

Resting and Recharging: A Narrative Review of Strategies to Improve Sleep During Residency Training

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ABSTRACT

Background Residency involves demanding training with long hours that may cause fatigue and sleep deprivation and adversely impact residents and patients under their care.

Objective To identify, using a narrative review, evidence-based interventions to reduce the physiologic effects of fatigue and sleep deprivation from overnight and night shift work.

Methods A PubMed literature search was conducted through August 30, 2021, using the terms “resident” and “sleep” in the title or abstract and further narrowed using a third search term. Observational studies, randomized controlled trials, systematic reviews, and meta-analyses of human subjects written and published in English were included. Studies that were not specific to residents or medical interns or did not investigate an intervention were excluded. Additional studies were identified by bibliography review. Due to the heterogeneity of study design and intervention, a narrative review approach was chosen with results categorized into non-pharmacological and pharmacological interventions.

Results Initially, 271 articles were identified, which were narrowed to 28 articles with the use of a third search term related to sleep. Bibliography review yielded 4 additional articles. Data on interventions are limited by the heterogeneity of medical specialty, sample size, length of follow-up, and reliance on self-report. Non-pharmacological interventions including strategic scheduling and sleep hygiene may improve sleep and well-being. The available evidence, including randomized controlled trials, to support pharmacological interventions is limited.

Conclusions Non-pharmacological approaches to mitigating fatigue and sleep deprivation have varying effectiveness to improve sleep for residents; however, data for pharmacological interventions is limited.

Introduction

Residency involves demanding training with long hours that may impact a resident’s sleep. Sleep deprivation may occur acutely, such as during extended and nocturnal shifts, and chronically through accumulated work hours. Effects of sleep deprivation on residents and the patients under their care include decreased alertness,¹ creative thinking,² working memory capacity, and neurocognitive function.^{3,4} Sleep deprivation is also associated with poor mood and increased depression,^{5,6} driving risk,⁷ and increased medical errors.⁸ Sleep deprivation has been linked to resident burnout, while restful sleep can lead to a higher sense of well-being.⁹

While significant focus has been shifted to fatigue mitigation at the Accreditation Council for Graduate Medical Education (ACGME) level, including significant changes to work hours and scheduling strategies and a heightened awareness of issues related to

burnout, the effectiveness of these strategies to limit fatigue is largely unknown. It is also unclear whether these interventions lead to improved patient care or resident satisfaction. The aim of this narrative review is to identify evidence-based non-pharmacological and pharmacological interventions to reduce the physiologic effects of fatigue and sleep deprivation after overnight and night shift work during residency training.

Methods

A PubMed literature search was conducted by 2 authors (J.R., L.K.D.) from inception of the database through August 30, 2021 using the terms “resident” and “sleep” in the title or abstract. This list was further narrowed by inclusion of a third search term from the following list: fatigue, sleep deprivation, intervention, duty hours, work hours, night float, night shift, wellness, napping, sleep hygiene, meditation, sedative, and stimulant. The bibliographies of the included studies and review articles were also

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reviewed to identify other potentially relevant studies not included in our search strategy.

Inclusion and Exclusion Criteria

The search was limited to retrospective and prospective observational studies, randomized controlled trials, systematic reviews, and meta-analyses of human subjects written and published in the English language. Studies were excluded if they were not specific to residents, interns, or fellows or if they did not investigate a treatment or intervention (eg, studied the effect of overnight work and night shift work rather than comparing intervention to control) or were reviews, surveys, case reports, case series, or editorials. Two authors (J.R., L.K.D.) assessed the articles for eligibility, and disagreements were resolved by consensus between the 2 authors. If consensus was not reached between the 2 authors, a third author (A.M.K.) provided the majority decision. The articles were organized and summarized by one author (J.R.). Due to the heterogeneity of study design and intervention, a narrative review approach was chosen with results categorized into non-pharmacological and pharmacological interventions.

