for 1 to 7 additional days to make up missing data due to actigraph failure, incomplete diary data, unreliable data, or school absence. Both the adolescents and their parents/guardians received monetary compensation in the form of gift certificates for their participation in this study.

Analyses

First, to reduce the SES indicators to meaningful dimensions, these indicators were subjected to a principal components analysis with varimax rotation. Seven underlying factors emerged having factor loadings $>$ .50: (a) *SES demographics* (income, education level, number of adults working in the home, and proportion of single family homes in the neighborhood), (b) *sleep hygiene* dimensions (ASHS physiological, cognitive/emotional, sleep environment, daytime sleep, and sleep stability subscales), (c) *neighborhood condition* (condition of the block and condition of public spaces), (d) *street environment* (type of street and amount of traffic), (e) *bedroom environment* (TV or computer in bedroom), (f) *number of people in the home* (single item), and (g) *bedtime routine* (the ASHS subscale). Scores for these factors were calculated using the weighted method and while imputing the mean for missing data. These factors were used in the analyses described in the next section, rather than the individual items.

Second, the Statistical Package for the Social Sciences generalized linear model (SPSS, Inc., Chicago, IL) multivariate procedure was used, with *sleep onset time, sleep offset time, sleep period,* and *minutes asleep* as the dependent variables. Separate analyses were conducted for sleep patterns, sleep consistency, and school-night/weekend-night sleep regularity. The seven factor scores described earlier were simultaneously entered as predictors, and their unique contributions to sleep were examined. Results reported include the multivariate significance test and, when a significant factor emerged, the partial eta-squared as an estimate of effect size. Significant multivariate results were followed up with partial correlations of the SES factor with the sleep outcome while covarying gender, pubertal status, race, the presence of any chronic physical illnesses, and the presence of any psychological conditions. Participants missing data on the actigraphy variables were eliminated on a per-analysis basis; for example, participants missing weekend-night sleep data were excluded from these analyses but were included in the analyses for school-night sleep data.

RESULTS

Descriptive Statistics: Sleep Patterns

The mean school-night sleep onset time occurred at 22:42 ($SD = 54$ min), and sleep offset time occurred at 07:12 ($SD = 36$ min). The average weekend sleep schedule was approximately 1.5 hr later, with the mean sleep onset occurring at 24:01 ($SD = 91$ min) and sleep offset occurring at 08:48 ($SD = 78$ min). Participants had a mean total sleep period on school nights of 8 hr, 33 min ($SD = 43$ min), with an average 7 hr, 35 min estimated time asleep ($SD =$ 52 min). On weekends, participants had a mean total sleep period of 8 hr, 50 min ($SD = 71$ min), with an average 7 hr, 53 min estimated time asleep ($SD = 72$ min).

School-Night Sleep

The mean school-night sleep patterns were most strongly associated with sleep hygiene practices: multivariate $F(3, 108) = 5.92$, $p = .001$ (partial $\eta^2 = .140$); and by the SES demographic factor: multivariate $F(3, 108) = 3.24$, $p = .025$ (partial $\eta^2 = .083$). Specifically, poorer sleep hygiene practices within the home were associated with later school-night sleep onset (partial $r = -.24$), shorter sleep periods (partial $r = .22$), and fewer minutes asleep (partial $r = .30$). Lower SES, as reflected by the demographic factor, was associated with later school-night sleep onset (partial $r = -.12$) and fewer minutes asleep (partial $r = .17$).

School-night sleep consistency was significantly predicted by the SES demographic factor only: multivariate $F(4, 107) = 3.93$, $p = .005$ (partial $\eta^2 = .128$). Follow-up analyses indicated that lower SES, as reflected by this factor, was associated with more variability in sleep onset (partial $r = -.19$), total sleep period (partial $r = -.26$), and number of minutes asleep (partial $r = -.32$).

Weekend-Night Sleep

The mean weekend-night sleep patterns were most strongly predicted by the SES demographic factor: multivariate $F(3, 107) = 6.05$, $p = .001$ (partial $\eta^2 = .140$); followed by the sleep hygiene factor: multivariate $F(3, 107) = 5.46$, $p = .002$ (partial $\eta^2 = .13$); and the neighborhood condition: multivariate $F(3, 107) = 3.24$, $p = .025$ (partial $\eta^2 = .080$). Specifically, lower SES, as reflected by the demographic factor, was associated with later school-night sleep onset (partial $r = -.25$) and later sleep offset (partial $r = -.25$). Poorer sleep hygiene practices were associated with later school-night sleep onset (partial $r = -.11$) and later sleep offset (partial $r = -.12$). Poorer neighborhood conditions were associated with later sleep onset (partial $r = -.20$) and later sleep offset (partial $r = -.17$).

Weekend-night sleep consistency was associated with the street environment only: multivariate $F(4, 101) = 3.67$, $p = .008$ (partial $\eta^2 = .127$). Busier street environments were associated with more variability in weekend-night sleep offset (partial $r = -.24$).

School-Night and Weekend-Night Sleep Regularity

Discrepancies in school-night and weekend-night sleep patterns were most strongly associated with the SES demographic factor: multivariate $F(2, 108) = 8.46$, $p = .000$ (partial $\eta^2 = .14$); followed by the neighborhood condition: multivariate $F(2, 108) = 5.53$, $p = .025$ (partial $\eta^2 = .09$). Lower SES demographics were associated with greater discrepancy in sleep onset on the weekend (partial $r = -.17$) and less discrepancy in sleep period on the weekend (partial $r = -.30$). Poorer neighborhood conditions were associated with greater discrepancy in sleep onset on the weekend (partial $r = -.24$).

