



Sleep health inequities in vulnerable populations: Beyond sleep deserts

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ARTICLE INFO

Keywords:

Sleep inequity
Sleep disturbances
Prisoners/inmates
Refugees
Homelessness

ABSTRACT

Despite the importance of sleep to overall health and well-being, there is a high prevalence of undiagnosed sleep disorders and adverse sleep health, particularly among vulnerable populations. Such vulnerable populations include people experiencing homelessness (PEH), refugees, and incarcerated individuals. In this narrative review, we provide an overview of the literature on sleep health and disorders among key and vulnerable populations (e.g., PEH, refugees, and incarcerated individuals). The limited research among these populations indicated a high prevalence of sleep disorders, mainly insomnia, short sleep duration, and fatigue. Substance abuse and PTSD were commonly found among PEH and refugee populations, respectively, which were related to poor sleep. Similar across the included vulnerable populations, the individuals reside in environments/facilities with inopportune light exposure, noise disruption, inadequate bedding, and forced sleep schedules. Studies also found a high prevalence of psychosocial stress and reports of threats to safety, which were associated with poor sleep health outcomes. Additionally, several studies reported environmental barriers to adherence to sleep disorder treatment. This paper highlighted the conditions in which these vulnerable populations reside, which may inform interventions within these various facilities (homeless shelters, refugee camps, prisons/jails). The improvement of these facilities with a sleep equity focus may in turn improve quality of life and daily functioning.

Funding

This work was in part funded by NHLBI R01HL157954.

1. Introduction

Sleep health is a public health priority. Mental and physical health, productivity, safety, and quality of life are related to sleep across the lifespan [1,2]. Despite the importance of sleep to overall health and well-being, there is a high prevalence of undiagnosed sleep disorders and adverse sleep health including short sleep duration, poor sleep quality, sleepiness, and irregular sleep [3–5]. Further, adverse sleep health is disproportionately prevalent among vulnerable populations, thus creating sleep inequities. To-date, most of the literature around sleep inequities has focused on racially minoritized groups and individuals of lower socioeconomic status (SES). Data support that these historically marginalized groups have worse sleep health and more

severe sleep disorders in comparison to their non-Hispanic White counterparts [6]. Determinants of sleep inequities include social and contextual factors. For example, individuals of lower SES are more likely to live in sleep deserts, defined as areas not conducive to healthy sleep [7], and encounter challenges such as transportation, access to care, and social stressors that operate as barriers for healthy sleep. Therefore, contextual factors are important determinants of sleep health, and are encountered by vulnerable populations that are typically understudied in the context of sleep inequities.

Environmental determinants of sleep have mainly focused on neighborhood environments, and to a lesser extent household environment [8,9]. In achieving sleep equity, it is important to consider groups of individuals from specific environments that have exposures that may hinder healthy sleep. Such vulnerable populations include people experiencing homelessness (PEH), refugees, and incarcerated individuals. These populations are particularly vulnerable to poor sleep health due to their environments, such as refugee camps, homeless

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<https://doi.org/10.1016/j.sleepx.2024.100110>

Received 24 December 2023; Received in revised form 21 March 2024; Accepted 29 March 2024

Available online 30 March 2024

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shelters, and prisons/jails. Individuals in these environments face threats to their safety, are economically disadvantaged, and sleep in environments that are conducive to poor sleep. These environments/facilities often expose individuals to sleep disruptions via inopportune light exposure, which can alter sleep and circadian health, and/or necessary monitoring of inmate counts during sleep hours. Further, PEH, refugees, and incarcerated individuals tend to lack beds or have thin mattresses and are exposed to sleep hindering environmental characteristics that they are unable to control (e.g., temperature, lighting), which is associated with adverse sleep health [10]. Psychosocial stress is also common in these populations, and can disrupt sleep. Thus, individuals in these facilities are vulnerable populations at increased risk for adverse sleep health.

