

A Literature Review Applying the Social-Ecological Framework for Black Children with OSA

By Leone Farquharson, Alicia Chung, Sarah Honaker
Department of Science and Technology Studies, College of Arts and Sciences

Abstract

The purpose of this literature review is to compile an up-to-date overview of the academic literature on the parental detection of OSA in children and its subsequent diagnosis and treatment. It serves as an outlook into racial health disparities that exist in this area of research. The existing literature serves as evidence for this phenomenon, which is explored using the social-ecological model as a framework for inquiry. A literature search was performed using The National Library of Medicine and Google Scholar databases between July and August 2020 and August 2022 to assess the various factors affecting parental detection of obstructive sleep apnea in their children. Different combinations of keywords including but not limited to “health disparities,” “racial disparities,” “racial differences,” “pediatric OSA,” “pediatric obstructive sleep apnea,” “OSA treatment,” “OSA diagnosis,” “OSA detection” and “parental experiences” were used to find relevant studies and reviews. There were approximately 30,000 hits from these terms. The inclusion criteria were peer-reviewed literature published within the last 10 years, except if the paper included the etiology of the disease. Children’s access to care can act as the inclusion criteria for examining studies. Children between the age 2 and 12 years old, as well as adolescents below age 18, were considered. The main extraction of data from the primary studies were risk factors of pediatric OSA, the foundation of the socio-ecological framework, the detection process of OSA and racial differences among pediatric populations. OSA knowledge is important for detection by parents, family members, and teachers who are constantly around children. They are the main interpersonal supports that detect OSA and prevent delay in detection. The community support roles are health care providers and specialists that can monitor the progression of OSA and ensure adequate treatment. Additionally, the access of children to care can act as a barrier of OSA treatment. Black children experience pediatric OSA severity more than their white counterparts based on the factors outlined in the social-ecological framework.

Introduction

Approximately 3% of children are affected by obstructive sleep apnea (OSA) (Chang & Chae, 2010). Nevertheless, racial and ethnic minority children are affected up to six times more than white children. African-Americans, Hispanic-Americans and Native-Americans have higher prevalence of OSA than Asian-Americans and Caucasian Americans. African-Americans are 4-6 times more likely to have OSA than white children. One study shows craniofacial structure, genetics and obesity explain prevalence differences in OSA prevalence between races, contributing to African-American OSA disparities, which leads to

the worst reported treatment outcomes (Dudley & Patel, 2016). The degree of OSA severity is higher in Hispanic-Americans although data is limited. Native-Americans have moderate to severe OSA approximately 1.7 times greater than whites. Meanwhile, Asian-Americans report a lower occurrence of pediatric OSA (~18% to ~36%) than whites (Dudley & Patel, 2016). The etiology of pediatric OSA has been attributed to inflammatory factors and biomarkers, craniofacial abnormalities, genetics, allergic rhinitis, adenoid or tonsil hypertrophy and obesity. There are two types of pediatric OSA: type 1 is distinguished by marked lymphadenoid hypertrophy without obesity and type 2



is associated with airway lympho-denoid hyperplasia with obesity (Capdevila et al., 2008). Adults and children have distinct levels of physiology which includes, but is not limited to, respiratory function, sleep physiology, thoracic mechanics and upper airway development that may lead to various manifestations of OSA (Alsubie & BaHammam, 2017). It is recommended that children are screened for snoring, via a polysomnography (PSG) study or an alternative diagnostic test should be performed such as an adenotonsillectomy (T&A). The first line of treatment for adenotonsillar hypertrophy (ATH) patients is the leading cause for OSA. Otherwise, continuous positive airway pressure (CPAP) is used as the standard treatment. High-risk patients must be monitored post-operatively and weight loss should be considered with other therapy in obese children (Marcus et al., 2012). These disparities will magnify unfavorable health outcomes if left untreated. Obstructive sleep apnea is defined by repeated cessation of breaths during sleep. In 1976, the pediatric condition was distinguished from the disorder found in adults (Huang & Guilleminault). Adult and pediatric OSA differentiate in causes, risk factors, polysomnography (PSG), treatment, and co-morbidities. Therefore, they must be considered separately to prevent deleterious consequences. Consequences of untreated pediatric OSA may include sleep disruption, cardiovascular problems, endocrine issues, snoring, repetitive apneic episodes, daytime sleepiness, metabolic systems difficulties, neurobehavioral dysfunction, and hypoxemia (Spilsbury et al., 2006) (Capdevila, Kheirandish-Gozal, Dayyat, & Gozal, 2008) (Strocker & Shapiro, 2007). These comorbidities may contribute to poor academic performance. The under-detection of childhood OSA leads to under-diagnosis, developmental problems, and amplified health disparities.

