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Sleep and disparities in child and adolescent development

Mona El-Sheikh[1], **Brian T. Gillis**[1], **Ekjyot K. Saini**[2], **Stephen A. Erath**[1], **Joseph A. Buckhalt**[1]

[1]Auburn University, Auburn, AL, USA

[2]Pennsylvania State University, State College, PA, USA

Abstract

Sleep is a robust predictor of child and adolescent development. Race/ethnicity, socioeconomic status (SES), and related experiences (e.g., discrimination) are associated with sleep, but researchers have just begun to understand the role of sleep in the development of racial/ethnic and SES disparities in broader psychosocial adjustment and cognitive functioning during childhood and adolescence. In this article, we discuss poor sleep as a potential mechanism contributing to the development of such disparities, and better sleep as a potential protective factor that diminishes such disparities. We conclude by offering recommendations for research to advance understanding of sleep as a key bioregulatory system that may underlie or protect against detrimental developmental outcomes related to socioeconomic adversity and belonging to a historically minoritized group.

Keywords

adjustment; children; cognitive functioning; race/ethnicity; sleep disparities; socioeconomic status

Sleep predicts multiple domains of child and adolescent well-being (Shochat et al., 2014; Spruyt, 2019), including mental and physical health, cognitive functioning, and academic achievement (Shochat et al., 2014). However, scholars have only recently considered the role of sleep in the development of racial/ethnic and socioeconomic (SES) disparities during childhood and adolescence. In this article, we use a developmental ecological systems perspective (Bronfenbrenner, 1994) adapted to sleep (El-Sheikh & Sadeh, 2015), and review key studies to discuss less optimal sleep as a potential mechanism underlying differences in socioemotional adjustment and cognitive functioning (collectively referred to as psychosocial adjustment for brevity) associated with race/ethnicity and SES, and better sleep as a potential protective factor that reduces these disparities. We also highlight conceptual and methodological issues and research questions to advance the literature.

Correspondence Mona El-Sheikh, Department of Human Development and Family Science, Auburn University, 203 Spidle Hall, Auburn, AL 36849, USA. elshemm@auburn.edu.

MEASURES OF KEY CONSTRUCTS

Sleep–wake processes are multifaceted, including duration, quality, schedule, satisfaction, daytime sleepiness, and regularity in each parameter. Assessing multiple domains of sleep facilitates a fuller understanding of sleep and its predictors and outcomes (El-Sheikh & Sadeh, 2015). Sleep research is conducted with both subjective and objective measures. Subjective measures include self- and parent reports on surveys and sleep diaries. Objective measures include *actigraphy*, in which a device typically worn on the wrist uses an accelerometer to monitor activity and define periods of sleep or wakefulness, and *polysomnography*, a behavioral and physiological observation of overnight sleep. More optimal sleep is characterized by longer duration, better sleep quality (e.g., self-reported satisfaction with sleep, actigraphy-derived efficiency, and fewer awake episodes), and regular schedules (e.g., consistent bedtime and wake time, consistency over the week; Spruyt, 2019). All these sleep parameters are associated with health and well-being in youth (Shocat et al., 2014; Spruyt, 2019). Throughout this article, we indicate the method and sleep variable examined.

SES is also a multidimensional construct, composed of monetary resources, indices of social prestige, perceptions of financial stability, educational status, and broader community variables. Yet most of the relevant studies on children's sleep are based on family income (e.g., income-to-needs ratio, INR) or maternal educational attainment. In presenting these studies, we identify the relevant measure of SES. Furthermore, although a growing number of studies are of other racial and ethnic groups, most of the pertinent research has examined samples in the United States and is primarily of Black and White youth.

Most of the literature on children's sleep as related to racial/ethnic and SES disparities concerns cognitive functioning and socioemotional adjustment. Thus, we focus on these constructs (broadly construed as psychosocial adjustment) and calls for studies examining other aspects of youth's health and development. Throughout the article, we review some but not all studies that illustrate how sleep may contribute to or protect against disparities in psychosocial adjustment.

