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Health Disparities in Pediatric Sleep-Disordered Breathing

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Abstract

Sleep-disordered breathing reflects a continuum of overnight breathing difficulties, ranging from mild snoring to obstructive sleep apnea syndrome. Sleep-disordered breathing in childhood is associated with significant adverse outcomes in multiple domains of functioning. This review summarizes the evidence of well-described ethnic, racial, and socioeconomic disparities in pediatric sleep-disordered breathing, from its prevalence to its treatment-related outcomes. Research on potential socio-ecological contributors to these disparities is also reviewed. Critical future research directions include the development of interventions that address the modifiable social and environmental determinants of these health disparities.

Keywords

Sleep-disordered breathing; health disparities; race; environment

1.1 Sleep-disordered breathing definition, diagnosis, and sequelae

Sleep-disordered breathing (SDB) reflects a continuum of overnight breathing difficulties, ranging from mild snoring to its most severe form, the obstructive sleep apnea syndrome (OSAS).¹⁻³ SDB is characterized by respiratory symptoms, such as snoring, gasping, and pauses in breathing, that disrupt sleep architecture.^{4,5} Polysomnography (PSG) is the gold standard for diagnosing pediatric SDB severity,⁵ although some caregiver-completed questionnaires show strong sensitivity and specificity in detecting clinically significant OSAS.^{6,7}

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Regardless of its severity, untreated pediatric SDB is associated with significant adverse outcomes in multiple domains of functioning. Snoring and OSAS have each been associated with obesity, hypertension,^{8–10} and poor asthma control.¹¹ Across the continuum of children with SDB, there is also evidence of marked deficits in neurobehavior, including impairments in attention, behavioral regulation, and broad executive functioning skills.^{12–14} Indeed, a recent study using brain imaging has shown that greater caregiver-reported child SDB symptoms are linked to thinner cortical gray matter in the frontal lobes, which impacts executive functioning skills.¹⁵ Untreated SDB is costly for patients and the healthcare system, as SDB can result in a 215% elevation in child healthcare usage and 40% more hospital visits.¹⁶ Specifically, children with OSAS additionally show a 7-fold increase in risk of death,¹⁷ underscoring the importance of early SDB identification and treatment.

1.2 Prevalence and disparities

SDB occurs in 10 to 17% of children,^{1–3,18} with 1 to 3% experiencing OSAS,¹⁹ making OSAS the second most common pediatric chronic health condition after asthma (8.6%).²⁰ SDB is more prevalent among some pediatric populations. SDB risk is increased during early childhood, as adenotonsillar hypertrophy, which can cause obstructive events, peaks between 3 and 6 years of age.^{21,22} However, obesity is another factor that can increase SDB risk, with one study finding that SDB occurred in 13% of adolescents with obesity versus a prevalence of 2% in non-obese adolescents.²³ OSAS is also estimated to occur in over 69% of youth with Down Syndrome, due to the impact of hypotonia and other craniofacial differences on upper airway patency.²⁴

There are well-documented racial, ethnic, and socioeconomic disparities in pediatric SDB, from its prevalence to its treatment-related outcomes. Most of the available research on racial and ethnic disparities in SDB has compared non-Latinx Black/African American (hereafter, ‘Black’) youth to non-Latinx White (hereafter, ‘White’) youth.²⁵ Research indicates that Black youth are 4–6 times more likely than their White counterparts to experience SDB, across severities.^{26,27} Black children also experience greater OSA severity (increased apnea hypopnea index) on PSG relative to White children, even when controlling for obesity and other OSA contributors, such as asthma and a history of prematurity.^{28,29} Adjusting for racial and ethnic differences, socioeconomic status (SES) is also independently associated with SDB, with children living in lower-SES homes or socioeconomically disadvantaged neighborhoods being more likely to evidence SDB compared to their more socioeconomically advantaged peers.^{25,30,31}

Among youth diagnosed with OSAS, Black children are also less likely than White children to receive adenotonsillectomy,^{25,32,33} the first line treatment approach.²⁸ In a large-scale study using state-level pediatric healthcare data, tonsillectomy among all youth, regardless of presenting diagnosis, was lower among Black as well as Hispanic/Latinx patients compared to White youth and among those who were publicly compared to privately insured.³² A smaller study of children diagnosed with SDB also found that publicly-insured youth experienced delays in related care, with longer intervals between the initial SDB diagnosis and subsequent polysomnogram or surgical treatment compared to privately insured children.³⁴