Results

Our initial search using the terms “resident” and “sleep” yielded 271 articles. This was narrowed to 28 original articles with the sequential addition of a third search term. Bibliography review of these studies yielded 4 additional articles. Given the low number of relevant articles as well as the heterogeneity of study design and intervention type, we were unable to systematically analyze the data via a meta-analysis. In order to present the most inclusive and broad range of interventions along with their limited evidence, we chose to present these results using a narrative approach with articles sorted into 2 broad categories: non-pharmacological (TABLE 1) and pharmacological (TABLE 2) interventions.

Non-Pharmacological Interventions

Perhaps the most widely recognized intervention to address acute and chronic sleep deprivation in resident physicians is work hour limitations. In 2003, the ACGME issued requirements that limited resident work hours to 24 consecutive hours a day and 80 total hours per week. Multiple systematic reviews have attempted to investigate the affects of the work hour limits on residents and patients. Despite the heterogeneity of existing data, systematic reviews have found generally positive effects on measures of resident well-being, including sleep,

burnout and mood, and quality of life.¹⁰⁻¹² Mixed effects on patient safety outcomes were found which often varied based on the medical specialty evaluated.¹⁰⁻¹² The majority of negative findings were related to resident education, such as an inability to attend teaching conferences due to work hour requirements, decreased continuity of care, limited supervising attending availability, and reductions in case volume related to unavailability.¹⁰⁻¹³ Whether fewer work hours translate to reduced work remains unclear, and several studies cited work compression resulting in increased stress and decreased educational time under the new restrictions.^{12,14}

In addition to limiting total work hours, the impact of eliminating extended duration shifts (>24 hours) to comply with ACGME restrictions has also been evaluated. Resident and patient outcomes of shortening shift length were largely similar to the overall outcomes of reducing total work hours as previously described. An observational study found increased sleep and improved performance on psychomotor vigilance testing in residents working shorter shifts when compared to extended duration shifts.¹ Multiple randomized controlled trials comparing extended duration shifts to shortened shifts (<16 hours) in intervention groups found reduced sleepiness and increased sleep duration, again at the potential cost of resident education.^{15,16} There were no changes in patient mortality or medical errors after adjusting for the number of patients per resident.^{15,17} Systematic reviews of eliminating extended work shifts had more favorable findings, including fewer medical errors, motor vehicle crashes, and percutaneous injuries, and improved resident quality of life.^{18,19} Overall no effects were found in resident education in these studies.

Strategic Scheduling: Major scheduling changes in response to work hour limitations have had varying effects on resident sleep and wellness. Traditional internal medicine scheduling typically requires attendance at ambulatory clinics during inpatient rotations. Block scheduling separates these responsibilities into consecutive weeks on inpatient rotations followed by consecutive weeks in ambulatory clinics. A single center study compared traditional scheduling (attendance at ambulatory clinics during inpatient rotations) vs block scheduling (ie, 3 weeks in an inpatient setting followed by 1 week of ambulatory clinic). Block scheduling was associated with greater total sleep time during the ambulatory week. A traditional schedule was associated with worse Epworth Sleepiness Scale (ESS) and Perceived Stress Scale (PSS) scores throughout week 4, while residents on a block schedule returned to their pre-MICU

