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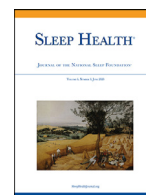
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Contents lists available at ScienceDirect

# Sleep Health

Journal of the National Sleep Foundation

journal homepage: [sleephealthjournal.org](http://sleephealthjournal.org)

## Editorial

# Bidirectional relationships between sleep and work



For most people, work is inextricably linked with home life and the amount, timing, and quality of sleep. While the recent novel coronavirus pandemic changed work practices for billions of people, this global change had already started with more and more people working at home, sometimes morning, evening, and night, under increasingly uncertain employment conditions. In addition, our work, home life, and sleep can compete for time, particularly in the face of second and third jobs, flexible schedules, night shift work, unstable work practices, and the emergence of the gig economy. The inevitable compromises, when not well-managed, can result in suboptimal sleep, suboptimal work, and suboptimal home life. Even if time for work, sleep, and leisure can be effectively separated, they still all affect each other. For instance, stress at work can affect subsequent sleep, and the quality and amount of sleep, in turn, can affect subsequent work performance. In this special issue of *Sleep Health*, there are 20 original research articles from 7 countries that describe the enormity of the issues related to sleep health across work settings, populations, and specific conditions; their impact on workplace productivity and worker health; and interventions to help workers, managers, and workplaces address their priorities and manage these competing demands. By recognizing and publicizing the importance of these interactions, we hope to stimulate researchers to develop and evaluate solutions to the global concern of poor sleep degrading work and quality of life and work degrading health, including sleep health.

Varied facets of sleep health are associated with work characteristics, although specific challenges differ among workers from different industries, contexts, and countries, as addressed in the papers in this special issue on sleep & work, work & sleep. For example, Salas-Nicás et al.<sup>1</sup> conducted a survey of Spanish salaried workers and identified associations between job insecurity (salary decrease or recent restructuring at work) and sleep problems. Furthermore, recent or current household economic hardship was a primary factor associated with sleep problems. This is an ominous finding, given the ongoing severe impact of the COVID-19 pandemic on job stability for a much larger proportion of workers. Shimura et al.<sup>18</sup> examined a wide range of lifestyle and sleep hygiene-related factors associated with sleep disturbances in a large sample of employees from 29 companies in Japan. Long commute times, regular nightcaps, irregular meal times, inadequate morning light, and excessive evening light from devices were among the potentially modifiable factors strongly related to sleep disturbances. In a study of oil rig workers using actigraphy, Dr. Zahabi and colleagues<sup>3</sup> identified multiple elements of sleep deficiency and sleep disorders. Using data from the longitudinal Health and Retirement Study, Dr. Cho et al.<sup>19</sup> identified bidirectional, longitudinal relationships between perceptions of effort-reward imbalance, a

work-related psychosocial stressor, and sleep problems over a 4-year follow-up period. Persistent effort-reward imbalance predicted greater odds of future sleep problems, whereas sleep problems at baseline predicted greater odds of future effort-reward imbalance. In a large cross-sectional study of Hispanic/Latino adults Tom et al.<sup>4</sup> found, in adjusted models, that short sleep duration was associated with more work-related physical activity per day, but not transportation or leisure-related physical activity, suggesting that greater work demands can negatively influence sleep duration. Elliman and colleagues<sup>20</sup> report on occupational hazards for US Army drill sergeants, including long working, short sleep, and consequences of excessive sleepiness such as falling asleep behind the wheel. Visvalingam et al.<sup>5</sup> evaluated the self-reported sleep of a multiethnic sample of full-time employees in Singapore. The prevalence of poor sleep quality was over 40%, and two-thirds obtained less than the recommended amount of sleep. As other authors did, they recommend workplace policies and intervention programs to improve worker sleep health.

Ishibashi and Shimura<sup>2</sup> examined the impact of sleep health on productivity in a sample of working adults in Japan. In fully adjusted models, poor sleep quality, sleep disturbances, and use of sleep medications were each associated with greater presenteeism, a measure of reduced productivity while at work. Taylor et al.<sup>6</sup> evaluated, in a sample of over 200,000 US Air force recruits, the impact of “difficulty sleeping at night” on the likelihood of being discharged for any reason within 1 year. In trainees discharged within 1 year, difficulty with sleep was a strong predictor of attrition. Shriane et al.<sup>16</sup> queried Australian paramedics and found that these shift workers as a group had little knowledge of sleep hygiene recommendations, highlighting an opportunity for interventions. Grier et al.<sup>17</sup> evaluated special operations soldiers in the US Army, finding that short sleep duration more than doubled the risk of a musculoskeletal injury within a year. Stimpfel et al.<sup>7</sup> studied a cohort of registered nurses in the United States, finding that the prevalence of short sleep was high; a majority of these nurses were sleeping less than the recommended amount (7 or more hours per night) on a regular basis. They also identified cross-sectional associations of shorter sleep duration with lower reported quality of patient care and reduced patient safety. Current conditions in the US healthcare system with the COVID-19 pandemic are likely to make this situation even worse. Future surveillance of the health and well-being of health care workers, a particularly vulnerable group in a pandemic, should include sleep health as a modifiable factor that may impact workforce health and potentially patient care quality.