Initial evidence also demonstrates disparities in the neurobehavioral symptoms of SDB and related treatment response. Neurobehavioral impairments and daytime sleepiness are key symptoms of pediatric SDB that may especially impact children, who have a plastic and rapidly developing nervous system.^{28,35} Although not designed to examine racial differences in OSAS, in the Childhood Adenotonsillectomy (CHAT) study, Black youth showed greater neurobehavioral impairments and daytime sleepiness at baseline compared to White youth and those of other racial and ethnic backgrounds.²⁸ Of note, CHAT also demonstrated that adenotonsillectomy for OSAS reduced the obstructive apnea hypopnea index (OAHI) and child neurobehavioral concerns, however, these improvements were diminished in Black youth.²⁸

1.3 Contributors to disparities in SDB and related outcomes

In identifying contributors to racial and ethnic health disparities, it is crucial to recognize that race and ethnicity are socio-political as opposed to a biological constructs, and that observed disparities are due to social and environmental factors.^{36,37} From a socio-ecological perspective,³⁸ socio-political and neighborhood-level factors along with other child, family, school, and healthcare setting factors are determinants of disparities in SDB prevalence, treatment access, and SDB-related child outcomes. We have applied this socio-ecological perspective to sleep health disparities across the lifespan³⁹ and with regard to pediatric sleep problems⁴⁰ and treatments.⁴¹ In the sections that follow and in Figure 1, we summarize putative mechanisms of disparities in SDB and its outcomes. Of note, the factors summarized here do not represent an exhaustive list of potential determinants of these disparities, and future research is needed into factors at multiple levels that could be leveraged to inform SDB prevention and intervention.

Racism.

While racism and discrimination are understudied in the context of pediatric sleep and SDB in particular, racism and discrimination are undoubtedly root causes of disparities in SDB and its impact on child functioning.³⁶ Racism is therefore a crosscutting theme in our socio-ecological model that impacts children at the level of the individual child, family, school, healthcare system, and neighborhood. This is because racism operates across multiple domains (i.e., systemic, institutional, and structural; personally-mediated; internalized)^{42–44} Structural racism refers to policies, laws, and regulations on a local, state, and national level that result in differential access to the goods, services, and opportunities based on race.⁴³ For example, the legacy of redlining has lasting effects on residential segregation, impacting where children live.^{45,46} Increased exposure to allergens and toxins found in historically redlined neighborhoods may in turn increase upper airway inflammation and propensity for SDB.³¹

Next, personally-mediated racism exists in the form of discrimination, implicit bias, and explicit bias.^{42,47} Historical and ongoing personally-mediated racism faced by Black families is understudied in relation to pediatric sleep health disparities, despite multiple pathways linking racism to sleep and functional outcomes. Personally-mediated racism is associated with poorer caregiver mental health,^{44,48} which can in turn impact the caregiver-

child relationship and child neurobehavioral and social-emotional skills.^{49,50} Caregivers' own experiences of racism and discrimination have been directly linked their parenting practices,⁵¹ child mental health,^{52–54} caregiver's own sleep,⁵⁵ and their child's sleep duration.⁵⁶ Research has also linked child experiences of racism to worse child sleep, typically in older samples.^{57–60} A study of Black, Asian, and Latinx adolescents found that daily experiences of discrimination were linked to increased same-night sleep disturbances and greater next-day daytime sleepiness,⁶⁰ although SDB was not assessed. More broadly, experiences of bias and discrimination are robustly linked to worse behavioral health (anxiety; emotional distress)^{61–63} and can trigger physiologic responses that increase risk for poor health outcomes,^{64–66} such as those related to SDB.

Child factors.

A crucial but largely overlooked factor that could account for some of the observed disparities in child SDB outcomes is broad sleep health, and particularly sleep duration. Similar to pediatric SDB, there are racial, ethnic, and socioeconomic disparities in the proportion of youth obtaining insufficient sleep,^{67,68} or less total (24-hour) sleep than recommended according to age-based national (US) guidelines.⁶⁹ Insufficient sleep is even more common than SDB, occurring in approximately 36% of preschoolers,⁴⁰ 50% of school-aged children,⁷⁰ and over 70% of adolescents.⁷¹ In addition, like SDB, insufficient sleep is associated with impairments in attention, executive functioning, and other neurobehavioral outcomes,^{72,73} as well as increased risk of obesity and cardiometabolic concerns.⁷⁴ Few studies have examined the overlap among SDB symptoms and insufficient sleep,^{75,76} and the potential synergistic effects of these co-occurring sleep problems on child neurobehavioral and physical health functioning.⁷⁷ There is also a paucity of research on how other modifiable aspects of sleep health, including poor sleep health behaviors (e.g., inconsistent bedtime routines, evening electronics usage, caffeine consumption),⁷⁸ may contribute to disparities in SDB-related outcomes.