Vulnerable populations are at increased risk for adverse sleep health and insomnia due to socioeconomic disadvantages, stress, and other related social determinants. They are often subject to sleeping in environments that are unsafe. Safety has been shown to be a key determinant for healthy sleep [11]. The psychosocial stressors experienced by vulnerable populations are associated with insomnia symptoms, short sleep duration, and poor sleep quality [12]. Included among the vulnerable populations is PEH, and despite the difficulty of conducting research in this population given the transient nature, emerging data discussed below supports that sleep disturbances are a major health obstacle in this population. Refugees are also understudied in the sleep literature. Individuals who, by force, have fled their country because of persecution or violence are considered refugees. Data suggests that experiences of trauma among refugees are related to adverse sleep health [13]. This population faces many barriers that are similar to those that are historically marginalized including lack of access to health care specialists, language barriers, and racial bias [14]. Further, similar to PEH and refugees, incarcerated individuals lack control over their sleep environment, which is often subject to inopportune light exposure and adverse temperatures, which are associated with poor sleep health [15, 16]. To eliminate health inequities, it is critical to understand the sleep of PEH, refugees, and incarcerated individuals.

In this narrative review, we provide an overview of the literature on sleep health and disorders among key and vulnerable populations (e.g., PEH, refugees, and incarcerated individuals). Understanding the sleep patterns of these populations has several public health implications that can potentially enhance their quality of life and reduce sleep-related burden.

2. People experiencing homelessness

PEH is a term used to describe individuals who lack stable housing. This population includes people living on the streets and those who move between homeless shelters and other forms of temporary accommodations. Although the rates of homelessness differ by country, the above definition of PEH holds true across the world. In 2022, 18 out of 10,000 Americans were homeless [17]. PEH undergo significant sleeping difficulties in terms of quality and/or quantity of sleep due to economic challenges, lack of access to care, poor health literacy, and poorly-controlled chronic illnesses, among a wide range of significant health-related obstacles. Thus, PEH should be considered a population vulnerable to sleep health inequities. Yet, inadequate sleep remains a major contributor to physical and mental health problems in this population [18,19].

Recent studies show associations between homelessness and poor sleep, which can present as sleep fragmentation, insomnia, sleep restriction, and reduced rapid-eye-movement (REM) sleep [20]. In a mixed-methods survey of 32 adults, PEH reported sleeping less than seven to 9 h each night, negatively affecting daily activities and functioning [21]. In a group of 244 PEH, a greater number of days of inadequate sleep per month, more days of unintentionally falling asleep per week, and obtaining an average of 6 or less hours of sleep per night were independently associated with depression and poor overall health [22].

Further, a study conducted in France compared sleep outcomes of 3453 PEH who completed a nationwide health survey to a sample of controls who were age-, sex-, and location-matched from a separate national survey conducted a few years prior. The authors of the prior study reported PEH compared to controls had a higher prevalence of insomnia (41% vs. 19%), higher levels of fatigue (33% vs. 15%), shorter sleep duration (6 h 31 min vs. 7 h 9 min), and severely curtailed sleep of <4 h a night (8% vs. 3%), respectively [23]. These studies are examples of the higher burden of poor sleep among PEH compared to the general population.

While the study of determinants of poor sleep among PEH is limited, it is important to consider the role of substance use. In a sample of 32 American PEH, the use of substances such as prescription drugs, over-the-counter drugs, and alcohol as sleep aids was prevalent (39%), and inability to access those drugs or substances constituted a barrier to falling asleep for dependent individuals [21]. However, data suggests that the use of sleep aids is not associated with improved sleep quality, and can lead to further disruptions in sleep [21]. Thus, it is important to further explore the contribution of substance use to sleep problems in this population.

There are many environmental barriers to sleep among PEH, such as feeling the need to remain alert to protect oneself from others while sleeping [21,24]. Additionally, the environment may hinder treatment of sleep disorders in PEH [24]. For example, limited electrical outlets, storage, and cleaning can make it difficult to properly use PAP machines. Further, the city and shelter policies that require PEH to vacate certain areas or shelters during certain times, consequently, prohibit the storage of personal property, which can present challenges to maintaining PAP machines, and therefore untreated sleep disorders and disrupted sleep [24].