POORER SLEEP AS A MECHANISM CONTRIBUTING TO THE DEVELOPMENT OF DISPARITIES

Sleep may operate as a mechanism, or mediator, linking race/ethnicity or SES with psychosocial adjustment during childhood and adolescence. Studies consistent with this possibility have shown that race/ethnicity or SES are associated with sleep, or that sleep mediates associations between race/ethnicity or SES and psychosocial adjustment. These studies suggest that poor sleep stems in part from experiences related to race/ethnicity or SES (e.g., discrimination) and transmits the effect of these experiences on psychosocial maladjustment.

Numerous studies have reported disparities in sleep among racial/ethnic groups (e.g., see Guglielmo et al., 2018, for a review). For instance, on average, Black/African-American youth have shorter actigraphy-derived sleep duration than their Asian-American and Latinx

peers at ages 13–15 (Yip, Cheon et al., 2020) and shorter actigraphic and self-reported sleep duration than White/European-American children and adolescents (Guglielmo et al., 2018). Black youth also self-report lower sleep quality (Guglielmo et al., 2018), and in a study of youth at ages 9–11, daytime sleepiness (Philbrook et al., 2018), than White youth.

In relation to socioeconomic adversity, 9- to 11-year-olds from families with lower SES (e.g., as measured by INR, Title 1 school status, perceived economic well-being, maternal education) had shorter and poorer-quality actigraphy-derived sleep and greater subjective sleep problems than did youth from families with higher SES (El-Sheikh et al., 2013; see Covington et al., 2021; Fuligni et al., 2021; Sosso et al., 2021, for reviews). While race/ethnicity and SES differences in sleep are generally found, some exceptions exist. An examination of objectively measured sleep quality (efficiency; i.e., percent of time asleep from sleep onset to wake time) in children did not find Black/White race differences at ages 9–11 (El-Sheikh et al., 2010). As another example, SES differences in children's objective sleep duration were observed cross-sectionally at 30 months but not longitudinally from ages 30 to 42 months (Hoyniak et al., 2019).

In addition to documenting racial/ethnic and SES differences in sleep, studies have tested experiences related to race/ethnicity or SES (e.g., discrimination)—"process" variables—that explain associations between race/ethnicity or SES and sleep. In several studies with racially/ethnically diverse youth, researchers have found associations between perceived discrimination and sleep (Goosby et al., 2018; Huynh & Gillen-O'Neel, 2016; Jackson et al., 2020; Majeno et al., 2018; Yip, 2015). For example, in repeated-measures studies of youth at ages 13–15, daily experiences of discrimination were associated with same-day, self-reported sleep disturbances (Yip, Cham, et al., 2020; Yip, Cheon, et al., 2020). In a cross-sectional analysis of youth at ages 13–17, high levels of discrimination were associated with self-reported shorter sleep for Black adolescents and objectively assessed shorter sleep for Latinx adolescents in families with low SES (indexed via parent education) relative to Asian youth (Cheon et al., 2019). Thus, evidence suggests that perceived discrimination may underlie some of the race/ethnicity and SES differences in sleep, pointing to the need for further study of discrimination as it relates to sleep.

Building on research linking race/ethnicity or SES (or discrimination) with sleep, several studies have examined whether sleep mediates associations between race/ethnicity or SES and youth's psychosocial adjustment. In one, of children with a mean age of 9 years at Time 1 and 11 years at Time 2, subjective sleepiness mediated longitudinal associations between both race/ethnicity (Black/White) and SES (INR) and academic and cognitive outcomes among children (Philbrook et al., 2018). Black children and children of lower SES reported greater sleepiness which, in turn, predicted lower cognitive performance, standardized test scores, and teacher-r eported academic functioning (Philbrook et al., 2018). Similarly, lower SES, measured using parents' occupational prestige and education, was associated with later sleep timing problems, indexed by actigraphy-derived sleep onset and parent-reported bedtime, which in turn was associated with poorer verbal and nonverbal cognitive outcomes among toddlers (Hoyniak et al., 2019). In addition, parent-reported difficulty initiating or maintaining sleep mediated the cross-sectional association between perceived family

economic well-being and mental health difficulties among youth at ages 11 to 13 (Bøe et al., 2012).