Driving is an activity where sleep and work can clash with especially drastic consequences, including crashes and loss of life. There are three articles about driving in this special issue. Crain et al.<sup>8</sup> developed

a conceptual model of driver sleep and fatigue in the ride-sharing gig economy and provide practical suggestions on how researchers, companies, and drivers can improve sleep health, reduce fatigue, and improve performance and safety in the ride-sharing industry. Wolkow et al<sup>9</sup> examined how a simple, noninvasive, wrist-worn heart rate monitor could be used to detect drowsiness in heavy vehicle drivers in Malaysia. Even though the device could not always reliably detect the occurrence of a drowsy driving event, simply wearing the device appeared to have altered the drivers' behaviors and resulted in a decrease in the rate of harsh braking events in naturalistic conditions. Sleep scientists often talk about the “drive to sleep” that increases as a consequence of staying awake for long periods, a process modulated by the internal circadian system, which leads to especially decreased vigilance. Long-haul drivers often drive through this vulnerable period of increased sleepiness when the circadian body temperature is lowest, usually in the early morning. Diez et al<sup>10</sup> reported that long-haul bus drivers in Argentina combine sleep at different locations (bus, destination, and home) to obtain on average 6–7 hours of sleep, but those exposed to higher risk working schedules (e.g., overnight shifts) had disrupted circadian temperature rhythms. Such studies are important for helping to design optimal fatigue management systems for drivers. In a systematic review and meta-analysis, Dr. Patterson et al<sup>11</sup> evaluated the role of exposure to shift work on sleep-related blood pressure dipping. The limited heterogenous research was judged to be of low quality and mostly acute studies, but suggests that the dip in blood pressure during sleep was not blunted in shift work.

In addition to the long-haul driver study that examined circadian rhythmicity, two other papers study shift work in relation to circadian rhythms and sleep. Shift work disorder (SWD), a medical diagnosis that involves excessive sleepiness or insomnia caused by the work schedule, is common. Given the strength of the circadian system and the amount of sleep disruption caused by shift work, it is perhaps surprising that more night shift workers do not complain of SWD symptoms. Dr. Bastille-Denis et al<sup>12</sup> found that, when compared to shift workers who slept well, shift workers with SWD had more thoughts that kept them awake, including presleep cognitive arousal and worries. This suggests that cognitive variables may provide an avenue for SWD therapies. Relatedly, Khan et al<sup>13</sup> found that paramedics, who often perform shift work, had higher symptoms of depression, anxiety, fatigue, posttraumatic stress disorder (PTSD), and insomnia and lower well-being than the general population in Australia. These symptoms were particularly apparent in those shift workers who were “night owls” (evening chronotypes), compared to those who were morning chronotypes. Thus, addressing sleep issues and, perhaps, matching chronotype to shift preference, could help to improve mental health and well-being in shift workers.

In an intriguing article on sleep and leadership, Barnes et al<sup>14</sup> describe a series of studies evaluating the relationship of workplace leadership behaviors with subordinates' sleep and ethical behaviors. Leaders exhibiting behaviors that “devalue” sleep have employees with poorer sleep quality, “above and beyond the effects of abusive supervision and other alternative explanations.” Further, in mediation analyses, poorer sleep quality mediated the effect of leaders' devaluing of sleep on their subordinates' self-reported unethical behavior. Workplaces represent a target-rich area for interventions to improve employee sleep (e.g., Olsen et al<sup>15</sup>). Soprovich and colleagues<sup>21</sup> conducted a systematic review of workplace health promotion programs to improve sleep among men and identify intervention program design features associated with improved sleep.

Unpacking the many facets of sleep health encompassed by “difficulty sleeping” in workers could be a fruitful area for investigations and intervention efforts. Future studies are needed to assess the impact of the global downturn, pandemic mitigation practices, and related anxiety on sleep health. Interventions will need to consider the effects of economic hardship on sleep health, mental health, and

physical health and recognize the existence of major disparities in the extent and impact of these hardships.

We hope you enjoy this special issue of *Sleep Health* on sleep & work, work & sleep.

## Disclosure

Dr. Buxton receives funding from the Social Science Research Institute, Pennsylvania State University, and NIH grants R01 AG056538 (Derby & Buxton, mPI), R01 HD073352 (Hale, PI), UH2/UH3 AG052167 (Almeida & Smyth, mPIs), R01 DK103663 (Wagner, PI), UL1 TR002014 (Sinoway, PI/PD), R01 MD011600 (Grandner, PI), R01 DK88244 (Paul, PI), R44 and R01HD087266 (Teti, PI). Dr. Shea receives funding from NIH grants R01 HL125893 (Shea, PI), R01 HL142064 (Shea, PI), and R01 HL140577 (Link & Shea, mPI), DoD grant PT150133 (Hammer, PI), CDC grant U19 OH010154 (Anger, PI), and the Oregon Institute of Occupational Health Sciences at Oregon Health & Science University via funds from the Division of Consumer and Business Services of the State of Oregon (ORS 656.630).