Sleep patterns differ between sheltered and unsheltered PEH by way of environmental factors. For instance, noise levels of others and disruptive shelter schedules are a barrier to sleep for PEH living in a homeless shelter [21,24]. Despite unsheltered sleep being affected by outdoor noises and weather challenges, some unsheltered outdoor locations may be preferable over sheltered areas due to decreased noise and more privacy [21]. Therefore, shelters may not prevent noise-related sleep barriers, due to overcrowding. Both sheltered and unsheltered PEH are prone to sleeping difficulties that must be addressed, which may be through enhancing safety. Of note, the perceived safety of one's sleeping environment may be a more important predictor of sleep quality than the availability of shelter [25].

Lifestyle factors like physical activity may affect sleep patterns. Physical activity is linked with improving both the quality and quantity of sleep. A cross-sectional study that explored associations between physical activity and subjective sleep problems in 747 PEH found that the risk of insufficient sleep was significantly lower for participants not meeting physical activity guidelines [26], contradictory to the hypothesis that physical activity enhances sleep. This could be due to physical activity not conferring the same benefits on sleep among high stress groups (like PEH) relative to populations with lower stress.

Distress intolerance is defined as the inability to withstand distress related to affective, cognitive, and/or physical states [18]. PEH are particularly susceptible to distress intolerance as a result of the challenges that come with experiencing homelessness. The relationship between distress intolerance and sleep in this population is bi-directional. Distress intolerance can exacerbate sleeping problems, and sleeping difficulties may contribute to distress intolerance by reducing stress-management capabilities. In a cross-sectional sample that included 513 PEH [18], distress intolerance was found to partially mediate the associations between inadequate sleep and unintentional sleep with urban stress and poor physical and mental health, although sleep duration was unrelated to distress intolerance.

Emotion and thought also impact sleep in PEH; negative feelings may hinder sleeping abilities while thoughts related to spirituality, hope, and faith may improve sleep [21,27]. In fact, studies show that forgiveness –

a component of religious involvement – is associated with improved sleep quality by decreasing the levels of anger and regret [27]. A significant problem for unhoused women is adverse childhood experiences, which include various forms of abuse. Having experienced abuse is associated with poorer future health outcomes, one of which is sleep. A cross-sectional study on 13 females (all victims of abuse) living in a faith-based homeless mission [27] showed that lower forgiveness and religion/spirituality scores were both significantly correlated with poorer sleep. In addition to abuse, violence may also drive poorer sleep outcomes, as shown in a study on PEH in which witnessing violence was associated with insufficient sleep [28].

Permanent supportive housing (PSH) is considered a permanent solution to homelessness. Contrary to expectations, however, the sleep disturbances suffered by PEH do not end with the attainment of PSH and the end of homelessness [24,29]. For example, in a study of 237 formerly homeless adults, 28% had moderate or severe sleep disturbance measured by the PROMIS scale [29]. Moreover, mental health problems can remain unresolved even after obtaining PSH, which can further exacerbate sleep problems [24]. These findings support the importance of screening for sleep disorders not only in PEH but also those in PSH programs and to provide them with supportive services. A 2012 study assessed a multidisciplinary approach to improving health in PEH and those recently domiciled [30]. Although the study did not specifically address sleep health inequities, the 10-step approach discussed could result in better sleep quality in PEH [30]. The approach included assessing and addressing health hazards in the community, informing, educating, and empowering people to make their own health decisions, and linking them to the necessary health care services and assuring the availability of these services [30].

3. Refugees

In the third decade of the 21st century more people were displaced from their home due to either war or persecution than any other time in modern history. Between 1991 and 2021, according to the United Nations High Commissioner for Refugees 89.3 million people were forcibly displaced [31]. Sleep disorders affect a high number of refugees. In a neurological clinic that specifically services US resettled refugees, sleep disorders were the second most common diagnosis after headaches, affecting 11.2 % of the patient population [31].

