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SLEEP DISORDERS (P GEHRMAN, SECTION EDITOR)

Mental Health Consequences of Shift Work: An Updated Review

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Abstract

Purpose of Review Approximately 25% of employed individuals engage in shift work, which can substantially alter opportunities for restorative sleep. Being tired on the job can lead to safety risks in professions such as healthcare, first responders, manufacturing, and numerous others. In addition to the physical stress and health consequences of shift work, recent evidence links shift work to poor mental health outcomes. The current review examines the literature from 2016 onward, emphasizing the impact of shift work on mental health.

Recent Findings Shift work is associated with considerable impacts on sleep, depressed mood and anxiety, substance use, impairments in cognition, lower quality of life, and even suicidal ideation. Pronounced sleep disturbances frequently underlie the mental health consequences of shift work.

Summary Shift work can have physical, mental health, and safety consequences. Future research should aim to better understand the interplay of shift work, sleep, and mental health and seek to mitigate the adverse consequences of shift work.

Keywords Shift work · Sleep · Mood · Substance use · Cognition · Insomnia

Introduction

Shift work is essential for the modern industrialized economy, especially in the healthcare, public safety, and transportation workforces, as well as other service sectors where 24-h access and service are expected. Although no universal definition of "shift work" is accepted, working outside of a typical 9 a.m. to 5 p.m. workday is commonplace for one fifth of workers internationally [1, 2]. Indeed, recent estimates from a nationally representative US survey suggest the prevalence of shift work has increased to 27% [3]. Despite the frequency of shift work and its societal necessity, marked health consequences have been observed.

Shift work demands nontraditional and often irregular sleep/wake schedules, which are in turn associated with worsened daytime function. For example, regardless of engagement in shift work, only 30% of American workers report keeping a consistent sleep schedule [4]. Further, employees with the most varied sleep schedules report the lowest levels of feeling well-rested and the highest levels of reductions in daytime productivity due to irregular sleep schedules. Since shift workers often experience less total sleep time and worse sleep quality than non-shift workers, sleep-related impairments in daytime function are compounded for shift workers.

The purpose of the current review is to synthesize recent literature regarding the mental health consequences of shift work. A comprehensive review of all aspects of shift work and shift work disorder is beyond the scope of the current paper; rather we seek to highlight recent findings regarding the impact of shift work on mental health outcomes. First, we describe the circadian misalignment that can result from shift work, followed by the health and safety effects of shift work. Next, we discuss the current literature on the associations of shift work and mental health with special attention to mood disorders, substance misuse, and cognition. Finally, we conclude with recommendations for further investigation.

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Shift Work and Sleep Physiology

In humans, cycles of sleep and wakefulness are regulated by the interaction of two physiologic mechanisms: homeostatic sleep pressure and circadian rhythmicity [5]. During wakefulness, homeostatic pressure builds and eventually increases sleepiness; this pressure for sleep subsequently diminishes during sleep. In parallel, the circadian rhythm is an internal "pacemaker" that responds predominantly to external and environmental cues, the strongest of which is the naturally occurring light/dark cycle. Thus, whereas homeostatic pressure pertains to sleep need, the circadian rhythm dictates sleep/wake timing. Unfortunately, shift workers' schedules frequently conflict with this endogenous rhythm of sleep and wakefulness, creating a desynchronization between homeostatic pressure and the circadian rhythm (Fig. 1). Thus, during the same periods that a shift worker needs to be awake (e.g., during night shift), the alerting signal is at its lowest, resulting in sleepiness on the job. Conversely, when the shift worker has the opportunity to fall asleep (i.e., during the day), the circadian alerting signal is at its highest, leading to short, fragmented daytime sleep and homeostatic sleep debt, both of which can have negative health and work performance consequences.

Multiple person-level characteristics have been associated with engagement and adaptability to shift work. For example, relative to women, Caucasians, and full-time employees, respectively, men, racial/ethnic minorities, and part-time workers are all more likely to be shift workers [1]. Perhaps the most important characteristic is "chronotype," which refers to a person's innate circadian preference (i.e., "morningness/eveningness") and thus the periods of the day during which an individual is most likely to feel active and awake. Evidence suggests that chronotype influences one's ability to adapt to shift work [6], such that "morning types" (i.e., those who are most functional in the early morning hours) show a lower tolerance for shift work [7]. Additionally, a polymorphism in the PER3 gene is partially linked to chronotype and has been associated with resistance both to sleepiness and to sleep-related performance deficits [8], which are common among shift workers.

