

Sleep, Poverty, and Biological Stress: Mitigating Sleep Health Disparities in Early Childhood

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Abstract

In the first years of life, poverty increases the risk of sleep problems such as late bedtimes and frequent night awakenings. In turn, children with sleep problems are more likely to go on to have poor physical and mental health outcomes as adults. The development of sleep and biological stress systems is connected, so that sleep problems can lead to abnormal function of the stress hormone cortisol and contribute to enduring socioeconomic health disparities. Sleep also is critical to brain and cognitive development. Sleep practices such as inconsistent bedtime and absence of a bedtime routine are more common in families experiencing poverty and stress. To address early childhood sleep problems, there is an urgent need for policies that help low-income families to access behavioral sleep interventions; provide families with affordable healthcare, housing, and nutrition; and adjust childcare and school practices to support healthy sleep.

Keywords

sleep, children, health disparities, socioeconomic status, cortisol, brain development

Tweet

Young children living in poverty often do not get enough sleep or have disrupted sleep, which increases stress hormones and leads to health disparities. To support healthy sleep, we need policies to help families access sleep interventions and resources to meet their basic needs.

Key Points

- Poverty puts young children at greater risk for sleep problems, including insufficient sleep, late bedtime, and night waking.
- Sleep deprivation leads to abnormal stress hormone levels and disrupts healthy brain development.
- Children with sleep problems are more likely to have poor physical and mental health as adults. Thus, sleep problems are a key pathway through which early poverty leads to long-term health disparities.
- Poor sleep practices, like inconsistent bedtime and lack of a bedtime routine, are more common in low-income families due to structural barriers such as long commutes, crowded living situations, and air, noise, and light pollution.
- Policies to provide affordable access to behavioral sleep interventions can help low-income families to treat sleep problems effectively.
- Policies to meet families' healthcare, housing, and nutrition needs can build the foundations of sleep health in low-income children.

Introduction

Sleep problems often develop in early childhood (Mindell, Du Mond et al., 2011), but while common, they are far from benign. Early-developing sleep problems are prevalent and persistent risk factors for lifelong poor mental and physical health outcomes, and may be key mechanisms underlying early and enduring socioeconomic health disparities (Garrison, 2015; Jackson et al., 2015; Sivertsen et al., 2015). About 30–50% of young children will experience insufficient sleep, sleep problems (e.g., bedtime resistance, prolonged night wakings), and/or late sleep timing (Carter et al., 2014; Meltzer et al., 2010). Early sleep difficulties tend to endure into adolescence and relate to internalizing and externalizing symptoms, poor academic achievement, poor emotion regulation, lower physical activity, and obesity (Dutil et al., 2022; Hager et al., 2016; Mindell, Leichman et al., 2016; Sivertsen et al., 2015; Vik et al., 2022).

Socioeconomic Status and Early Childhood Sleep Problems

Children living in poverty are at elevated risk of sleep problems (Duh-Leong et al., 2020; Schmied et al., 2022;

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Williamson & Mindell, 2020). Further, early poverty may strengthen the association of sleep problems with later health problems such as obesity (Breitenstein et al., 2019), such that children living in poverty not only are more likely to have sleep problems but also are particularly vulnerable to the long-term adverse health effects of those sleep problems. As the number of sociodemographic risk factors a child is experiencing increases, so does the likelihood of poor sleep habits, insomnia symptoms, and obstructive sleep apnea symptoms (Williamson & Mindell, 2020). Family processes are fundamentally linked to child symptoms: psychosocial stress, maternal depression, family conflict, and household chaos contribute to the development and worsening of sleep problems (Field, 2017; Gress-Smith et al., 2012; Mannering et al., 2011), as do crowded family living situations, housing disrepair, food insecurity, and single caregiver homes (Duh-Leong et al., 2020; Na, Eagleton et al., 2020; Williamson & Mindell, 2020). Neighborhood disadvantage also contributes to sleep problems: Children in neighborhoods with more economic deprivation and social fragmentation have shorter nighttime sleep duration and lower quality sleep (Bagley et al., 2018), and neighborhood deprivation has been linked to lower sleep quality even after controlling for family-level risks (Grimes et al., 2019). Further, racially and ethnically minoritized children are at greater risk of insufficient sleep duration and later sleep and wake times (Pal et al., 2023; Peña et al., 2016) and racial/ethnic disparities are only partially explained by poverty (Peña et al., 2016). Racial/ethnic disparities may reflect the impact of structural racism and daily experiences of discrimination on family and neighborhood risks for child sleep problems.