Pathways and Frameworks for Pediatric OSA Health Disparities Research

The socio-ecological framework for prevention contemplates the interplay between individual, relationship, community, and societal factors that cause health risk for populations (Krug E, 2002).

These factors overlap and influence each other continuously. Health disparities are interwoven in social, environmental, behavioral, and biological influences (Roux, 2012). Roux outlines five models for exploring research methods in health disparities which include the genetic model, the fundamental cause model, the pathways model, and the interaction model, which considers the interconnected mechanisms that impact these disparities. His approaches highlight the importance of selecting a conceptual framework that leads to the necessary research questions, hypotheses and systems that tackle the OSA disparities problem. The main takeaway is that the factors previously outlined are comparable with the social intervention frameworks described in the social-ecological model of health. The social-ecological model is a six-level framework for prevention that integrates the individual, relationship, organization, community, and societal factors that lead to public health influence (Dahlberg LL, 2002). Micheals (2022) stated that these factors are broad contributors of disparities that may collectively provide insight into the status of OSA experiences among Black children. In recent research, the six levels of the social-ecological framework have been applied to sleep health in families of young children to prevent poor sleep quality. A recent review summarizes the ethnic, racial, and socioeconomic disparities related to sleep-disordered breathing (SDB) (Williamson et al., 2022). The following were the socio-ecological levels analogous to the framework explored in this review: neighborhood and broader socio-cultural factors (societal and policy), healthcare setting factors (organizational), school setting factors (community), family factors (interpersonal) and individual factors like our model. Another study explored the socio-ecological framework to understand adherence to the positive airway pressure (PAP). The socio-ecological model was helpful to understand and identify predictors of pediatric continuous positive airway pressure (CPAP) adherence and determine possible treatment for OSA (Xanthopoulos et al., 2021). The socio-ecological model is a steady model for exploring predictors, barriers, and treatment of obstructive sleep apnea in children.

The socio-ecological model organizes factors causing disparities of OSA symptoms, diagnoses, and treatment delivery. Societal and lifestyle factors have been studied in previous research. For instance, neighborhood disadvantage is a community (and environment) factor that explains racial differences that affect waking after sleep onset (WASO) and sleep efficiency (Fuller-Rowell et al., 2016). A study by Spilsbury et al. (2006) compounded primary caregiver education, household characteristics, and race amongst other components of neighborhood disadvantage, that found a significant relationship within the African-American subgroup (Spilsbury et al., 2006). Single-parent households, public insurance, and proximity to care centers were determined by sociodemographic and socioeconomic status (Xie et al., 2018). The proximity of participants to the medical center in the study determined the prevalence of OSA. Thus, the nearer families lived, the less there were occurrences of OSA in their children, illustrating the importance of access to care at the organizational level of the socio-ecological framework. The theoretical framework follows the Centers for Disease Control and Prevention Socio-Ecological Model (SEM): A Framework for Prevention (CDC, 2020). It is posited that the factors that contribute to pediatric OSA disparities can be represented at each level of the SEM framework, and that intervening upon multiple levels of this model is needed for effective OSA prevention and treatment strategies to narrow the pediatric OSA health disparities gap.