TABLE 1
Non-Pharmacological Interventions

Studies	Sample Size	Participants	Study Design	Main Outcomes
Work Hour Limitations				
Basner et al (2017) ¹	224	Internal medicine residents	Single center observational study	Residents who worked extended duration shifts overnight performed worse on PVT and had worse sleepiness scores
Fletcher et al (2005) ¹⁰	54 studies	Medical residents	Systematic review	Heterogeneous effects of work hour interventions on resident well-being and education
Harris et al (2015) ¹¹	11 studies	Orthopedic residents	Systematic review	Work hour restrictions may improve resident well-being; neutral effects on resident education and patient outcomes; potentially negative effects on surgical skills
Philibert et al (2013) ¹²	83 studies	Medical residents	Systematic review	Increased resident sleep and alertness, decreased burnout, and improved mood; reduced continuity of care and resident education; no effect on operative volume; mixed effects on patient safety dependent on medical specialty
Bolster et al (2015) ¹³	27 studies	Medical residents	Systematic review	Work hour restrictions resulted in negative impact on resident education and well-being
Auger et al (2012) ¹⁴	31	Pediatric and family medicine residents and attendings	Single center partially randomized cohort study	Residents working shorter shifts were less fatigued at work but scored lower on general well-being, citing work compression; education and professionalism rated lower by residents and faculty in the intervention group
Barger et al (2019) ¹⁵	302	Residents working in pediatric ICU	Multicenter clustered-randomized crossover study	Compared to residents working extended duration shift schedules, residents capped at 16-hour shifts worked fewer hours, slept more, and were more likely to rate their education and work experience as poorer
Parshuram et al (2015) ¹⁶	47	Residents working in medical-surgical ICU	Multicenter RCT	No effect of various overnight schedules on patient outcomes of adverse events or mortality; no effect on resident outcomes of day or nighttime sleepiness or burnout
Landrigan et al (2020) ¹⁷	333	Residents working in pediatric ICU	Multicenter clustered-randomized crossover trial	Residents who worked <16-hour shifts made more serious medical errors than those working extended duration shifts; no difference in medical errors between schedules when adjusted for number of patients per resident
Levine et al (2010) ¹⁸	23 studies	Medical residents	Systematic review	Reduction or elimination of extended duration shifts resulted in improved resident quality of life, improved safety and quality of care, and no significant changes in resident education
Reed et al (2010) ¹⁹	64 studies	Medical residents	Systematic review	Residents working shorter shifts had fewer medical errors, decreased percutaneous needle injury or motor vehicle crashes, and no changes in measures of education when compared to residents working longer shifts
Strategic Scheduling				
Bordley et al (2017) ²⁰	49	Residents in medical ICU	Single center observational	Block scheduling with ambulatory clinic helped to recover sleepiness and stress accumulated during ICU time compared to traditional scheduling
Desai et al (2013) ²¹	43	PGY-1 internal medicine residents	Single center crossover study	Night float and every fifth night call (with 16-hour limit) resulted in more total sleep but decreased educational opportunities, increased handoffs, and decreased perceived quality of care rated by both residents and nurses compared with evaluating every fourth night call with a 30-hour limit

TABLE 1
Non-Pharmacological Interventions (continued)

Studies	Sample Size	Participants	Study Design	Main Outcomes
Chua et al (2011) ²²	46	Residents working general pediatric inpatient wards	Single center prospective cohort study	Implementing a night float system resulted in decreased work hours as well as decreased sleep hours compared to traditional call
Dunn et al (2019) ²³	30	Anesthesiology residents	Single center observational study	After 6 consecutive night float shifts, sleep efficiency, sleep latency, and wake after sleep onset worsened during night float recovery with total sleep time decreased from baseline
Napping				
Tempesta et al (2013) ²⁶	54	PGY-1 medical residents	Single center RCT	Residents who took <i>ad libitum</i> naps on night shift performed better on task-switching tasks after the night shift than those who did not take naps
Hilaire et al (2019) ²⁷	34	PGY-1 medical residents in ICU	Single center observational study	Napping >4 hours on call improved PVT, although not enough to fully recover to post-call performance. Napping <4 hours showed no improvement on PVT compared to not napping
Arora et al (2006) ²⁸	38	PGY-1 internal medicine residents	Single center crossover study	Residents with protected nap time slept more, had improved sleep efficiency on actigraphy, and reported less fatigue
Volpp et al (2012) ²⁹	106	PGY-1 medical residents and senior medical student subinterns	Multicenter RCT	Residents with protected sleep time overnight had twice as many sleep periods of 3 hours or greater and performed better on PVT the morning after extended duration shifts compared to those without protected sleep
Shea et al (2014) ³⁰	94	PGY-1 medical and psychiatry residents and medical students	Multicenter RCT	Residents with protected sleep time overnight had more sleep on call and performed better on PVT the morning after extended duration shifts; no difference in patient mortality
Amin et al (2012) ³¹	27	PGY-1 internal medicine residents	Single center controlled intervention trial	Number of attention failures pre- and post-nap decreased after a 20-minute protected nap period
Paging Efficiency				
Young et al (2012) ³²	Not reported	General surgery residents	Single center pilot study	Streamlining pages through a charge nurse resulted in fewer non-urgent pages, fewer pages overall, and fewer pages per patient overnight; no difference in patient morbidity or mortality