Health Consequences of Shift Work and Shift Work Disorder

Shift work and shift work disorder (SWD, a persistent or recurrent pattern of sleep disturbance including insomnia and/or excessive sleepiness associated with a work schedule that overlaps with typical sleep times; see [9] for a comprehensive review including clinical evaluation and management) is associated with multiple physical and mental health consequences, as well as workplace consequences such as accidents and errors during shift work. For example, in terms of sleep, relative to non-shift workers, shift workers demonstrate higher prevalence of sleep loss, excessive daytime sleepiness, and insomnia [10]. Shift workers are also more likely to report poor subjective sleep quality together with wake time difficulties with concentration, as well as social and leisure time activity engagement [3]. These associations suggest substantial impacts of work schedule on not only sleep but also lifestyle during nonwork hours.

Relative to non-shift workers, shift workers are at higher risk for numerous adverse health outcomes such as cardiovascular disease [11], stroke [12], obesity [13], gastrointestinal issues [14], pregnancy complications and reduced fertility [15], and various types of cancer [16–18]. Further, individuals working shift work jobs also experience more psychiatric disorders, such as depression [10], anxiety [19], and alcohol abuse [20], in addition to greater psychosocial distress such as poorer quality of life [21] and work-stress spillover. Finally,

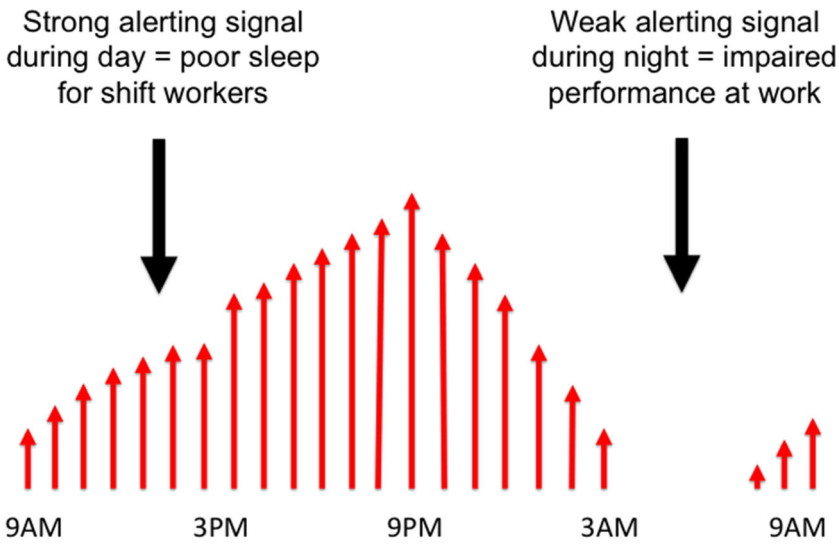

Fig. 1 Mismatch of circadian alert signal and sleep opportunities in shift workers Opportunities for sleep among shift workers are misaligned to the circadian altering signal depicted by vertical arrows above. As a result, daytime sleep may be poor and nighttime work performance may be impaired. Image © Emerson M. Wickwire, Ph. D. Used with permission

shift work negatively impacts neurocognitive performance, including adverse impact on attention and memory [22] and increased risk for accidents and errors both within and outside of the workplace. Shift workers are at increased risk not only for motor vehicle crashes [23–26] but also workplace accidents and errors, with resulting costs of $71 to $93 billion per annum [26]. When these accidents occur in healthcare settings, such as drug administration or other medical errors, patient safety is at risk. Furthermore, drowsy driving and sleep-related transportation accidents, either in a personal vehicle or as a mass transit operator, put the general public at risk [27].

Methods

For this informal but thoroughly structured review, a literature search was conducted using the PubMed database. The following keywords were used: (1) "shift work" and "mental health," (2) "shift work" and "cognition," (3) "shift work" and "mood disorders," and (4) "shift work" and "quality of life." Publications were chosen from January 2016 to July 2019 resulting in 181 articles from 30 different countries identified in peer reviewed journals. After removing duplicates and irrelevant articles, 23 were selected for the final review. Reports from North America, Europe, Asia, and Australia are reviewed here. The following occupations were evaluated: nurses, medical interns, other healthcare workers, police officers, and industrial workers. Overall, the most up-to-date literature documents that shift work has a detrimental effect on mental health (Table 1). As outlined below, the negative impact of shift work on sleep is associated with an increased risk of mood disturbance, suicidal ideation, substance misuse, cognition, and quality of life.