A systematic review on sleep health among refugees showed that chronic insomnia is highly prevalent, ranging from 32.6% to 73.3% depending on the definition of insomnia and the screening tools utilized [32]. The prior study reported that chronic insomnia was associated with fibromyalgia (FM), anxiety, and depression among other psychiatric conditions [32]. Furthermore, in a group of 384 Syrian refugees living in Jordan, FM was diagnosed in 115 (30%) [33]. Using validated Arabic translations of the Fibromyalgia Impact Questionnaire (FIQ) and the Insomnia Severity Index (ISI) the investigators found a significant correlation between the severity of FM and the severity of insomnia [33]. The same group surveyed 288 Syrian and Iraqi refugees with FM with the ISI, the validated Arabic translation of the Hamilton Anxiety Rating Scale, and a validated Arabic language Post-Traumatic Stress Disorder (PTSD) scale. They demonstrated a significant correlation between the severity of FM and that of anxiety and PTSD [34]. Anxiety is associated particularly with longer sleep onset latency [35]. In a group of 40 adolescent refugees, from 10 countries living in Germany, investigators, using in person interviews, standardized questionnaires, and a smartphone-assisted assessment, discovered a significant correlation between PTSD, anxiety, and prolonged sleep onset latencies and shorter sleep duration [36]. Depression was not associated with sleep disturbances in this cohort [36]. Basishviili et al., however, in a group of 87 Akhazian refugees, discovered a significant association between depression, insomnia, and war-related perceived stress [37]. The investigators used the Beck Depression Inventory (BDI), the ISI and the Perceived Stress Scale (PSS) [37].

PTSD remains the most associated disorder with disturbed sleep in refugees. Its severity correlates with shorter sleep duration as mentioned above [36]. Using structured interviews in a cohort of 311 refugee children from the Middle East, PTSD nightmares were shown to impact sleep in a bidirectional manner; poor sleep increases the risk of nightmares and nightmares increase the risk of poor sleep [38]. In a 2023 Danish study, 20 refugees with PTSD were matched with 20 healthy controls [39]. The refugees showed a significantly greater reduction in sleep quality, efficiency and duration both subjectively and by polysomnography [39]. In a small sample of 53 Syrian refugees, PTSD was positively associated with overall poor sleep quality ($r = 0.42$, $p < 0.01$) and current living difficulties ($r = 0.37$, $p < 0.05$) [40].

A few studies among refugee populations from Syria and North Korea have demonstrated that as PTSD is treated and improves, there is also an improvement in sleep [41–43]. Apart from this, however, most insomnia treatment modalities tried among refugees have shown modest, if any, improvement [32]. These include the pharmacological agents of valerian-hops [44], chlorpheniramine (an over-the-counter sleep aid) [44], and minaserin [45]. One hundred and ninety-one Syrian and Iraqi refugees with insomnia were randomized to either placebo, valerian-hops or chlorpheniramine [44]. The chlorpheniramine group fell asleep significantly faster than the other two but there was no difference in total sleep duration among the three groups [44]. In a 2021 Danish study, 219 adult refugees with insomnia and PTSD were randomized to treatment as usual, or image rehearsal therapy (IRT), or minaserin, a sedating antidepressant [45]. There was no difference in subjective sleep quality among the three groups at the conclusion of the study [45]. IRT was also studied in 42 refugees with PTSD and disturbed sleep with no significant improvement in sleep [46]. Other non-pharmacological methods that have been studied include music therapy [47] and narrative exposure therapy [48]. The former showed a modest yet significant improvement in subjective sleep quality among 15 refugees with PTSD and insomnia [47], while the latter produced more robust improvement in insomnia, depression and PTSD symptoms compared to treatment as usual among 20 N. Korean refugees [48].

A proposed multistep treatment plan includes identifying the primary health care providers (PHCP) of a specific refugee population and barriers that prevent PHCPs from screening for and addressing sleep problems, addressing said barriers with easy-to-use tools and personnel help when needed, and periodically reassessing the impact of the intervention as well as issues and inefficiencies in its implementation [32]. One of the limitations of this approach, is that it requires the availability of PHCPs, which is likely a barrier in a large proportion of refugee populations.