TABLE 1
Non-Pharmacological Interventions (continued)

Studies	Sample Size	Participants	Study Design	Main Outcomes
Loew et al (2019) ³³	49	Pediatric residents, attendings, and nurse practitioners	Quality improvement study	Post-intervention, total nighttime pages decreased by 50%; no significant difference in total sleep time
Sleep Hygiene Education				
Arora et al (2007) ³⁵	58	PGY-1 medical residents	Single center observational study	No significant change in sleep time surrounding call after participation in a single sleep educational session
Spiotto et al (2019) ³⁶	8	Neurological surgery residents	Single center prospective trial evaluating implementation of comprehensive wellness program	A yearlong wellness program including sleep hygiene education in addition to mental health support and exercise resulted in decreased anxiety, improved quality of life, and decreased sleepiness.
Other Non-Pharmacologic Interventions (Non-Resident Populations)				
Boivin et al (2002) ⁴⁶	15	Night shift nurses	Single center controlled study	Compared to control, the intervention group that received 6 hours of bright light in the workplace were better able to phase shift as measured by temperature and salivary melatonin
Gong et al (2016) ⁴⁷	6 studies	Patients diagnosed with insomnia	Meta-analysis	Mindfulness meditation improved sleep quality and decreased total wake time during sleep; no effect on sleep onset latency, total sleep time, wake after sleep onset, sleep efficiency, insomnia severity index, PSQI, and attitudes about sleep
Black et al (2015) ⁴⁸	49	Adults >55 years with moderate sleep disturbances	Single center RCT	Mindful awareness practices program resulted in improved sleep quality compared to sleep hygiene education program
Huberty et al (2021) ⁴⁹	263	Adults with sleep disturbances	RCT	Use of mindfulness meditation Calm app associated with decreased fatigue, daytime sleepiness, and somatic pre-sleep arousal

Abbreviations: PVT, psychomotor vigilance testing; ICU, intensive care unit; RCT, randomized controlled trial; PGY, postgraduate year; PSQI, Pittsburgh Sleep Quality Index.

TABLE 2

Pharmacological Interventions

Studies	Sample Size	Participants	Study Design	Main Outcomes
Stimulants				
Shy et al (2011) ³⁷	226	Emergency medicine residents	Survey of use of stimulants and sedatives	89% reported caffeine use during night shifts; 52% used caffeine every night shift
Huffmyer et al (2020) ³⁸	26	Anesthesiology residents	Randomized crossover study; caffeine (160 mg-containing beverage) vs non-caffeinated beverage on driving simulator performance following 6 night shifts	Caffeine consumption was associated with overall better driving performance, fewer collisions, and quicker reaction time on psychomotor vigilance testing
McBeth et al (2009) ³⁹	2372	Emergency medicine residents	Survey of prevalence and patterns of modafinil and zolpidem use	Modafinil use 2.4%; 66.7% initiated during residency, 64% reported improved clinical performance, 31% reported side effects: insomnia, agitation, palpitations, and nausea or anorexia
Sedatives (Benzodiazepines, Nonbenzodiazepines, Anti-Histamines)				
Shy et al (2011) ³⁷	226	Emergency medicine residents	Survey of use of stimulants and sedatives	38% reported using sedatives to sleep, including antihistamines (31%), zolpidem (14%), melatonin (10%), benzodiazepines (9%)
McBeth et al (2009) ³⁹	2372	Emergency medicine residents	Survey of prevalence and patterns of modafinil and zolpidem use	Zolpidem use 21.8%; 62.8% initiated use during residency, 22.6% reported side effects: drowsiness, dizziness, headache, hallucinations, depression/mood lability, amnesia
Handel et al (2006) ⁴¹	602	Emergency medicine residents	Survey of sleep aid use	46% used a sleep aid, antihistamines (diphenhydramine and doxylamine) reported as most commonly used
Melatonin				
Thottakam et al (2020) ⁴³	25	Resident physicians and acute care nurses	Pilot double-blinded randomized, placebo-controlled crossover trial; melatonin use in participants who had worked 12-hour shifts ≥ 3 nights in a row	Participants who took 6 mg melatonin performed better on double digit addition and reaction time testing; no difference on psychomotor vigilance testing, sleep latency, duration, wake after sleep onset, or Epworth Sleepiness Scale scores
Cavallo et al (2005) ⁴⁴	45	Pediatric residents	Single center, randomized placebo-controlled crossover study; melatonin 3 mg vs placebo after night shift	No difference in measures of sleep, mood, or 5/6 measures of attention; the 1 measure of attention (number of omission errors) lower for melatonin group vs placebo
Farahmand et al (2018) ⁴⁵	24	Emergency medicine residents	Single center, randomized placebo-controlled crossover study; melatonin (3 mg) vs placebo	Melatonin associated with decreased nighttime awakening and daytime drowsiness compared to placebo