Methodology

A literature search was performed using National Library of Medicine (PubMed) and Google Scholar between July and August 2020 and updated in July 2022 to assess the various factors affecting parental detection of obstructive sleep apnea in their children. The following keywords and search terms were used during the search: “Obstructive Sleep Apnea in Children”, “Parental Experiences with Obstructive Sleep Apnea”, “Racial Differences in Obstructive Sleep Apnea”, “OSA Detection in children”, “OSA in

children and parental experiences”, “Disparities in obstructive sleep apnea”, “Parental experiences with OSA” and “Racial disparities and children with OSA”. Different combinations of these search terms generated 30,000 articles. The articles that were included were published in the last 10 years and if not, they described important etiology of OSA and improved racial/ethnic relevance with OSA. The inclusion criteria for examining studies were studies that included children between the age 2 and 12 as well as adolescents below age 18 to be considered. The main extraction of data from the primary studies were risk factors of pediatric OSA, the foundation of the socio-ecological framework, the detection process of OSA and racial differences among pediatric populations. The interventions and claims were formed based on the main findings of primary articles in Table 1 and key socio-ecological factors outlined in Table 2.

Results

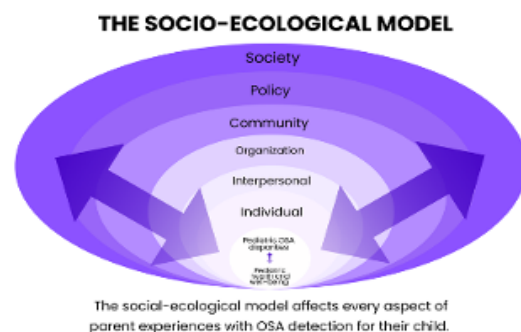


Figure 1. The Social-Ecological Framework showing overlapping levels contributing pediatric OSA health disparities. This diagram shows the social ecological model as a framework that shows the factors affecting OSA detection and treatment in Black children. Adapted from Krug E et al., World Report on Violence and Health. Geneva, Switzerland: World Health Organization; 2002:1-21

Levels of the Social Ecological Framework: Intervention

Individual Level

The individual is the primary pillar of the framework includes the biological and personal history that affects OSA detection as shown in Table 2. To improve the diagnosis of OSA,

the knowledge and awareness of parents about their child's sleep must be changed. There must be individual awareness, knowledge, or prior experience about a biological predisposition. Delayed detection may be due to the parents' lack of awareness. Snoring may be normalized and not necessarily a point of concern which may delay the detection process (Honaker et al. 2022).

Interpersonal Level

The interpersonal level includes parent experiences, social connections and healthcare provider support which is outlined in Table 2. To strengthen the child's support system, the patient-provider relationship must be built with trust. The communication threshold (low to high) determines the likelihood of OSA detection at an early age. Implicit bias often acts as a barrier for patient experience, care, and treatment especially among Black patients. A study on this topic found that implicit bias was significantly related to patient-provider treatment decisions, interactions and patient health outcomes (Hall et al., 2015). Moreover, research shows that Black patients experience discrimination and provider bias that affects treatment adherence (Williams et al., 2022). Also, parents can learn from their family members which may further increase their own knowledge and awareness.

Organizational Level

At the organizational level the child's teachers, social worker and or healthcare provider (such as a dentist) must have the ability to identify and detect

symptoms of OSA in the child. Research shows that teacher-reported child sleepiness was associated with lower adaptive behaviors, more problems in the classroom and lower academic achievement, especially in Black children (Ursache et al., 2021). Thus, their observation of children's behavior is crucial for OSA diagnosis and treatment. Moreover, Honaker et al. (2022) stated that teachers identify sleep disorders in children such as daytime sleepiness which may be an indicator of sleep problems that affect classroom achievement.