Family factors.

Family beliefs and behaviors are crucial contributors to pediatric sleep health and development but are understudied in the context of SDB. Emerging qualitative research,⁷⁹ for example, indicates that sleep health promotion for young children may need adaptation to address caregivers' beliefs about optimal child sleep duration and evening electronics usage. Caregivers' own sleep and the home sleep environment (light, noise) may also influence child sleep duration and other key sleep health behaviors linked to developmental outcomes among youth with SDB.^{80,81}

Additional family factors, such as parenting style,^{82,83} child and caregiver exposure to stress and adverse childhood experiences,^{80,84,85} and household chaos^{86,87} have all been linked to both child sleep health and the neurobehavioral outcomes implicated in child SDB. Consistent with a socio-ecological framework, these factors likely accumulate and interact to influence child outcomes. For instance, lower family-level SES, typically indexed by family income and caregiver education or occupation, can exacerbate parenting stress, negatively impacting parenting practices and child wellbeing.^{46,88,89} Limited family resources (e.g., availability of an individual bed or room) may also impede sufficient and healthy childhood

sleep.⁹⁰ Lower caregiver health-related literacy has been linked to worse pediatric sleep habits⁹¹ and could impact sleep treatment-related behavior and decision-making, but has not been studied in relation to disparities in pediatric SDB. Thus, multiple family functioning and environmental factors are necessary to examine in relation to disparities in SDB-related neurobehavioral outcomes.

School factors.

In addition to family, teachers and the educational context contribute to broad child development and could theoretically contribute to disparities in SDB-related neurobehavioral and academic outcomes. Relevant to racial disparities, teachers are often included in research on the neurobehavioral impacts of SDB. However, the potential impact of teachers' racial biases and stereotypes on their ratings of child behavior in SDB research is unknown. Research in other areas of child development demonstrates that teachers hold pro-White/anti-Black implicit racial biases.^{92,93} Implicit bias refers to attitudes toward a person, group, or idea that are unconscious but can influence behaviors. Accordingly, racial biases influence how teachers interpret students' behaviors as well as their expectations of future student behavior.^{94,95} Biases and stereotypes may also explain racial disparities in suspensions and expulsions that occur as early as preschool and kindergarten.⁹⁶ Compared to White youth, teachers perceive Black boys as having more dangerous misbehavior, Black girls as being naturally angrier, and Black youth overall as being angry more often.^{97,98} These disparities and their consequences can lead to poor educational outcomes and juvenile justice involvement.^{99–101} Students who experience bias and discrimination additionally have worse student-teacher relationships, school engagement, and academic motivation.¹⁰² Research that considers these school factors is necessary to better understand and intervene upon the causes of racial disparities in SDB outcomes.

Healthcare setting factors.

As described above, there are racial, ethnic, and socioeconomic disparities in SDB identification and treatment.^{25,103} However, salient healthcare setting factors are largely unexplored in pediatric SDB. For example, patient and family trust in the physician and the healthcare system have been associated with disparities in use of preventive services, medication adherence, and satisfaction with care.^{104–106} Mounting research indicates that healthcare providers also have implicit racial bias that may contribute to health disparities. van Ryn has proposed a theoretical model for mechanisms through which healthcare providers and implicit bias may contribute to these disparities.¹⁰⁷ Within this model, it is hypothesized that patient race/ethnicity activates provider conscious (explicit) and unconscious (implicit) patient-related beliefs.¹⁰⁸ A recent review of 37 studies on implicit bias in healthcare revealed that most healthcare providers, similar to the general US population, have implicit racial/ethnic biases that negatively impact patient-provider communication.¹⁰⁹ It is further hypothesized that explicit and implicit provider beliefs influence symptoms interpretation;¹⁰⁷ in the context of SDB, this could lead to delayed diagnosis or referrals for care. This hypothesis is supported by research among psychiatrists demonstrating that, compared to vignettes with White patients, otherwise identical cases with Black patients were regarded as more violent and criminal.¹¹⁰