baseline ESS and PSS scores by the end of their week of ambulatory clinic.²⁰

Dedicated night coverage is another common scheduling adaptation to provide 24-hour coverage while adhering to work hour limits; however, its benefit remains unclear. A crossover study in medical interns comparing every-fourth-night call with

30-hour work limits to an intervention group of dedicated night shifts with 16-hour work limits found increased sleep in the intervention group at the cost of reduced educational opportunities, increased handoff, and both nursing and resident reduction in perceived quality of care.²¹ A prospective cohort study of residents on a general pediatric ward had conflicting

results—compared to traditional call schedule with extended duration shifts, dedicated night shifts unexpectedly resulted in decreased sleep hours.²² There is limited data on the optimal schedule and duration for overnight or night shifts. However, an observational study of electroencephalographic patterns of anesthesiology residents following 6 consecutive night shifts found that time spent in restorative (deep and rapid eye movement) sleep did not return to baseline over a 3-day period, thereby suggesting insufficient time for recovery.²³

Napping: The ACGME previously recommended “strategic napping” in its 2003 work hour guidelines, which was later retracted.^{24,25} Several studies aimed to evaluate if, when, and how long napping while working extended duration shifts. In one study of interns, napping *ad libitum* when fatigued on night shift (average 2 hours duration) was associated with improved performance on task switching attention tests but not on go/no-go attention tasks.²⁶ Another single center study of residents working 24-hour shifts found that >4 hours of napping resulted in improved performance on psychomotor vigilance testing, although improvement was not enough to fully recover to post-call performance.²⁷

Beyond *ad libitum* naps, several studies have evaluated scheduled and protected nap time overnight ranging from 3 to 6 hours. On extended duration shifts (>24 hours), protected nap time resulted in more total sleep and sleep efficiency, less fatigue,²⁸ improved performance on psychomotor vigilance testing,²⁹ and no changes in patient outcomes.³⁰ Protected nap time of just 20 minutes during the daytime was associated with improved performance on testing for attention failures.³¹ Despite beneficial outcomes, napping may be limited by residents’ desire for continuity of care, and notably multiple studies demonstrated only a fraction of protected nap time was spent sleeping.

Paging Efficiency: Paging is still the primary method of communication in many hospitals and occurs frequently throughout the night, often for non-urgent issues. The ability to rest on extended duration shifts or night shifts is often interrupted by frequent pages. At a single institution, an interventional program that filtered pages through a charge nurse resulted in a decrease in total and non-urgent pages by 50% and 75%, respectively.³² A quality improvement study developed focus groups for nighttime paging which led to a 50% decrease in total nighttime pages; however, no significant difference in total sleep time was observed.³³

Sleep Hygiene Education: The ACGME requires that residency programs educate their residents on fatigue mitigation,³⁴ but there is currently no set standard for how to teach this. A single institution study investigated the effect of the Sleep, Alertness, and Fatigue Education in Residency (SAFER) program developed by the American Academy of Sleep Medicine to improve intern sleep, but demonstrated no significant changes in sleep time after participation in the program.³⁵ Another center implemented a complete wellness program with biweekly mental health and sleep education lectures. After 1 year, residents reported decreased anxiety and sleepiness and improved quality of life.³⁶ Although a single education session is likely insufficient to change resident sleep habits, longitudinal educational programs and individual practice changes may improve resident sleep while limiting fatigue.