Community Level

The support of parents, health care providers, specialists and teachers are pertinent for OSA detection (Honaker et al., 2022). Table 2 shows the breakdown of parent experiences, social connections and healthcare provider support. To support the parents and their child, OSA education during pregnancy, post-partum and before enrollment in school is imperative. If the parents realize there are symptoms related to poor sleep quality, they may be better equipped to advocate for their child.

Policy Level

Those that live closer to health centers find that they have lower rates of OSA in their children (Spilsbury et al., 2006). Thus, the enactment of policy that requires sleep apnea screening at a minimum age for free or at a reduced cost for children under their parent's insurance can help mitigate the neighborhood disadvantage. Moreover, clinics in metropolitan cities may be



Figure 2: The social ecological model showing overlapping levels contributing pediatric OSA health disparities in expanded form with framework subcategories.

helpful for the attraction of parents and their children from different zip codes to seek screening.

Society Level

The societal level includes broad factors such as social and cultural norms, economic standing, technology, media, and resources available.

These factors require systemic changes by organizations such as the World Health Organization, fundraising established by non-profit organizations and governments, donations from private corporations and online or in-person education programs for communities.

Table 1: List of key studies and reviews outlining the social-ecological factors (society as the main contributor) associated with pediatric sleep apnea and their main findings

Author, Year	Sample Size	Framework Category	Main Findings and Outcomes
Xie et al, 2018	105 patients with Refractory Obstructive Sleep Apnea and 52 patients with Obstructive Sleep Apnea	Community Organizations	Despite higher rates of single parent households and public insurance, those patients that lived closest to our care center had lower rates of OSA, suggesting how access to care can affect outcomes
Kendzerska et al., 2016	659 participants	Society	A potential 27% improvement in CPAP acceptance associated with higher neighborhood income not ignorable
Marcus et al., 2012	N/A	Society Community	All children/adolescents who snore should be screened for OSA. PSG should be performed in children/adolescents with snoring and symptoms/signs of OSA; if PSG is not available, then alternative diagnostic tests/specialist referral should be considered. Objective testing should be performed in patients who are high risk or have persistent symptoms/signs of OSA after therapy. CPAP is recommended as treatment if adenotonsillectomy (T&A) is not performed or if OSA persists postoperatively. Weight loss is recommended for overweight/obese patients
Strocker et al., 2007	584 patients	Society, Community, Individual, Interpersonal	Sleep disordered breathing and OSA can affect a child's physical and mental health. Parent and child quality of life may also be affected. Poor screening of children for the more subtle signs of disordered breathing such as

			snoring, daytime sleepiness, frequent awakenings during sleep, may result in reduced evaluation and treatment to prevent poor academic performance or behavioral problems. If pediatricians are more aware of the spectrum of severity of sleep disordered breathing and its impact on quality of life, there are more likely to screen children and, when necessary, refer to sleep specialists and/or otolaryngologists for diagnosis and treatment.
Honaker et al., 2022	30 parents	Society, Community, Organizational, Interpersonal	Parental experiences with OSA were attributed to the health care system, parent willingness to report, knowledge of nighttime and daytime symptoms and overall OSA knowledge.
Goldstein et al., 2011	364 children	Society, Individual	Black race and prematurity were associated with snoring.
Stephanski et al., 2008	198 children and adolescents	Individual	African-American children with SDB has greater oxygen desaturation with obstructive dealings as compared to Caucasian and Latino children. African-American children experienced increased risk for hypoxemia and cardiovascular consequences of SDB.
Boss et al., 2011	33 children	Society	Black children (12/33) and children with poor socioeconomic status were the most studied. The children with higher prevalence and increased risk for SDB were in racial or ethnic and socioeconomic minorities. White children with private insurance were most likely to undergo an adenotonsillectomy (T&A).