Sleep Problems and Biological Stress

Disrupted or insufficient sleep in early childhood can perturb the developing hypothalamic–pituitary–adrenal (HPA) axis, a biological stress system, representing one pathway through which early poverty leads to increased disease burden in adulthood. Both sleep patterns and the stress hormone cortisol are characterized by the emergence of a circadian rhythm over the first year of life. Newborns have a fragmented sleep pattern, distributed across the 24-hour day, but as a sleep circadian rhythm takes hold, there is consolidation of nighttime sleep by 12 months of age (Davis et al., 2004). In parallel, a circadian rhythm also emerges for the HPA axis by late infancy (De Weerth et al., 2003), with peak production of the stress hormone cortisol just before morning waking, and cortisol levels dropping across the day to reach the lowest cortisol production in the early phases of nighttime sleep (Born & Fehm, 1998). This diurnal rhythm of cortisol production is controlled by the central circadian pacemaker in the suprachiasmatic nucleus of the hypothalamus (O’Byrne et al., 2021).

Given the parallel development and circadian nature of sleep and biological stress, it is not surprising that interruptions to sleep circadian rhythms alter cortisol function. For instance, when airline pilots have early shifts that deprive them of nighttime sleep, they have a flatter diurnal cortisol rhythm and more overall cortisol exposure compared to when they work a daytime schedule that does not disrupt their sleep (Bostock & Steptoe, 2013). The vulnerability of HPA function to sleep disruption has been demonstrated in young children as well. In infancy, insufficient nighttime sleep duration is related to higher chronic cortisol exposure, as indexed by hair cortisol, and a flattened diurnal cortisol rhythm (Flom et al., 2017) while delayed sleep onset, that is, late bedtime, is related to a larger morning cortisol awakening response (Stalder, Bäumlér et al., 2013). Relatedly, in middle childhood, poor sleep quality is associated with cortisol and inflammatory cytokine levels the following morning (LaVoy et al., 2020). The impact of sleep deprivation on cortisol function can be induced experimentally in young children: When preschoolers were compelled to stay awake later at night, their cortisol levels were dysregulated the following morning (Gribbin et al., 2012).

Sleep-related cortisol disruptions are not merely fleeting but cumulatively can have long-term implications for HPA function. The development of sleep and biological stress systems are intertwined, such that disruptions to one system can impair the development of the other (Palagini et al., 2015). Disruption to HPA axis development during this vulnerable period in early childhood is of great concern, as it can lead to enduring HPA dysregulation and elevated long-term risk of health problems (McEwen & McEwen, 2017). Chronic increases in cortisol exposure, that is, hypercortisolemia, increase the likelihood of poor physical and mental health in adulthood, including cardiovascular disease, metabolic syndromes, cancer, immune-mediated disorders, and mood disorders (O’Byrne et al., 2021). Thus, early childhood sleep problems can contribute to enduring socioeconomic health disparities, in part through their impact on the developing HPA axis.

Importantly, the reverse is also true: dysregulated HPA function can contribute to sleep problems. Toddlers with higher hair cortisol concentrations, indexing chronic cortisol exposure, were at heightened risk of increasing difficulties initiating and maintaining sleep a year later (Bates et al., 2021). Temporal dependency between cortisol and sleep also has been demonstrated in infancy, such that higher cortisol exposure on a given day was associated with shorter sleep duration the following night, and higher bedtime cortisol levels were related to delayed sleep onset that same night (Tuladhar et al., 2021). Similarly, higher evening cortisol levels in young children predicted shorter sleep duration and lower sleep efficiency that night (Philbrook, 2022). The HPA axis is sensitive to poverty and other forms of early adversity (Saridjan et al., 2010). Thus, for young children, not only do poverty-related sleep problems contribute

to cortisol dysregulation, but also, poverty-related cortisol dysregulation further increases the risk of developing sleep problems.