Sleep Disturbances

A substantial proportion of the articles selected emphasized the association of shift work and poor sleep. Three papers demonstrated an association between shift work and shorter sleep duration [28–30]. In a study of 233 registered nurses in Thailand, nurses working ten or more night shifts per month reported poorer quality sleep and shorter sleep duration and had approximately four times more difficulty initiating sleep than their counterparts who worked less than ten night shifts per month [28]. Shift type has also been associated with severity of sleep disturbance. For example, in a cross-sectional study of factory workers, relative to day workers (8 a.m.–6 p.m.), the prevalence of insomnia was three times higher among rotating shift workers, with 18% of shift workers suffering from insomnia [31•]. Shift workers in a variety of professions who typically start work in the early morning (between 4 and 7 a.m.) and those on rotating shifts reported shorter sleep duration, greater discrepancies between actual and desired sleep duration, as well as greater daytime sleepiness and insomnia in comparison to night shift and daytime workers [32]. Even after adjustment for demographics, socioeconomic factors, diet, and physical activity, a large UK population-based study ($N > 270{,}000$) found that shift workers displayed greater daytime sleepiness, tiredness, and difficulty initiating and/or maintaining sleep [30].

Patterns and consequences of sleep loss are similar among medical trainees. For example, nurses and medical interns showed similarities in sleep patterns with 75.9% of nurses reporting less than 7 h of sleep per night and medical interns reporting an average loss of 2 h and 48 min of sleep per week [28, 29•]. When compared to pre-internship levels, first year interns reported heavier workloads, longer work hours, and rotating shifts which negatively impacted mood, sleep, and physical activity. Specifically, based on objective measurement of both sleep duration and step counts from wrist accelerometry, as well as ecological momentary assessment (via SMS) measurements of overall daily mood, interns had shorter sleep duration, decreased physical activity (11.5% reduction), and worse overall mood during the first 6 months of intern year. Daily data collection allowed the investigation of the bidirectional relations of sleep and mood in relation to work demands. When interns obtained shorter sleep, they reported worse mood on the following day, which was related to shorter sleep again the next night [29•], suggesting a potential

Table 1 Summary of mental health consequences of shift work

Domain	**Consequence**
Sleep disturbances	Shorter sleep duration, poor quality sleep, difficulty initiating sleep, excessive daytime sleepiness, and higher rates of chronic insomnia
Depressed mood and anxiety	Higher rates of depressed mood and anxiety
Suicidal ideation	Increased risk of suicidal ideation
Substance use	Higher usage of sleep-promoting drugs, wake-promoting drugs, consuming alcohol to initiate sleep, and smoking cigarettes to stay awake
Cognition	Decline in cognitive function
Quality of life	Dissatisfaction with overall well-being

viscous cycle of sleep loss and daytime impairment, where decreases in one lead to ongoing decreases in the other and vice versa.

Depressed Mood and Anxiety

Along with sleep disturbances, several mental health concerns are associated with shift work. Depressed mood was found to be one of the most prevalent psychiatric consequences identified in this review and was discussed in 8 of the 12 articles reviewed [28–35]. In a European sample, depressive symptoms and anxiety were shown to affect 26% and 17% of shift workers [32]. Similarly, poor mental health was found to be highly prevalent among nurses, with 57% of nurses at risk for depression and particular risk identified among female nurses who reported short sleep duration [28]. Notably, in a subset of Korean factory shift workers of both sexes who reported moderate to severe insomnia over the past month, the risk of depressive symptoms was nearly 5 times greater than the risk for depression among peers who did not have insomnia [31•].

Shift workers were more likely to report mood instability, feeling depressed, and a lack of enthusiasm over a 2-week period [30]. Furthermore, relative to traditional workers, shift workers were more likely to report ever discussing these feelings with a general practitioner [30]. Among women only, those with the least regular work schedules (e.g., both variable days and times) were twice as likely as regular daytime workers to have been treated for depression over a 2-year follow-up period [36]. This association was observed after statistically adjusting for demographics, other work characteristics, and prior depressive symptoms or antidepressant use. Over a 1-year period, both higher depressive symptom scores and longer history of shift work were related to taking more sick leave in healthcare workers [37].

Suicidal Ideation

One article examined the increased risk of suicidal ideation among shift workers [31•]. Much like the associations seen for mood, the odds of suicidal ideation were greatest in those also suffering from insomnia. While the odds are slightly elevated, yet statistically significant, when comparing shift workers and day workers on suicidal ideation, an alarming near eightfold greater odds was measured when comparing shift workers with and without self-reported insomnia [31•].

Substance Use

Along with sleep and mood disturbances, substance use was found to be among the most common effect of shift work on mental health. First, use of alcohol as a sleep aid was reported by 17% of shift workers [38]. Similarly, 23.3% of North American police officers reported high caffeine consumption to stay awake, 21.6% reported use of sleep-promoting drugs, 19.5% used drugs with sleepiness as a side effect, 5.4% used wake-promoting drugs, and 4.2% smoked cigarettes (representing over one quarter of participants who were smokers) to either stay awake or fall asleep within the past month [39•].Importantly, the use of sleep-promoting drugs, wake-promoting drugs, and cigarette smoking to stay awake was associated with an increased risk of stress, fatigue, excessive daytime sleepiness, performance errors, burnout, and near misses while driving [39•].