Although more rigorous longitudinal designs are needed, these mediational studies suggest that poor sleep may contribute to the development of racial/ethnic or SES disparities in psychosocial adjustment during childhood and adolescence. Studies of connections between sleep and other systems that underlie psychosocial health complement findings from the mediational studies, showing how sleep functions as a mechanism. For example, in neuroimaging studies, sleep deprivation affects areas of the brain associated with attentional and working memory systems, including the prefrontal cortex (Krause et al., 2017). Sleep problems also contribute to psychosocial maladjustment by undermining emotion regulation and, more specifically, decoupling cortical and limbic regions of the brain, which diminishes cognitive control over strong negative emotions and impulses (Gruber & Cassoff, 2014; Kamphuis et al., 2012). In addition, sleep problems are associated with heightened activity of the sympathetic nervous system and dampened activity of the parasympathetic nervous system (e.g., El-Sheikh et al., 2017), which may reflect or exacerbate stress. In contrast, better sleep can protect by strengthening executive functioning and emotion regulation.

BETTER SLEEP AS PROTECTION AGAINST THE DEVELOPMENT OF DISPARITIES

Longer, higher-quality, or more consistent (i.e., better) sleep may also function as a protective factor that diminishes racial/ethnic and SES disparities in psychosocial adjustment. Studies related to these functions of sleep have tested whether sleep moderates associations between race/ethnicity or SES (or related experiences, like discrimination) and psychosocial adjustment, or whether race/ethnicity or SES moderates associations between sleep and psychosocial adjustment; many more studies have examined the latter than the former. Although these types of interaction may be based on different conceptualizations (e.g., good sleep or socioeconomic well-being as the protective factor), tests of the interactions are statistically identical and both kinds of interaction can be consistent with the proposition that better sleep diminishes disparities in psychosocial adjustment.

First, better sleep diminishes disparities when sleep moderates the association between race/ethnicity or SES (or related experiences, like discrimination) and psychosocial adjustment, so an association between racial/ethnic-minority status or lower SES and poorer psychosocial adjustment is weaker under conditions of better sleep. Few studies have tested this type of interaction; here, we review four studies in which sleep-moderated associations between discrimination and psychosocial maladjustment. More studies have tested the second type of interaction, also consistent with the proposition that sleep can diminish disparities: Race/ethnicity or SES moderates the association between sleep and psychosocial adjustment so that an association between better sleep and better psychosocial adjustment is stronger for racial/ethnic minorities or children from families with lower SES. Based on either type of interaction (sleep as moderator or sleep as predictor), the evidence suggests that sleep is at least partially independent of race/ethnicity or SES (otherwise an interaction could not exist) and that sleep can diminish racial/ethnic or SES disparities

in psychosocial adjustment. Next, we summarize the results of research on interactions between sleep and race/ethnicity or SES as related to cognitive/academic outcomes and socioemotional outcomes.

COGNITIVE/ACADEMIC FUNCTIONING

Several studies have examined whether race/ethnicity or SES moderates associations between sleep and cognitive outcomes. For example, in one, race/ethnicity (but not SES) moderated cross-sectional associations between sleep quality and cognitive performance at age 9 (El-Sheikh, Philbrook, et al., 2019). The positive association between objective sleep quality (efficiency) and cognitive performance was stronger among Black children than among White children. The difference in cognitive outcomes was smaller at greater levels of sleep efficiency, with better sleep diminishing race/ethnic differences in cognitive scores, academic functioning, and standardized testing (El-Sheikh, Philbrook, et al., 2019). Similarly, race/ethnicity moderated longitudinal associations between objective sleep efficiency and cognitive performance across childhood and early adolescence across three timepoints, each 1 year apart, with youth averaging 9 years at Time 1 (Philbrook et al., 2017). Sleep predicted total cognitive performance and working memory scores more strongly among Black children than among White children. Again, the race difference in outcome was smaller at better levels of sleep than at poorer levels of sleep, with better sleep decreasing race differences across time (Philbrook et al., 2017).