4. Incarcerated individuals

Incarcerated individuals are vulnerable to poor sleep health and sleep disorders. About 10 million people are incarcerated worldwide [49]. Often, in high security prisons, lights are on 24/7 [15,16] to prevent violence. At others, ambient temperatures are not regulated and noise levels are high [16]. Inadequate bedding and forced schedules also contribute to poor sleep [15]. Yet, there is very little research on sleep in prisons. Our literature search identified 26 papers specifically studying sleep disorders among prisoners. In the largest trial to date, conducted in Taiwan from 2017 to 2018, insomnia, using the ISI, was estimated to be 26.9% among 1490 male inmates [49]. Independent predictors of insomnia were low self-rated health, lack of religious beliefs, and higher number of chronic illnesses including depression and anxiety [49]. Similarly poor sleep quality as measured by a Pittsburgh Sleep Quality Index (PSQI) > 5 affected 239 (77.1%) out of 310 male prisoners in Ethiopia. Independent determinants were unmarried status, previous incarceration, living in urban areas and history of alcohol use [50].

Subjectively assessed poor sleep quality and insomnia are not the only abnormalities that occur with higher frequency among incarcerated individuals. An Italian actigraphic study from 2023 showed shorter

total sleep time (TST) and longer sleep latency (SL) among incarcerated individuals compared to age- and sex-matched community dwelling male volunteers who served as controls [15]. In addition, the risk of obstructive sleep apnea (OSA) is higher among incarcerated women who complain of poor sleep (higher PSQI scores) compared to those who do not have higher PSQI scores [51]. The prior data was from a study conducted at a maximum security prison in the USA [51]. Using a subjective 13-item self-report Multivariable Apnea Prediction Score, 10% of incarcerated women were at high risk for OSA and 72% had poor sleep as measured by the PSQI [51]. Nightmares, ruminating thoughts, chronic medical problems, and environmental disturbances were predictors of poor sleep among incarcerated individuals [51].

Several studies have shown that among incarcerated individuals, poor sleep quality, as measured by PSQI, as well as insomnia ISI are associated with higher scores on validated depression and anxiety scales after adjusting for confounders [15,52]. Among 237 English incarcerated individuals across three institutions, the prevalence of probable insomnia disorder by DSMV guidelines was 61.6% and subjective poor sleep quality was 88.2% [16]. Incarcerated women were more likely to have probable insomnia than incarcerated men (70.6% vs 52.5%) [16]. Insomnia was associated with a history of poor physical health (OR = 3.62, 95% CI, 1.31–9.98), suicidal thoughts (OR = 2.79, 95% CI, 1.01–7.66), depression (OR = 2.06, 95% CI 1.31–3.24), and disruptive prison environment (e.g., noise, light or temperature) (OR = 1.07, 95% CI, 1.02–1.12) [16]. An Indian study also demonstrated a significant association between poor sleep and suicidality and depression among incarcerated individuals, with women affected more than men [53]. In addition, having smoked tobacco or cannabinoid substances, and having committed violent crimes put incarcerated individuals at higher odds of poor sleep quality [cigarette use (OAR = 2.16, 95% CI 1.21,5.58), marijuana and hashish use (OAR = 5.02, 95% CI 1.63,15.46), violent crime (OAR = 4.12, CI 1.29,10.63), rape (OAR = 5.57, CI (1.45, 13.89)] [54]. Lastly, PTSD and older age were also associated with short sleep [55]. The adjusted OR of insomnia in older age (≥ 50 years) was 1.54 CI (1.01, 2.35) and 2.38 CI (1.47, 3.85) with PTSD [55]. Poor mental and physical health are not the only concerning complications of poor sleep in prisons. Perception of poor sleep was associated with higher risk of having perpetrated aggression the prior week [56]. Thus, sleep problems affect health and behaviors among incarcerated individuals.

There is research examining the intersection of PEH and incarceration on sleep. Interestingly, having been homeless prior to being incarcerated was associated with better sleep quality than having had stable housing [57]. Among those who had permanent housing before imprisonment 42.6% reported poor sleep or very poor sleep quality compared to only 17.7% of individuals who had unstable or no housing prior to prison [57].