Outside of the current work, Orfeu M. Buxton discloses that he received subcontract grants to Penn State from Mobile Sleep Technologies/Proactive Life/Sonic Sleep (NSF/STTR #1622766, NIH/NIA SBIR R43AG056250, R44 AG056250), received honoraria/travel support for lectures from Boston University, Boston College, Tufts School of Dental Medicine, New York University and Allstate, and receives an honorarium for his role as the Editor-in-Chief (designate) of *Sleep Health*. Dr. Shea has nothing to disclose.

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## Reference

1. Salas-Nicás S, Sembajwe G, Navarro A, Moncada S, Llorens C, Buxton OM. Job insecurity, economic hardship, and sleep problems in a national sample of salaried workers in Spain. *Sleep Health*. 2020;6:261–268.
2. Ishibashi Y, Shimura A. Association between work productivity and sleep health: a cross-sectional study in Japan. *Sleep Health*. 2020;6:269–275.
3. Sadeghniaat-Haghighi K, Zahabi A, Najafi A, Rahimi-Golkhandan A, Aminian O. Evaluating the quality and duration of sleep using actigraphy in petroleum industry shift workers. *Sleep Health*. 2020;6:406–409.
4. Tom SE, Brown JP, Avilés-Santa ML, et al. Self-reported sleep duration is associated with time in work physical activity but not transportation or leisure physical activity among Hispanic/Latino adults in the U.S.: results from the Hispanic Community Health Study/Study of Latinos. *Sleep Health*. 2020;6:305–312.
5. Visvalingam N, Sathish T, Soljak M, et al. Prevalence of and factors associated with poor sleep quality and short sleep in a working population in Singapore. *Sleep Health*. 2020;6:276–286.
6. Taylor DJ, Straud CL, Hale W, Grieser E, Garb L, Garb HN. Sleep difficulties as a predictor of attrition in United States Air Force recruits. *Sleep Health*. 2020;6:337–342.
7. Stimpfel AW, Fatehi F, Kovner C. Nurses' sleep, work hours, and patient care quality, and safety. *Sleep Health*. 2020;6:313–319.
8. Crain TL, Brossoit RM, Robles-Saenz F, Tran M. Fighting fatigue: A conceptual model of driver sleep in the gig economy. *Sleep Health*. 2020;6:357–364.
9. Wolkow AP, Rajaratnam SMW, Wilkinson V, et al. The impact of heart rate-based drowsiness monitoring on adverse driving events in heavy vehicle drivers under naturalistic conditions. *Sleep Health*. 2020;6:365–372.
10. Diez JJ, Plano SA, Caldart C, et al. Sleep misalignment and circadian rhythm impairment in long-haul bus drivers under a two-up operations system. *Sleep Health*. 2020;6:373–385.
11. Patterson PD, Mountz KA, Budd CT, et al. Impact of shift work on blood pressure among emergency medical services clinicians and related shift workers: A systematic review and meta-analysis. *Sleep Health*. 2020;6:386–397.

12. Bastille-Denis E, Lemyre A, Pappathomas A, Roy M, Vallières A. Are cognitive variables that maintain insomnia also involved in shift work disorder? *Sleep Health*. 2020;6:398–405.
13. Khan WAA, Conduit R, Kennedy GA, Jackson ML. The relationship between shift-work, sleep, and mental health among paramedics in Australia. *Sleep Health*. 2020;6:329–336.
14. Barnes CM, Awtrey E, Lucianetti L, Spreitzer G. Leader sleep devaluation, employee sleep, and unethical behavior. *Sleep Health*. 2020;6:410–416.
15. Olson R, Crain TL, Bodner TE, King R, Klein LC, Erickson L, Moen P, Berkman LF, Buxton OM. A workplace intervention improves sleep: results from the randomized controlled Work, Family, and Health Study. *Sleep Health*. 2015;1:55–65.
16. Shriane AE, Russell AMT, Ferguson SA, Rigney G, Vincent GE. Sleep hygiene in paramedics: What do they know and what do they do? *Sleep Health*. 2020;6:320–328.
17. Grier T, Dinkeloo E, Reynolds M, Jones BH. Sleep duration and musculoskeletal injury incidence in physically active men and women: A study of U.S. Army Special Operation Forces soldiers. *Sleep Health*. 2020;6:343–348.
18. Shimura A, Sugiura K, Inoue M, et al. Which sleep hygiene factors are important? comprehensive assessment of lifestyle habits and job environment on sleep among office workers. *Sleep Health*. 2020;6:287–297.
19. Cho E, Chen TY. The bidirectional relationships between effort-reward imbalance and sleep problems among older workers. *Sleep Health*. 2020;6:298–304.
20. Elliman TD, Schwalb ME, Adler AB. Sleep deprivation and hazardous unintended sleep in US army drill sergeants. *Sleep Health*. 2020;6:349–356.
21. Soprovich AL, Seaton CL, Bottorff JL. A systematic review of workplace behavioral interventions to promote sleep health in men. *Sleep Health*. 2020;6:417–429.