Table 2: The Categories and subcategories within the social-ecological framework

Society	<ul style="list-style-type: none"> -Public health initiatives -Trustworthy media influence (or lack thereof) 	<ul style="list-style-type: none"> -Overall quality of life -Poverty -Societal conflict -Racism, oppression, xenophobia, marginalization, implicit bias, and discrimination -Stigma and bias -Socio-economic status 	<ul style="list-style-type: none"> -Environmental forces 	<ul style="list-style-type: none"> -Technology and innovation
Policy	<ul style="list-style-type: none"> -Research and reporting gaps 	<ul style="list-style-type: none"> -Federal, statutory, and local regulations 	<ul style="list-style-type: none"> -Government resource allocation in research and development 	
Community	<ul style="list-style-type: none"> -Research and reporting gaps 	<ul style="list-style-type: none"> -Federal, statutory, and local regulations 	<ul style="list-style-type: none"> Government resource allocation 	
Organization	<ul style="list-style-type: none"> -Parent or guardian education level 	<ul style="list-style-type: none"> -Social Environment 	<ul style="list-style-type: none"> -Healthcare System -Accessibility to Health Systems & Health services -Health coverage Provider linguistic and cultural competency -Quality of care and PCP accountability -Two-sided Health Communication between PCP and Patient (Patient Provider relationship) 	<ul style="list-style-type: none"> -Zip code/neighborhood
Interpersonal	<ul style="list-style-type: none"> -Parent Experiences -Psychosocial status -Stress -Work-family Conflict -Racism -Sexism -Self-care -Mental health/disorders 	<ul style="list-style-type: none"> -Social Connections -Parent-child relationship -School nurse -Counsellor -Teachers -Coaches -Peers 	<ul style="list-style-type: none"> -Healthcare provider support -Telehealth -In-person physician support -In-person nursing support 	
Individual	<ul style="list-style-type: none"> -Personal characteristics -Identity 	<ul style="list-style-type: none"> -Biology and Genetic Factors 	<ul style="list-style-type: none"> -Stress Response 	<ul style="list-style-type: none"> -Race -Sex -Body Mass Index (BMI) - Genetic Endowment

Analysis

The socio-ecological framework is the chosen model for understanding the health disparities in parental experiences with their child's OSA in this paper. There are distinguished features such as the socio-ecological model to recommend possible intervention approaches based on the disparities that exist among ethnic minorities. This review is the first to address the disproportionate detection of pediatric OSA in marginalized groups by suggesting pathways and frameworks to curtail the deficiency in research of Black children. The claims are that health disparities are exacerbated because of the factors contributed by the socio-ecological model. Several studies' findings elucidated the current factors of pediatric OSA and left space for future research studies to tackle the field of knowledge.

Heterogeneity among races: Neighborhood disadvantages and genetic predispositions of African Americans

The purpose of the review is to highlight that the current literature displays heterogeneity among races within the cases of pediatric OSA. There is a research gap that exists in pediatric OSA and even more so related to racial and ethnic differences. According to Goldstein (2011), "neighborhood of severe socioeconomic disadvantage was significantly associated with OSA after adjusting for effects of prematurity, obesity, and African American race." Based on Table 2, Goldstein made connections between individual, community and societal factors that determine OSA outcomes. Interestingly, Wang et al. (2017) focused on using neighborhood variables to explain race and OSA associations and found that neighborhood socioeconomic variables provided a better explanation for racial disparities in pediatric OSA. Thus, society and community are socio-ecological key factors that increase risk of pediatric OSA. Goldstein (2011) found that there is a high prevalence of families of patients with OSA, whom likely have multiple genetic factors that cause the OSA phenotype phenotype. This refers to the genetic importance of the individual and their outcomes with pediatric OSA.