Pharmacological Interventions

Stimulants: Caffeine is frequently used to combat fatigue during overnight and night shift work. In a survey of 12 emergency medicine residency programs, 89% reported use of caffeine during night shifts.³⁷ In a single center randomized placebo-controlled crossover study, simulated driving performance of anesthesiology residents was evaluated following 6 consecutive night shifts. The intervention group (consumed beverage containing 160 mg caffeine) demonstrated overall better performance in a high-fidelity driving simulator, struck significantly fewer obstacles, and had quicker reaction time on psychomotor vigilance testing than the control group (consumed a non-caffeinated beverage).³⁸ Improved driving performance was observed only in the later part of the driving test, and residents who consumed caffeine performed worse in the first 15 minutes of testing. Larger studies are needed to further elucidate the benefits and potential limitations of caffeine on fatigue.

Modafinil is a central nervous system stimulant that is available only by prescription in the United States and used for treatment of narcolepsy, obstructive sleep apnea, and shift work sleeping disorder. In a survey of 133 emergency medicine residents, 2.4% reported using modafinil. Of these, 64% reported improved clinical performance with modafinil, while 31% of users reported significant side effects, including insomnia, agitation or restlessness, palpitations, and nausea or anorexia.³⁹ Evaluation of the effectiveness of modafinil in adjusting to shift work in residents is limited to survey-based reports.

Nonbenzodiazepines: Nonbenzodiazepines, sometimes called “Z-drugs,” include zolpidem, eszopiclone, and zalepon. Nonbenzodiazepines differ in structure from benzodiazepines, are less likely to cause physical dependence, and are approved for the treatment of insomnia. The benefit on any sleep or performance metrics with the use of nonbenzodiazepines has not been studied specifically in resident physicians, but between 14% and 22% of emergency medicine residents report using nonbenzodiazepines to sleep following shift work.^{37,39} Reported side effects include drowsiness, dizziness, headache, hallucinations, depression/mood lability, and amnesia. Although described as a safer alternative to benzodiazepines, the regular use of nonbenzodiazepines is associated with risk for physician dependence, rebound insomnia, and a single-case report of zolpidem withdrawal seizures in a resident with chronic heavy use of alcohol and zolpidem.⁴⁰

Antihistamines: First-generation H1 antagonists are widely available over the counter primarily as allergy medications but are frequently used for their sedating side effects. No specific study of the utility of antihistamines for improving sleep has been conducted in residents, though, similar to nonbenzodiazepines, they are commonly used by residents to improve sleep. Among 226 emergency medicine residents surveyed, antihistamines were the most commonly used sleep aid (31%), followed by zolpidem (14%), melatonin (10%), and benzodiazepines (9%).³⁷ Another survey of emergency medicine residents found that 46% used a sleep aid with antihistamines (diphenhydramine and doxylamine) reported as the most commonly used.⁴¹

Melatonin: Melatonin is a hormone secreted by the pineal gland that regulates several physiological functions including circadian rhythms. Exogenous melatonin is widely available over the counter and is a popular sleep aid, classified in the United States by the Food and Drug Administration as a “dietary supplement.” There is no standard dosage for melatonin although typical dosages range from 1 to 10 mg.⁴² Modest benefits of melatonin were shown in night-shift doctors and nurses in a pilot double blinded, randomized, placebo-controlled crossover trial. Intervention participants took 6 mg of melatonin following their first of 3 contiguous night shifts. Compared to placebo, the intervention subjects performed better on double digit addition and reaction time testing. Psychomotor vigilance testing, sleep latency, duration, wake after sleep onset, and ESS scores were not significantly different between treatment arms.⁴³

