SLEEP, 2022, 1–4

https://doi.org/10.1093/sleep/zsac145
Advance Access Publication Date: 23 June 2022
Editorial

EDITORIAL

# Investigate the complexities of environmental determinants of sleep health disparities

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The "neighborhood environment and health" literature is burgeoning and has demonstrated that features of the neighborhood social environment, such as lower neighborhood social cohesion, are associated with higher psychological distress [1] including depression [2], and that psychological distress has been connected to compromised sleep health [3]. Further, the neighborhood social environment, psychological distress, and sleep health all vary by race/ethnicity [4–7]. For instance, we previously reported—using nationally representative data from the National Health Interview Survey—low versus high neighborhood social cohesion was associated with a higher prevalence of shorter sleep duration and more sleep disturbances, which varied by race/ethnicity [8]. In a separate study, poor sleep health was associated with higher psychological distress, as measured by the Kessler-6 scale, and the magnitude of the association was generally stronger among minoritized racial/ethnic groups [9]. These studies—like most—have relied on self-reported, cross-sectional data.

Therefore, Kim et al. [10] is a welcomed contribution to the extant literature as this study investigated longitudinal associations between objectively and subjectively measured neighborhood social characteristics and multiple objectively measured sleep dimensions among a sample of predominantly black, low-income adults. After adjusting for sociodemographic characteristics and length of residency, their study found neighborhood crime was associated with insufficient sleep, more frequent wake after sleep onset (WASO), and lower sleep efficiency. Neighborhood social cohesion was associated with lower risk of insufficient sleep, and neighborhood disorder was associated with lower sleep efficiency [10]. As a particularly important contribution, the authors also found that psychological distress—measured by the Kessler-6 scale [11]—mediated associations between both neighborhood crime and neighborhood social cohesion in relation to insufficient sleep, WASO, and sleep efficiency [10]. These findings add to the literature by identifying modifiable aspects of the neighborhood social environment that may inform multilevel, multimodal interventions [12] and thus may help prevent the manifestation of poor sleep health.

The objective of this editorial is to offer recommendations to expand upon the findings of Kim et al. [10] and further advance sleep health disparities research. Ultimately, we recommend (1) embracing the complexity of the real world by studying the interplay between the neighborhood social and physical environments over the life course, (2) incorporating measures that apprize public health impact, and (3) prioritizing research that employs pragmatic interventions designed to address identified drivers of sleep disparities.

As the authors noted [10], it is important to measure the complex, realistic, and robust interplay between the neighborhood social and physical environments since they are inextricably linked. In fact, the environmental health community along with institutions such as the Environmental Protection Agency have called for researchers to engage in efforts that combine both social and physical stressors [13]. To demonstrate how the neighborhood physical environment may impact the social, we provide three illustrative examples. First, artificial light at night, such as Light Emitting Diode bulbs, may negatively impact both sleep and mental health [14–16]. For instance, a review found that artificial light can suppress melatonin secretion, increase sleep onset latency, and increase alertness [17], and a separate

study reported that exposure to light at night was associated with higher depressive symptoms [18]. Racial disparities in sleep health may be affected by greater light exposure since exposure to artificial light at night varies across residential characteristics (e.g., urbanicity) and is generally placed near, for instance, industrial complexes where minoritized racial/ethnic groups are more likely to reside due to racial residential segregation [19, 20]. The negative impacts of adverse physical and social neighborhood environments combined likely synergize to produce an even larger negative impact on both poor sleep and mental health than each type of environmental adversity alone. Two additional physical environmental exposures more prevalent in minoritized and/or low-income neighborhoods are air pollution and lack of greenspace, which also have been found to impact both sleep [21, 22] and mental health [23, 24].

Given that sleep disparities emerge in infancy, continue throughout the life course, and are influenced by features of the physical (e.g., light) and social (e.g., parental establishment of bedtime routines, safety) environment [24–29], it is important to take a more comprehensive life course, exposomic approach when conducting research related to sleep health disparities [30]. Incorporating a life course perspective may address limitations described in Kim et al.'s [10] study, which, although longitudinal, relied on a small window of exposure relative to participants' life course. There are sensitive and critical periods throughout the life course, and an accumulation of living in adverse physical and social conditions likely contribute to disparities in incidence as well as severity of sleep-related outcomes. Consequently, life course approaches concerned with disparities should consider sensitive periods within the context of structural racism because discriminatory policies and practices create and influence exposures across the life course, including the conditions of the physical and social neighborhood environment [31]. For example, Kim et al.'s study was conducted among a lower income predominantly black sample of participants who are more likely to be affected by racial residential segregation. This form of exclusion, maintained for generations, limit opportunities including in labor market earnings and, thus, perpetuate existing low-income status in neighborhoods [32], which can impact sleep.