Roux's Models vs. The Socio-Ecological Framework: Pediatric OSA Study

The current literature highlighting genetic endowment and neighborhood disadvantage nudges a focus on the interaction model (role of gene-by-environment interactions) as explained by Roux, a relevant conceptual framework for future study. Scientists have found social factors that appeal to the interaction of environment and genes, which faces challenges such as broad causal models and the complexity of phenotypic acquisition (Diez Roux, 2012). The fundamental cause model relates the social and economic as primary causes of health disparities in pediatric OSA, which is highlighted by Goldstein. The articles mentioned previously show that there is an opportunity to focus on environment and genetics, any other subcategory outlined in Table 2 can be used as variables for health disparities research to develop the current field of pediatric OSA knowledge. As such, the socio-ecological model creates a comprehensive scope for examination since it recognizes that individuals are affected by a complicated range of social factors that are embedded in environmental interactions. Roux's models offer specialization for investigators who wish to dive deeper in the subcategories displayed in Figure 2. Thus, the socio-ecological model is the preferred framework for explaining in-depth factors that affect the health and well-being of children with OSA. Pediatric OSA outcomes are heavily dependent on the interplay of society, policies, community, interpersonal relationships, and the individual patient (Honaker et al., 2022). The overarching societal level includes socio-economic and socio-demographic influences on the reality of children with sleep disorders. Research outlined in this review clearly shows that the type of insurance (public vs. private) determines the delay in treatment and controls the outcome of pediatric OSA. At the same time, community plays a crucial role in the health outcomes of pediatric OSA since children experience many forms of socialization that monitor their well-being. These may include the teacher, school nurse, pediatrician, dentist, and teacher which may increase the likelihood of detecting OSA. These

individuals all serve as checkpoints for the child; thus, their knowledge of signs and symptoms is significantly important. Additionally, the family is the core of a child's support system as it does take a village to raise a child. The roles of parents are to monitor daytime and nighttime symptoms, advocate for their children, and ensure follow-up with their appointments. All these factors are controlled by the child's racial and ethnic identity which directly affect their health trajectory.

Recommendations and Implications

The research topic has been growing over the years, but current and continued efforts are underwhelming. As such, sleep scientists, academics and physicians should daycares, clinics and schools are the research of pediatric OSA is underwhelming. This calls for adjustments of educational programs in medical schools among other post-graduate health curricula to prevent the under-diagnosis of pediatric OSA. Also, there needs to be minority specific interventions and public health campaigns targeting these high-risk families to bridge the gap in knowledge and cultural behaviors. Future research can address gaps in research considering the effect of lack of physician knowledge on existing racial disparities of pediatric OSA. Racial disparities configure different problems for individual groups of OSA patients and their parents. Risk factors such as healthcare system, physical environment, economic stability, and community create unique contributions to OSA based on heterogeneity. Future research is needed to better understand the heterogeneity that exists within races, validation of screening instruments in non-white groups, a better understanding of potential differences in susceptibility to cardiovascular consequences of OSA, and the development of strategies to reduce the barriers to diagnosis and optimal treatment in minorities. Moreover, disadvantaged neighborhoods must focus on organizational and community health education and promotion. Thereafter, adequate interventions can be outlined based on unequal burden of OSA among races.

Conclusion

In sum, there are different experiences for children with obstructive sleep apnea. These differences are based on the individual awareness of parents due to lack of experience and knowledge. The family and patient-provider relationships can prevent delayed detection. Implicit bias can create distrust with parents that may reduce appointment attendance, follow-up, and overall treatment. The healthcare providers control the outcome of pediatric OSA by effectively treating children as required. The access to healthcare acts as an upstream factor that interferes with the first line of treatment which is a PSG. Overall, health disparities clearly exist in pediatric OSA, and the levels of the socio-ecological model can help elucidate these issues, especially among Black children.

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Abbreviations

OSA	Obstructive Sleep Apnea
CPAP	Continuous Positive Airway Pressure
PAP	Positive Airway Pressure
SDB	Sleep Disordered Breathing
ATH	Adenotonsillar Hypertrophy
T&A	Adenotonsillectomy
SEM	Socio-Ecological Model