DISCUSSION

Young adolescents in this study obtained less sleep than the established need of 9.2 hr per night (Carskadon et al., 1980). The average school-night total sleep period was approximately 39 min less (minutes asleep = 1 hr, 37 min less), and the average weekend-night sleep period was 22 min less (minutes asleep = 1 hr, 19 min less), than the established need. Furthermore, the results indicated that adolescents living in lower socioeconomic conditions experienced significantly poorer sleep outcomes in terms of the timing, duration, and regularity across the week.

The results also indicated that SES influenced sleep patterns differently for school nights versus weekend nights. On school nights, SES demographics and sleep hygiene practices were associated with more delayed, shorter duration, and less consistent sleep patterns. On the weekend, SES demographics, sleep hygiene, and neighborhood conditions were associated with more delayed and less consistent sleep patterns. Neighborhood factors may have played less of a role in school-night sleep because school-night sleep schedules are probably closely tied to, and even somewhat regulated by, school start-time schedules (Wolfson et al., 2003). However, the results for sleep hygiene practices are consistent with other studies that find parenting practices, attitudes, and the home environment differentially influence children's and young adolescents' sleep and health in general (Owens et al., 2006; Spilsbury et al., 2005). Together, these findings add to the developing research on SES and sleep in showing that the context in which early adolescents are growing up contributes to their ability to obtain sufficient and consistent sleep throughout the week (El-Sheikh et al. 2010; Knutson & Lauderdale, 2009).

Although these results establish an association among SES and sleep, they do not explain the possible underlying mechanisms. For example, parents with less education may not be aware of sleep hygiene practices, and may not utilize them in their homes. Likewise, it is possible that young adolescents in these households may have had less supervision regarding their sleep habits, especially considering the fact that there was an average of 3.8 children in these households. Furthermore, although we controlled for the number of medical and psychiatric conditions, it is possible that living in lower SES conditions is associated with the development of medical conditions that affect sleep or sleep disorders that were not assessed in this study. For example, the chaos of poverty might lead to emotional and physical health problems that, in turn, negatively affect sleep (Evans et al., 2005). All of these potential mechanisms warrant further study.

These results need to be interpreted with some limitations and qualifications. First, although SES-related variables were collected at baseline, this was not a main focus when the study was designed, and the results indicate the need for research to specifically examine the influence of SES on early adolescents' sleep patterns. Second, the adolescents in this study attended schools with relatively late school start times (8:37 a.m.) in comparison to middle schools throughout the United States (Wolfson & Carskadon, 2005). If these young adolescents were enrolled in schools with typically earlier start times, it is likely that their sleep would be further disadvantaged, as suggested by a study by Wolfson et al. (2007) in the same school district. Adolescents at an earlier-starting middle school (7:15 a.m.) reported less school-night sleep, earlier rise times, and greater daytime sleepiness, along with poorer academic performance and more tardiness, in comparison to middle school students at the later-starting schools (8:37 a.m.). Similar results were found in a study of self-reported sleep in early adolescents (ages 10–12) from Israeli schools with starting times that ranged from 7:10 a.m. to 8:30 a.m. (Epstein, Chillag, & Lavie, 1998). The mean total sleep times (8.7 hr) of the young adolescents attending the early-starting schools were significantly shorter than those at the later-starting schools (9.1 hr). Students in the early-starting schools experienced more frequent daytime sleepiness, a greater tendency to doze off in class, and attention/concentration difficulties. Because greater sleep deprivation places early adolescents at greater risk for behavioral disorders, academic difficulties, and physical illness (Fredriksen et al., 2004; Wolfson & Richards, 2011), the findings of this study strengthen the concern regarding the negative ramifications of early-starting schools for early adolescents, especially those from lower SES households. Nonetheless, it would be beneficial to further examine SES and adolescents' sleep in more typical early-starting middle schools and high schools.

This study also had several strengths. The main strength is its use of actigraphy for estimating sleep, rather than adolescents' subjective, self-reports of sleep. Second, the analyses used a multivariate approach and only followed up those findings that had significant multivariate tests; consequently, it is less likely to capitalize on chance findings than when using a solely univariate approach. Third, in addition to the more traditional demographic aspects of SES (i.e., income, occupation, and education), this study examined how aspects of the neighborhood and home environment related to SES influenced young adolescent sleep.

Finally, future research should further explore the underlying mediating and moderating factors that explain the effects of poverty and low SES on adolescents' sleep. Undoubtedly, researchers and clinicians need to better understand social class and sleep in developing adolescents, its associated consequences, and the need for sleep education and preventive-interventions for parents, teachers, and adolescents. Hale and Hale (2010) recently argued that, to ameliorate sleep-health disparities, one needs to address the underlying sources of the problems, rather than assume that clinicians and educators can correct poor sleep and sleep hygiene practices in contexts in which individuals lack the underlying autonomy. This problem may be particularly pronounced for young adolescents who might be relying on others to improve the surroundings in which they live.

In conclusion, despite its limitations, this study provides additional evidence that young adolescents from lower SES backgrounds have poorer and less consistent actigraphically estimated sleep than those from higher SES families. Aspects of SES within the neighborhood and within the home itself were associated with delayed weekend-night sleep schedules, insufficient school-night sleep, more night-to-night variability, and greater discrepancies between school-night and weekend-night sleep. This raises concerns regarding a significant number of developing adolescents when it is estimated that 38% of 12- to 17-year-olds live in low-income families in the United States (National Center for Children in Poverty, 2010). Further investigation is clearly necessary to better understand how social class affects the sleep of young adolescents.

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