In terms of interventions, a British study demonstrated positive results in improving insomnia following a mixed model approach [58]. This included screening for insomnia at the initial health assessment, specific arrangements more conducive to sleep for the first night in prison for those with insomnia, and multimodal therapies [58]. The multimodal therapies comprised sleep hygiene advice, non-pharmacological treatments, referrals to sleep specialists and availability of sedative hypnotics [58]. The limitation of this study was that the outcomes were subjective and based on semi-structured interviews and not standardized scales or objective testing [58].

5. Discussion and conclusion

This brief commentary discussed several populations (PEH, refugees, incarcerated individuals) vulnerable to poor sleep health. These groups were highlighted due to their context and unique characteristics that can lead to impaired sleep health, including short sleep duration, increased symptoms of insomnia, other sleep disturbances or circadian disruption. All of these dimensions of sleep health have been linked to other indicators of health and well-being, including cardiovascular and

metabolic diseases [59,60], cognitive function [61], and mental health [62]. Thus, understanding and improving sleep health equity may improve broader health equity. Health inequities and specifically sleep health inequities are the result of social determinants of health, thus addressing these various determinants such as lack of safety, food insecurity, and limited access to care are major priorities among these vulnerable populations, which will likely improve sleep health. This paper highlights the conditions in which these vulnerable populations reside, which may inform interventions within these various facilities (homeless shelters, refugee camps, prisons/jails). The improvement of these facilities with a sleep equity focus may in turn improve quality of life and daily functioning. While the focus of this paper was on PEH, refugees, and incarcerated individuals, this list is by no means exhaustive and there are other groups who are at increased risk of poor sleep health who should also be identified.

Several characteristics of these vulnerable populations were identified and included increased levels of stress, due to, for example, displacement and incarceration, which may impair sleep [63,64]. Another important dimension of sleep health discussed above was circadian disruption due to irregular sleep schedules, as often experienced by individuals in an unstable living situation. Environmental factors such as light at night, excessive noise and poor temperatures can also impair sleep and may be experienced by vulnerable populations with little control over their environment (e.g. refugees, incarcerated individuals). Further, research is limited among these population, thus additional research is needed to understand the specific determinants and consequences.

To enhance the research among vulnerable populations, it is imperative to address some of the limitations of these studies. There may also be residual confounding, thus the associations should be interpreted with caution. Most of the included studies relied on self-reported sleep, which is vulnerable to self-report bias [65]. Additionally, it is probable that individuals experiencing distress may overreport sleep problems. Thus, objective measures of sleep and the environment (e.g., temperature, light) are needed to understand the factors affecting sleep in these populations. Further, most of the studies reviewed were cross-sectional, which limits the ability to infer causation. It is also important to note that associations between sleep and mental health were bidirectional (e.g., sleep and depression), and without a longitudinal design the temporality is unclear. Thus, it is important to conduct longitudinal studies, to better understand the dynamic relationship of the determinants of sleep and circadian disruption in these vulnerable populations, which will help identify intervention targets.

The motivation for this manuscript was to both describe populations vulnerable to impaired sleep and to identify the determinants within each population that could impair sleep health. The populations included are often ignored and face stigma surrounding their circumstances. However, all individuals are worthy of adequate sleep. The identification of determinants of poor sleep in these populations is the first step towards developing strategies to improve the sleep health among these groups. For example, methods to mitigate the effects of stress (or ideally reduce or eliminate the stressors themselves), could help improve sleep. As a second example, methods to improve environmental factors to the extent possible (e.g. reduce light or noise at night) could also improve sleep. Of course, this brief commentary belies the complexity of improving sleep health in these diverse, vulnerable populations. While vulnerable populations experience unique combinations of factors that can impair sleep, it is evident that there are some shared determinants that can be targeted to improve sleep, and reduce inequities.

CRediT authorship contribution statement

Zeina Al-Khalil: Writing – original draft. **Hrayr Attarian:** Writing – review & editing, Supervision, Conceptualization. **Galit Levi Dunietz:** Writing – original draft, Conceptualization. **Ronald Gavidia Romero:**

Writing – original draft. **Kristen Knutson**: Writing – review & editing, Supervision. **Dayna A. Johnson**: Writing – review & editing, Validation.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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