Sleep Problems and Brain Development

Sleep plays a critical role in structural brain development and in memory consolidation. Rapid eye movement (REM) sleep provides endogenous stimulation to the brain, which is thought to promote neural processes including synaptic pruning and maintenance of new synapses (Li et al., 2017). A prospective study found that children with a history of sleep problems from 2 years onward had smaller grey matter volumes and a thinner dorsolateral prefrontal cortex at 7 years (Kocevska et al., 2017). In addition to supporting neural maturation, sleep also is important to memory consolidation. Sleep deprivation studies indicate that REM sleep facilitates synaptic plasticity in response to visual input and other learning experiences (Shaffery et al., 2006), and non-REM (NREM) sleep is implicated in synaptic remodeling via reactivation of neural activity patterns that occur during wakefulness (Peirano & Algarin, 2007). This neural restructuring during sleep, along with sleep spindle activity in the hippocampus during NREM sleep, may contribute to memory consolidation (Capellini et al., 2009); indeed, in adults, memory consolidation is impaired when sleep cycles are interrupted (Ficca et al., 2000). Similarly, in young children, napping promotes the abstraction of newly learned information (Gomez et al., 2006). While there is a dearth of research on neural mechanisms of memory consolidation during sleep in early childhood (Jiang, 2020), studies linking sleep disruption with cognitive outcomes are suggestive. In infants and toddlers, night awakenings and poor sleep consolidation are associated with poorer cognitive development (Dionne et al., 2011; Sun et al., 2018).

Poverty, Family Psychosocial Stress, and Suboptimal Sleep Practices

Suboptimal sleep practices are one mechanism through which poverty and family stress contribute to the emergence and persistence of early childhood sleep problems. Suboptimal sleep practices such as later bedtime, inconsistent bedtime, absence of a consistent bedtime routine, sleeping in a room with others due to crowding, feeding near bedtime, and screen use at bedtime are more common in families experiencing poverty and chronic stress (Covington et al., 2019; Duh-Leong et al., 2020; Hale et al., 2009; Ordway et al., 2020). Suboptimal sleep practices are associated with shorter sleep duration and more nighttime awakenings in early childhood (Covington et al., 2019). In particular, children without a consistent bedtime are less likely to meet the guidelines for sufficient nighttime sleep duration (Schmied et al., 2022). Within a Medicaid-eligible, racial/

ethnic minority sample, television use at bedtime was related to more sleep problems (Miller, Canfield et al., 2022). Further, economic hardship is associated with a greater increase in suboptimal sleep practices from infancy to the toddler years (Duh-Leong et al., 2020).

Parents experiencing socioeconomic adversity have been reported to have limited knowledge of sleep recommendations (Ordway et al., 2020). However, psychoeducation alone would be insufficient to resolve socioeconomic disparities in sleep practices, as these practices stem in large part from poverty-related stressors such as crowded housing, long commutes, and variable parent work schedules. Neighborhood noise and light pollution and household chaos all also contribute to suboptimal sleep environments. Effective behavioral sleep interventions for families experiencing socioeconomic adversity therefore must be tailored to their individual situations and help them to optimize sleep practices within real-world constraints (Ordway et al., 2020; Tinker et al., 2020). Policy changes that address these structural factors at the family and neighborhood levels are also essential to support early childhood sleep health and mitigate socioeconomic health disparities.

Policy Opportunities

Building the foundations of sleep health for young children living in poverty is an urgent public health concern. Early sleep problems are known risk factors for lifelong poor physical and mental health (Silversten et al., 2015), contribute to long-term dysregulation of biological stress systems (Palagini et al., 2015), and interfere with healthy brain development (Kocevska et al., 2017). To address entrenched socioeconomic disparities in early childhood sleep, a three-pronged approach is needed: (1) policies that enable low-income families to access affordable, empirically validated sleep interventions to support healthy sleep practices for young children; (2) policies to facilitate access to affordable healthcare, housing, and nutrition, thereby reducing sociocontextual and structural barriers to sleep health in early childhood; and (3) policies to address childcare and school practices that currently exacerbate sleep problems, including naptimes late in the day, excessive homework, and early school start times.