Provider beliefs about patients also influence clinical decision making, as supported by studies linking implicit bias with disparities in treatment.^{111,112} Provider patient-related beliefs can additionally influence providers' interpersonal behavior.¹⁰⁷ For example, patient race has been found to influence physician nonverbal attention, empathy, courtesy and information giving.¹¹³ Higher provider implicit bias is also associated with poorer ratings of patient-provider communication.^{114–117} Provider interpersonal behaviors can influence patient (or caregiver) attitudes and behaviors during the visit, adherence to treatment recommendations after the visit, and satisfaction with care.¹⁰⁷ Racially and ethnically minoritized patients have reported that medical staff treated them with disrespect based on race/ethnicity.¹¹⁸ Increased provider implicit bias is also linked to decreased patient confidence in treatment recommendations.¹¹⁷ It is possible that this lack of patient/family confidence in provider recommendations contributes to the documented racial disparities in OSA treatment via adenotonsillectomy.^{25,32} While this theoretical model and the associated supporting research provides a scientific premise for the ways in which healthcare providers contribute to disparities, to our knowledge no studies have examined these crucial factors in relation to pediatric SDB disparities.

Neighborhood factors.

Multiple aspects of the neighborhood context, including social (perceptions of safety) and physical characteristics (green space, walkability, air quality), have linked to child sleep outcomes, including SDB,¹¹⁹ although most pediatric SDB research has focused on neighborhood-level SES. In the CHAT study, neighborhood socioeconomic disadvantage partially accounted for OSA severity in Black children, beyond family income and education.³⁰ Residing in a disadvantaged neighborhood context may confer risk for heightened exposure to environmental toxins and allergens, which as noted above could contribute to increased SDB symptoms via upper airway inflammation.^{30,31} At the same time, toxins such as lead in poor-quality housing or secondhand smoke exposure are especially deleterious for the developing brain, resulting in significant neurobehavioral and social-emotional impairments.^{120–122} Collectively, these environmental toxins, as well as neighborhood characteristics including light, noise, and community violence,^{81,90} could account for variation in the neurobehavioral outcomes of children with SDB. Despite the growing body of research on neighborhood factors and pediatric sleep, additional work is needed to better understand the impacts of neighborhood exposures on SDB and its outcomes.

1.4 Conclusions and Future Directions

SDB is a prevalent multi-level pediatric health problem with deleterious impacts and well-documented racial, ethnic, and socioeconomic disparities in its prevalence, treatment, and outcomes. We have reviewed putative determinants of these disparities at multiple socio-ecological levels, including child and family sleep parameters, as well as racism and discrimination in schools, healthcare, and the built environment. Overall, these factors are understudied, and represent crucial directions for future SDB research. As most of the available research to date has focused on comparing Black to non-Latinx White youth, more investigations are needed that include youth of other racial and ethnic backgrounds

based on each country's socio-demographic profile. Of note, this review applies to typically developing children, as youth with neurodevelopmental disabilities have historically been excluded from large SDB trials.¹²³ This is an area that also deserves further research. Much of the extant literature on factors linked to SDB disparities is cross-sectional and, as such, there is a need for longitudinal and mechanistic studies that allow for causal inference. Qualitative research that solicits child, caregiver, and healthcare clinician perspectives may also provide a more nuanced understanding clinical care and decision-making in SDB,¹²⁴ among other potential socio-ecological determinants. Finally, research evaluating multi-level and modifiable determinants³⁶ of pediatric SDB disparities is critical for informing the development of comprehensive interventions that can promote health equity for youth with SDB and their families.

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Educational Aims.

At the end of this activity the reader will be able to:

1. Recognize the existence of health disparities in the prevalence of pediatric sleep-disordered breathing in the United States.
2. Summarize contributors to the racial, ethnic, and socioeconomic disparities affecting sleep-disordered breathing in children.
3. Distinguish that race and ethnicity are socio-political constructs and hence, disparities are due to social and environmental factors.

Future Directions:

1. Conduct longitudinal and mechanistic studies that allow for causal inference to better understand contributors to pediatric sleep-disordered breathing disparities.
2. Investigate sleep-related health disparities in youth with developmental disabilities.
3. Evaluate multi-level and modifiable determinants of pediatric sleep-disordered breathing disparities to inform interventions that mitigate these disparities.



Figure 1. Socio-ecological model showing multi-level factors contributing to sleep health disparities (adapted from Billings et al.³⁹ with permission).