Moderation by SES has also been reported in studies linking sleep with cognitive outcomes. Caregivers' SES moderated cross-sectional associations between reported sleepiness and executive functioning (Anderson et al., 2009). In this study, of youth who were 13 years old, on average, the association between sleepiness and executive functioning was stronger for adolescents whose parents had less educational attainment than for youth whose parents had greater educational attainment. SES differences in executive functioning were smaller at lower levels of sleepiness than at higher levels, with better sleep diminishing SES differences (Anderson et al., 2009).

Similarly, in a 7-year study, SES in early life moderated associations between sleep problems and academic achievement in middle childhood (participants were 12 months old at Time 1 and 8 years old at Time 2; Rea-Sandin et al., 2022). Parent-reported subjective sleep problems predicted reported overall academic achievement more strongly among children with lower early-life SES, assessed using a composite of education and INR. The difference in achievement was smaller at lower levels of sleep problems than at higher levels, with better sleep reducing differences in SES (Rea-Sandin et al., 2022). SES also moderated longitudinal associations between objective sleep duration and cognitive performance (Philbrook et al., 2017). However, these results contrast with several other studies in that fewer sleep minutes predicted better cognitive performance among children from families with lower INR, with better sleep failing to diminish disparities in SES (Philbrook et al., 2017).

Some studies of the moderating role of race/ethnicity or SES in relations between sleep and cognitive/academic outcomes have yielded null results. For example, in a study referenced

earlier, race/ethnicity did not moderate associations between actigraphy-based sleep minutes and teacher-reported academic functioning, or between subjective sleep problems and academic scores, among Black and White children (El-Sheikh, Philbrook et al., 2019).

SOCIOEMOTIONAL OUTCOMES

Several studies have examined whether race/ethnicity or SES moderates associations between sleep and socioemotional outcomes. In a 2-year study, which began when children were 9 years old, on average, race/ethnicity moderated the association between actigraphy-derived sleep quality (efficiency) and internalizing symptoms (El-Sheikh et al., 2010). Objective sleep quality predicted internalizing symptoms more strongly among Black children than among White children. The race difference in internalizing symptoms was smaller at better levels of sleep quality than at poorer levels of sleep quality, with better sleep quality decreasing race differences.

In the same study, race/ethnicity also moderated the longitudinal association between subjectively rated sleep quality and externalizing problems. Sleep/wake problems predicted externalizing more strongly among White children than among Black children. The race difference in externalizing was smaller at better levels of sleep quality than at poorer levels of sleep quality, with better sleep quality reducing race differences. In addition, in this study, SES (measured via parent education and occupation) moderated the cross-sectional association between objective sleep quality (efficiency) and externalizing problems (El-Sheikh et al., 2010). The association between objective sleep quality and externalizing was positive for children with higher SES and negative for children with lower SES, and the SES difference in externalizing was smaller at better levels of sleep quality than at poorer levels of sleep quality, with better sleep diminishing differences in SES. Similarly, SES moderated the cross-sectional association between subjective sleep quality and internalizing symptoms. The association between sleep quality and internalizing was stronger among children with lower SES than among children with higher SES. Again, the SES difference in internalizing was smaller at better levels of subjectively measured sleep quality than at poorer levels of sleep quality, with better sleep quality reducing differences in SES (El-Sheikh et al., 2010).

In another study, of children who averaged 3 years old, SES moderated the cross-sectional association between children's parent-reported symptoms of insomnia and both internalizing symptoms and externalizing problems, and between children's parent-reported poor sleep health behaviors and internalizing symptoms (Williamson et al., 2021). The association between sleep and socioemotional outcomes was stronger among children with lower SES risk based on multiple family and neighborhood indices of SES than among their counterparts with higher SES. The SES difference in internalizing symptoms and externalizing problems was smaller at better levels of sleep than at poorer levels of sleep, with better sleep reducing differences in SES (Williamson et al., 2021).