Ensuring That Behavioral Sleep Interventions Are Accessible and Covered by Insurance

Empirically validated behavioral sleep interventions offered by behavioral health specialists, nurses, or medical assistants may be a powerful resource for low-income families, especially when offered remotely via telehealth. Low-income families often can benefit from behavioral sleep interventions (e.g., Bonuck et al., 2016; Tinker et al., 2020; Williamson et al., 2022) when those interventions are accessible to

them, culturally adapted, and tailored to their needs. However, there are barriers to implementation, including accessibility of appointments and lack of insurance coverage. Behavioral sleep interventions typically are delivered by behavioral health specialists, whose services often are not covered by insurance agencies or Medicaid. Therefore, requirements should be established to expand coverage for behavioral health specialists. These coverages should also be extended to nurses and medical assistants who can be trained to deliver these services, to increase capacity to reach the many families who would benefit. If training is provided and insurance reimbursements at competitive rates are expanded to these providers, the number of medical professionals able to offer these interventions will increase, making it more feasible for low-income families to secure access to them. Increased insurance coverage for telehealth appointments will also make these programs more accessible to low-income families, who may not have the schedule flexibility or reliable, convenient transportation needed to readily access these services in person.

Increasing Access to Affordable Healthcare, Housing, and Food

Access to Affordable Healthcare. Affordable access to routine medical and dental care in early childhood will support sleep health. While it is essential for all children to have access to routine medical evaluations by a pediatrician, poverty is a particularly important determinant of chronic illness (Gitterman et al., 2016). Without affordable healthcare, children may not have access to well-child visits in which pediatricians screen for emerging health concerns, and families may be unable to access medical care for acute medical problems. Children may then face longer periods of disrupted sleep while they recover without treatment, or due to the worsening of chronic conditions. Children with asthma, which is more prevalent in low-income households, have higher rates of sleep-disordered breathing (Brockmann et al., 2014), and are particularly in need of careful monitoring. It is essential that there is equitable access to affordable and comprehensive health insurance not only for behavioral sleep interventions, as mentioned above, but more broadly, including competitive reimbursement rates that providers are willing to accept. Innovative payment models may also ease the financial burden on families seeking medical treatment for their children. Dental care coverage with competitive reimbursement rates is also essential. Sleep health and oral health are highly related and oral health professionals are in a position to identify sleep quality concerns related to oral health, administer sleep quality assessments, and offer appropriate referrals to sleep health experts (Schroeder & Gurenlian, 2019).

Access to Affordable Housing. Lack of housing affordability close to workplaces may lead families to live in units that

are far away from workplaces; that are not ideal for family sleep health in terms of air, light, and noise pollution; or that do not accommodate family size. Low-income families seeking affordable housing may be forced to live in areas without readily accessible public transportation or areas that require long commute times to workplaces. As a result, parents may arrive home later in the evening, delaying bedtime routines and resulting in less overall sleep duration for children. Further, low-income families may also be obliged to live in areas with high noise, air, and light pollution, such as next to an airport or highway, due to cheaper rents. These pollutants can delay sleep onset and increase night wakings for young children. Further funding for the Office of Housing and Urban Development would be beneficial to increase the development of housing units that are geographically close to accessible public transportation in order to shorten commute times and in neighborhoods with acceptable levels of noise, air, and nighttime light.

While some families co-sleep or bedshare as an expression of parenting or cultural values, other families share beds or rooms due to space limitations in the home. In these cases, sharing a sleeping space may have an adverse effect on sleep for all members of the family, especially young children. Sleep problems related to shared sleeping spaces include delayed bedtimes, increased sleep onset latency, increased sleep fragmentation, increased early wakings, and increased exposure to media use during a child's sleep period. It would be most beneficial for new subsidized housing development to be a family style to accommodate family size needs. The federal government has subsidized housing costs for families in private rental housing through federal Housing Choice Vouchers. However, additional funding is needed to expand rental assistance programs so that low-income families with young children can afford homes that meet their family-size needs.