Our second recommendation for future research is to routinely incorporate measures that provide information regarding public health impact, such as the population attributable risk (PAR). The PAR indicates the potential impact of removing a particular adverse exposure while considering its prevalence in a community of interest [33]. In addition to the PAR, it is important to incorporate descriptive measures that assess differences in the exposure and outcome burdens between groups in addition to the assessment of potential differences in the relationship between the exposure and outcome between groups [34]. As a result, researchers do not solely rely on utilizing interaction terms between an exposure and a potential modifier (e.g., race/ethnicity) in often underpowered statistical models and rather use other salient information regarding health disparities that can better inform resource allocation and translate to policy decisions [34].

Our third recommendation is to conduct pragmatic, upstream interventions [35]. Since there is a wealth of evidence documenting disparities and we are in the intervention era [36], it is essential to assess if modifying the neighborhood environment by addressing adverse physical and social exposures may improve sleep health. Given the aforementioned artificial light example related to melatonin suppression, we can intervene by optimizing lighting based on recent recommendations from expert consensus and thus avoid unnecessary exposure to light at night during sleep [37]. As mentioned by Kim et al. [10], reducing crime may be accomplished through social cohesion and other positive interventions versus increased policing or adding intense lights intended as a safety measure since they both may negatively impact sleep and mental health [38–40]. Further, individual-level light recommendations, such as light therapy, may also improve mental health, including alleviating depressive symptoms [41, 42]. Other interventions in the physical environment that could improve sleep include air pollution mitigation strategies. As an environmental justice example, airborne environmental pollutants from swine industrial livestock may impact sleep [22], and an intervention can include greater community control over local industrial development and changes to improve the neighborhood environment similar to home owners associations in more affluent neighborhoods. Relatedly, implementation of the World Health Organization guidelines [43] may prevent deaths directly related to $PM_{2.5}$. Similarly, the American Heart Association (AHA) advocates for policies designed to mitigate the known adverse health impacts of air pollutants by, for instance, reducing vehicle emissions, which are relevant to sleep health and may further reduce racial/ethnic disparities in sleep health [44]. The AHA also promotes individual-level interventions aimed at improving overall health but relevant to sleep [45]. These suggested interventions are cost efficient, easy to implement, and have widespread benefits including reducing racial/ethnic disparities and addressing environmental justice [46]. Moreover, a third and final example of intervention opportunities that builds on the strengths of Kim et al.'s [10] paper underscores the importance of how modifiable environments can impact mental health and subsequently sleep [47], includes utilizing greenspaces to improve mental health [48, 49]. Restoring vacant parking lots in urban neighborhoods, for instance, has been associated with reduced perceptions of crime and less gun use [50]. Improving neighborhood safety is beyond the removal of threat but also the creation of a safe and positive environment, such as building parks with ample green space [51]. Creating safe environments may also result in a variety of benefits including the removal of barriers (e.g., feeling unsafe) that could prevent individual- and family-level adoption of good sleep hygiene practices such as adhering to the American Academy of Pediatrics recommendations for safe sleep environments for infants (e.g., no bed sharing) [52]. For these reasons, we recommend that future research leverage innovative tools or approaches (e.g., geospatial science, wearables, environmental sensors, complex mixtures statistics, surveys) from the exposome [53, 54], for example, that allow investigators to better understand the complex nature of existence, which will inform effective, even more readily translational solutions.

Leveraging Kim et al.'s [10] contribution to the sleep health field along with our recommendations of (1) studying the interplay between the neighborhood social and physical environments, (2) including measures that underscore public health impact, and (3) modifying the neighborhood environment toward a culture of health and wellbeing may further advance our understanding and capacity to address sleep health disparities. By implementing these efforts, we can move closer toward sleep health equity.

## Funding

This work was funded by the Intramural Program at the NIH, National Institute of Environmental Health Sciences (Z1AES103325).

## Disclosure Statement

None declared.

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