In a study of three-way interactions, subjective sleep quality and SES (i.e., INR) conjointly moderated the cross-sectional association between objective sleep duration and rule-breaking behavior among youth at ages 14 to 18 (El-Sheikh, Saini et al., 2019). The negative association between sleep duration and rule breaking was strongest among youth

with lower SES and poorer subjective sleep quality compared to children with higher SES. Again, the SES difference in rule breaking was smaller at better levels of sleep duration and quality than at poorer levels of sleep duration and quality, with longer or better sleep diminishing differences in SES (El-Sheikh, Saini et al., 2019).

Additional studies have examined whether sleep moderated associations between discrimination, an experience often related to racial/ethnic-minority status or low SES, and socioemotional outcomes. For example, in a cross-sectional study of 14- to 18-year-olds, actigraphy-derived sleep minutes moderated relations between discrimination and adjustment (El-Sheikh et al., 2016). Specifically, the association between everyday discrimination and externalizing problems was weaker at higher levels of sleep duration than at lower levels of sleep duration; in contrast, the association between racial/ethnic discrimination and internalizing problems was weaker at lower levels of sleep duration, though youth with higher levels of sleep duration reported fewer internalizing problems overall (El-Sheikh et al., 2016).

In a cross-sectional study of late adolescents whose ages averaged 17 years, actigraphy-derived sleep moderated relations between discrimination and adjustment (El-Sheikh et al., 2022). Associations linking racial/ethnic discrimination and general discrimination with internalizing symptoms and rule-breaking behavior were attenuated at longer or more consistent sleep duration, compared to shorter or less consistent sleep duration, among both Black and White adolescents (El-Sheikh et al., 2022). Furthermore, in an ethnically diverse (9% African American, 25% Hispanic/Latino, 42% Asian, 25% White), longitudinal study examining self-r eported sleep quality as a moderator among middle adolescents at ages 14–15, racial/ethnic discrimination predicted higher levels of depressive symptoms and lower self-esteem, yet such relations were attenuated at higher levels of sleep quality (Yip, 2015). Similarly, in a study of 14- to 17-year-olds, longer and higher-quality sleep moderated the association between daily experiences of racial/ethnic discrimination and coping, with adolescents reporting more active coping and subsequent well-being when they experienced discrimination but slept well (Wang & Yip, 2020). In these studies of sleep as a moderator of discrimination, sleep served a protective function across racial/ethnic groups. Since racial/ethnic minorities experience more discrimination than their majority counterparts, these results also point to the potential for good sleep to diminish racial/ethnic disparities in psychosocial adjustment.

While the overall patterns of effects described here are representative of the literature, studies have not always found interactions between sleep and race/ethnicity or SES. For example, the associations between objectively measured sleep duration and adjustment (both internalizing symptoms and externalizing problems) were not qualified by race/ethnicity (El-Sheikh et al., 2010), and associations between children's poor sleep behaviors and internalizing symptoms did not vary by SES level (Williamson et al., 2021).

SUMMARY OF INTERACTION RESULTS

In studies that detected an interaction between sleep and race/ethnicity or SES, the results generally show: (1) a stronger positive association between sleep and psychosocial

adjustment among racial/ethnic-minority 3- to 18-year-olds from families with lower SES, (2) smaller differences in psychosocial adjustment between demographic groups when sleep is better, and (3) weaker associations between discrimination and psychosocial maladjustment when sleep is better. These results suggest that sleep may contribute to racial and SES disparities in psychosocial adjustment: Better sleep seems to diminish disparities and poorer sleep seems to create or amplify disparities.

CONCLUSIONS AND DIRECTIONS FOR RESEARCH

Next, we list several recommendations for research. These recommendations will advance our understanding of how sleep contributes to health disparities in socioeconomically disadvantaged and minoritized groups, consistent with the strategic goals and high-priority research areas of the 2021 National Institutes of Health plan for sleep research, *Advancing the Science of Sleep and Circadian Biology Research* (National Institutes of Health, 2021).