Access to Nutritious Subsidized Food. Food insecurity and malnutrition are linked with dysregulated sleep and suboptimal sleep quality (Na et al., 2019; Vantlaille, 2006). Low-income neighborhoods are more likely to be in food deserts. Even in communities with supermarkets, low-income residents often cannot afford the higher price of healthy options and still rely on unhealthy foods in cheaper stores (Ghosh-Dastidar et al., 2014). Unhealthy diets put children at greater risk for obesity, which is associated with shorter sleep duration in early childhood (Miller, 2015). However, there are promising government programs that can address these risks. Recently, for example, Delaware instituted a temporary Farmers' Market Nutrition Program which offered WIC participants vouchers to spend at markets offering fresh fruits and vegetables (Gbenro, Jr. et al., 2019). Further, expanded school breakfast and lunch programs, which provide free meals to all children, may allow children to maintain a nutritious diet even when their families cannot afford to provide one at home while

removing the stigma of income-based qualification for free or reduced-price meals. Expanding programs like these on a more permanent basis may offer low-income families the resources needed to provide their children with a regular and nutritious diet, mitigating childhood hunger and obesity and improving sleep quality.

Modifying Childcare and School Policies to Promote Sleep Health

Childcare Nap Policies. Early childcare centers can adversely impact young children's sleep health through rigidly enforced nap policies. States vary in requirements regarding sleep in childcare centers, and there is often ambiguity in interpreting state regulations with regard to whether children are required to nap, how long they should nap if providers should wake children from naps and if children whose parents opt out of the nap should be required to stay in the nap environment. The age at which children transition out of naps can vary across early childhood (Staton et al., 2020). For children who have transitioned out of their need for a nap, daytime sleep may result in evening sleep challenges like bedtime resistance and a longer sleep onset delay. Sleep in mid to late afternoon, common in childcare settings, can reduce sleep pressure so that children have difficulty falling asleep at bedtime. More education is needed on what policies require and how centers can be encouraged to maximize sleep consolidation within the policy. Training should be offered for childcare providers on sleep pressure, circadian cycles and sleep quality in early childhood. Finally, state or local regulations on naps in early childcare settings should clearly indicate what is required of childcare providers for optimal sleep health, and in some cases, states should revise preexisting policies that are detrimental to sleep health such as stating that a child should never be awoken from a nap. Handouts explaining how to comply with state regulations while prioritizing sleep health should be provided to centers. Together, sleep health education for center directors and staff and clearer communication about state regulations may influence centers to institute earlier nap periods and offer alternative quiet activities for children whose parents opt out of the nap. These changes would allow for earlier bedtime sleep onset and increased nighttime sleep duration for young children transitioning away from naps.

Primary School Homework Policies and Start Times. As children enter primary school, homework loads may lead to delayed bedtimes. The National Education Association suggests that children be given 10 min of homework per grade. However, primary school children often receive three times the recommended amount of homework (Pressman et al., 2015). This homework load is burdensome for low-income families, for whom later work schedules and longer commutes can affect when parents are available to help with

homework and thereby delay bedtime. Further, what a teacher expects to take 10 min may take longer for some children, especially those who are tired or who do not have adults available to supervise, so the effective homework load may be greater for the same families whose children are already getting inadequate sleep. If the 10-Minute Rule were to become a mandated requirement by the U.S. Department of Education, it may improve sleep health for children.

Children with long school bus commute times may need to wake earlier for school and complete homework later in the evening. Mandating school start times of 8:30 a.m. or later and securing funding for districts that require additional school buses to make these later start times possible also would be beneficial for sleep health in children experiencing low income.

Conclusion

Early childhood poverty puts children at risk for sleep problems, which can have cascading effects on biological stress, brain development, and long-term health. There is a compelling opportunity to build the foundations of sleep health in early childhood through policies that provide access to behavioral sleep interventions and mitigate structural barriers to sleep. These policies would represent a critical step toward overcoming entrenched socioeconomic health disparities.

Conflicts of Interest

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