Across three waves of data from the Korea National Health and Nutrition Examination Survey (KNHANES), sex was consistently related to substance use among shift workers. Specifically, relative to women day shift workers, women night shift workers were twice as likely to score high enough on an alcohol use disorder screening instrument for provider referral [40]. Like poor sleep itself, substance use is associated with adverse mental health consequences among shift workers. For example, an Australian study demonstrated that the number of alcoholic beverages consumed on nonwork days and the number of night shifts worked in the past month were associated with moderate to severe anxiety symptoms in healthcare workers [37]. While motivation for alcohol consumption was not directly assessed, the authors offer that participants could use alcohol to self-medicate to alleviate anxiety symptoms and/or as a sleep aid [37].

Cognitive Impairments

Evidence from epidemiologic, clinical, and experimental laboratory studies suggests that shift work is associated with impaired cognitive function. For example, middle aged and older adults who were current shift workers or engaged in shift work within the past 5 years demonstrated lower scores on a well-validated measure of executive function (e.g., Trail Making Test B) [41]. In a nationally representative sample in Canada, poorer sleep quality, but not sleep duration, among night shift workers resulted in lower subjective cognitive function [42]. In a laboratory study of night shift workers, cognitive flexibility was compromised among those with sleep complaints on tasks that reflected the cognitive demands in the workplace of needing to remain on a task, switch tasks, and return to the prior task [43]. Other domains of cognitive function such as sustained attention, information processing, and visual-motor performance are impaired in chronic night shift workers [44]. Additionally, these impairments were more pronounced after 11 h of wake time which could align with the end of a scheduled work shift. Impairments in attention and visual-motor performance were also associated with higher subjective ratings of sleepiness as well as lower polysomnography-measured sleep efficiency during the most recent sleep episode.

In aggregate, these data suggest that shift work alone contributes to lapses in judgment that can put the public at risk. Among police officers, working night shifts has been identified as an independent contributor to increased risk of daytime sleepiness, experiencing a near crash while off duty, and committing an error due to sleep deprivation or fatigue [39•]. Among this population, the increased risk of working a night shift on fatigue-related errors or experiencing a near crash was comparable to those of having a diagnosed sleep problem such as insomnia or obstructive sleep apnea [39•].

Quality of Life

In a study by Nena et al. [21], quality of life was measured using the WHO-5 Well-Being Index (WHO-5) and the Shift Work Disorder Screening Questionnaire (SWDSQ). Approximately 48% of shift workers reported being dissatisfied with their sense of well-being and 28.3% reported being dissatisfied with their physical and mental health [21]. Additionally, 58.2% of the shift workers reported dissatisfaction with their sleep and 37.7% reported severe sleepiness. Difficulties with sleep initiation and/or maintenance were endorsed by about one third of shift workers [21].

Conclusions

Despite methodological differences in characterization of shift work and the variety of mental health domains reported in the literature, an association of shift work and worse mental health is well documented. Further, the associations are more robust among those with sleep complaints including short sleep duration, excessive daytime sleepiness and insomnia. Substance use among shift workers seems to be both a short-term approach to manage the conflicting sleep and wake demands of shift work in opposition to the circadian signaling, as well as a longer-term, potentially harmful health behavior. Compromised cognitive tasks increase the risk of workplace errors which jeopardize the health of patients in the case of healthcare workers and that of the general public in the case of law enforcement or transportation workers. The most commonly reported consequence of mood disturbance may become so disruptive to a shift worker that it may lead to more sick leave taken, more frequent healthcare encounters, and perhaps the use of antidepressants.

Future work should employ both objective and subjective comprehensive measurements of sleep characteristics including duration, timing, and quality. Movement away from cross-sectional study designs will allow for more definitive linkages to be documented between shift work and mental health consequences. The use of statistical models to quantify and delineate the complex and often bidirectional relations among shift work, sleep, and poor mental health will move the field forward and help identify areas for intervention. Finally, there is a dearth of evidence regarding the economic consequences of shift work from the employer perspective, and many employer costs are directly attributable to shift work related accidents and errors.

Compliance with Ethical Standards

Conflict of Interest Jessica P. Brown, Destiny Martin, Zain Nagaria, Avelino C. Verceles, and Sophia L. Jobe each declare no potential conflicts of interest. Emerson M. Wickwire's institution has received research support from AASM Foundation, Department of Defense, Merck, and ResMed. Dr. Wickwire has served as a scientific consultant for Eisai, DayZz, Merck, and Purdue and is an equity shareholder in WellTap.

Human and Animal Rights and Informed Consent This article does not contain any studies with human or animal subjects performed by any of the authors.

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