First, researchers need to understand more completely the race/ethnicity-related and SES-related conditions and experiences that affect sleep (Alhasan et al., 2022; Jackson et al., 2020). Historically minoritized and economically disadvantaged groups experience structural barriers (e.g., systemic and institutional racism, criminal justice; Williams, 1999) and adversities, some of which are related to socioeconomic attainment (e.g., housing and home ownership, education, employment, criminal justice). These structural barriers likely interfere with the physical (i.e., sleep environment; Hoyniak et al., 2022) and psychological (e.g., stress) conditions that support sleep. The stress arising from navigating multiple cultural contexts (bicultural stress) has also been linked with disruptions in Latino adolescents' sleep duration, timing, and quality (Sladek et al., 2020). Thus, broader assessments of structural and experiential factors are critical to enhance understanding of sleep disparities in childhood and adolescence. More research on promotive factors in predicting sleep in marginalized populations is also needed.

Similarly, in addition to considering income-based SES, studying indices of SES more broadly (e.g., subjective economic well-being, community poverty; El-Sheikh et al., 2013) will advance understanding of sleep as a mechanism of health disparities and a protective factor against health disparities. For example, in studies, youth who reported concerns about community violence had poorer sleep quality (Philbrook et al., 2020), and neighborhood economic deprivation and social fragmentation were related to sleep problems (Bagley et al., 2018). In addition, exposure to community violence has been linked with lower academic achievement indirectly via sleep problems (Lepore & Kliewer, 2013). As this literature develops, we hope it will become possible to differentiate between specific measures of SES as they relate to sleep.

Likewise, experiences of youth from different racial/ethnic groups and historically minoritized groups (El-Sheikh et al., 2022; Yip, Cham et al., 2020) tend to differ, and enhanced attention to multiple minoritized groups is needed. For example, marginalization and associated experiences occur for sexual and gender minorities, and risk may be especially elevated for youth with intersectional identities (Fox et al., 2020); researchers need to examine the role of sleep in these contexts. Studies should also assess sleep as

a moderator and a mediator in specific marginalized groups without comparisons to other groups.

Second, the field would benefit from strong assessments of primary constructs as well as expansion to broader constructs of adjustment and health outcomes. In examining sleep, the advantages of multiple measures are well recognized (see El-Sheikh & Sadeh, 2015). Using rigorous sleep assessments and considering numerous important sleep–wake dimensions—including duration, quality, schedule (e.g., sleep onset and wake times, time of optimal arousal, other markers of chronobiology), satisfaction, daytime sleepiness, regularity in each measure, and sleep architecture (stages)—are important directions for research. Additional research with rigorous and comprehensive sleep measures may point to conclusions about specific dimensions of sleep that contribute to or protect against disparities. Similarly, researchers should investigate multiple domains of adjustment, including positive facets of well-being (e.g., happiness, self-esteem), physical health (e.g., somatic symptoms, body mass index), and physiological reactivity and regulation (e.g., hypothalamic pituitary adrenal axis functioning, sympathetic and parasympathetic nervous system activity).

Finally, researchers need to conduct more studies based on multiwave longitudinal designs across a wide age range or developmental periods. Developmentally oriented studies can examine the effects of the timing of racial/ethnic or socioeconomic stress on children's sleep and changes in sleep over time. For example, the effects of socioeconomic adversity early in life may predict sleep years later, even after accounting for concurrent SES (Doane et al., 2019), or decreased exposure to adversity over time may predict improvement in sleep longitudinally. Longitudinal designs could also clarify the effects of time-limited versus chronic sleep problems and reveal sensitive periods when the detrimental or protective effects of sleep on health disparities are heightened. Multiwave studies would also allow more rigorous tests of sleep as a mediator linking race/ethnicity or SES with psychosocial adjustment, thereby facilitating comparisons of evidence for sleep as a mediator or moderator of disparities (even if, as we hypothesize, sleep plays both roles to some extent). Answers to these questions are vital for understanding the role of sleep in the development of health disparities.

Current theory and research have already pointed to interventions to improve sleep and mitigate the risk of deleterious outcomes (Blake et al., 2017). We need to further understand sleep disparities to inform these programs. Although many systemic and structural barriers need to be rectified to facilitate sleep and overcome health disparities in youth, improving the sleep of historically minoritized youth and youth of lower SES through educational as well as direct prevention and intervention efforts may mitigate disparities in psychosocial and broader health outcomes.

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Abbreviations:

SES	socioeconomic status
INR	income-to-needs ratio

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