Melatonin has been shown to have limited or equivocal effects in medical residents. In a single center randomized placebo-controlled crossover study of pediatric residents, subjects received 3 mg melatonin or placebo in the morning following night shift. Intervention residents had isolated improvement in omission errors but no differences were observed in attention, sleep, and mood compared to placebo were observed.⁴⁴ In another single center randomized placebo-controlled crossover study of emergency medicine residents, nighttime awakening and daytime drowsiness were not significantly different with melatonin compared to placebo.⁴⁵

Discussion

This narrative review examined non-pharmacological and pharmacological interventions to reduce the physiologic effects of fatigue and sleep deprivation from overnight and night shift work. Non-pharmacological interventions such as strategic scheduling may improve total sleep time but at the expense of education (eg, availability to attend conferences) and continuity of patient care. Institutional changes in scheduling, faculty supervision, and innovation in technology and care may also contribute to improved resident well-being and patient safety. Although survey data suggest that pharmacological interventions are frequently used by residents to reduce fatigue and improve sleep, few have been rigorously studied in prospective randomized controlled trials. Based on limited data, the effects of melatonin on sleep are equivocal.

Other non-pharmacological interventions, such as bright light and dark exposure, mindfulness, and meditation, have been trialed to reduce fatigue in night shift workers and other medical professionals. For example, exposure to 6 hours of bright light in the workplace while adapting to night shift correlated with shifts in circadian rhythms (measured by core body temperature and salivary melatonin) by an average of 9.3 hours and 11.3 hours, respectively, compared to control group phase shifts of 4.1 hours and 5.1 hours, respectively.⁴⁶ Mindfulness and meditation are widely available and have been studied in patients with insomnia and sleep disturbances as a potential treatment modality. A meta-analysis of 6 randomized controlled trials found that mindfulness meditation improved sleep quality and decreased total wake time during sleep, but had no significant effect on sleep onset latency, total sleep time, wake after sleep onset, sleep efficiency, insomnia severity index, Pittsburgh Sleep Quality Index (PSQI) and Dysfunctional Beliefs and Attitudes about Sleep Scale.⁴⁷ When compared to standardized sleep hygiene education, one randomized controlled trial found that mindful

awareness practice, a standardized course on mindfulness meditation, was more effective in improving sleep quality as measured by the PSQI (improvement by a mean of 1.1 vs 2.8, respectively).⁴⁸ A single randomized controlled trial evaluated the use of at least 10 minutes of daily app-guided (“Calm”) meditation for 8 weeks was associated with decreased daytime sleepiness in adults with sleep disturbance.⁴⁹ Although these techniques have not been studied in residents as tools for managing sleep deprivation (and thus they were excluded from our review), their success in other populations make them potentially useful adjuncts for managing shift-work related insomnia and sleep disturbances.

Our results are limited by the low number of relevant articles, as well as the heterogeneity of study design and intervention type. We were unable to systematically analyze the data via a meta-analysis. Our results are presented as a narrative review, which is inherently less rigorous and reproducible. Data on non-pharmacological interventions were limited by the heterogeneity of intervention type, sample size, length of follow-up, and reliance on self-report. Existing studies are of a pre-/post-design or are small and specialty specific, limiting their applicability to other specialties and practice settings. Larger prospective interventional studies to evaluate the impact of non-pharmacological interventions on patient-related outcomes are needed to ensure these changes are not adversely affecting patient care. Despite the apparent lack of studies supporting the use of pharmacological agents, residents may be tempted to use these medications to mitigate fatigue. Randomized controlled studies are needed to evaluate both the utility and safety of pharmacological treatments to reduce fatigue and improve sleep in resident physicians.

Conclusions

Non-pharmacological interventions (eg, work hour limits, block scheduling, dedicated nighttime coverage, napping, paging efficiency, and sleep hygiene education) and pharmacological interventions (melatonin, anti-histamines, non-benzodiazepines, and caffeine) have been studied and demonstrated to have varying effectiveness on improved restful sleep. Other non-pharmacological interventions, such as mindfulness meditation, have demonstrated beneficial effects for improving sleep in other study populations and should be studied in resident physicians.

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