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A scoping review of sleep education and training for nurses☆

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ABSTRACT

Background: Shift work and resulting sleep impairment among nurses can increase their risk for poor health outcomes, occupational injuries, and errors due to sleep deficiencies. While sleep education and training for nurses has been recommended as part of a larger fatigue risk management system, little is known about training programs designed specifically for nurses.
Objective: Investigate the literature for current sleep education or training programs specifically for shift working nurses, with intent to assess training content, delivery characteristics, and outcome measures.
Design: A scoping review conducted October 2020 through September 2021.
Methods: The bibliographic databases Cumulative Index of Nursing and Allied Health (CINAHL), Scopus, PubMed, and NIOSHTIC-2 were searched using words such as "nurse," "sleep hygiene," "shift work," and "education". Studies were included if they: 1) were original research; 2) discussed sleep education, training, or sleep hygiene interventions; 3) included a study population of nurses engaging in shift work; 4) focused on sleep as a primary study measure; 5) were written in English language; and 6) were published in 2000 or later.
Results: Search results included 17,237 articles. After duplicates were removed, 14,620 articles were screened. Nine articles were found to meet established criteria. All studies included sleep hygiene content in the training programs, with five studies adding psychological and/or behavior change motivation training to support change in nurse sleep habits. Three studies added specific training for nurses and for managers. Delivery modes included in-person training of various lengths and frequency, mobile phone application with daily engagement, an online self-guided presentation, and daily reading material coupled with audio training. Pittsburgh Sleep Quality Index and Epworth Sleepiness Scale were the outcome measures most frequently used. Although studies demonstrated improved sleep measures, most were pilot studies testing feasibility.
Conclusion: Although there is a paucity of studies focused on sleep education and training for shift working nurses, we found the inclusion of sleep hygiene content was the only common characteristic of all nine studies. The variability in training content, delivery methods, and outcome measures suggests further research is needed on what constitutes effective sleep education and training for nurses.

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What is already known

- Sleep education and training for nurses has been recommended to reduce risks from work-related fatigue
- Little is known about what content, delivery mode, and frequency of training is most effective for the nursing workforce to prevent work-related fatigue.

What this paper adds

- Sleep education and training content for nurses may include sleep hygiene, sleeping strategies specific to shift work, behavior change approaches to reinforce healthy sleep habits, and psychological support to address sleep disturbances from job stress
- Sleep education and training delivery (in-person vs. technology based) and frequency vary, with limited information about what nurses prefer or is effective
- Conclusions regarding training effectiveness were unable to be made due to the variety of sleep outcome measures and the small-scale, preliminary nature of the studies published

1. Introduction

Despite the significance of sleep to health and wellbeing, obtaining sufficient sleep can be challenging for nurses. Nurses regularly report experiencing poor sleep quality and on average, sleep less than the 7–9 h/24-h recommended for optimal health and safety (Di Simone et al., 2020; Hittle et al., 2020; Stimpfel et al., 2019; Zeng et al., 2019). Poor sleep among nurses can increase their risk for occupational injuries, such as back injuries, needlesticks, sharps injuries, and motor vehicle crashes due to drowsy driving (Geiger-Brown et al., 2021; Lo et al., 2016; Vinstrup et al., 2020). Adverse outcomes related to poor sleep among nurses can have cascading effects, with a potential for decreased quality of patient care and increased risk to patient safety (Stimpfel et al., 2019).

Nurses face a multitude of barriers to achieving sufficient sleep duration and quality, of which, shift work is a primary factor. Shift work, defined as a series of work schedules to cover work throughout all or most of the 24-h period, can place workers at high risk for poor sleep due to work schedules which conflict with typical sleeping hours (Akerstedt and Wright, 2009). In 2020, approximately 60% of the 4.1 million U.S. nurses worked in facilities (i.e., hospitals, long-term care) requiring shift work (Smiley et al., 2021). Shift work schedules may include working more than 40-h per week, evening, night, or rotating shifts (Geiger-Brown et al., 2011), long shifts (i.e., ≥10 h) (James et al., 2020), and minimal time off in-between shifts (i.e., ≤11 h) (Dahlgren et al., 2016). These types of work schedules can result in limited hours off, leaving little time for nurses to engage in family or community activities and allow time for sufficient, quality sleep (Geiger-Brown et al., 2011). Therefore, organizational efforts designed to reduce work demands, improve schedules, promote and improve sleep among nurses can not only benefit nurse health and safety but can also reduce the risk for patient injuries and errors (American Nurses Association, 2014; Caruso et al., 2017; Wong et al., 2019).

There are a variety of organizational efforts that can support workers in obtaining adequate, quality sleep. Recommendations include scheduling practices which allow more time for sleep, such as 11-h minimum between scheduled shifts, (Wong et al., 2019) and environmental considerations, such as purposely timed light exposure (Harrison et al., 2020), which may help with improving sleep. Moreover, employer-provided sleep education and training (SET) to reinforce the importance of sleep and sleep-promoting behaviors (e.g., sleeping in a dark, cool and quiet bedroom) has been demonstrated to reduce levels of acute fatigue, stress, and burnout, and improve safety, sleep duration, and sleep quality among a variety of shift workers (Barger et al., 2018; Redeker et al., 2019).

Sleep education encompasses a wide variety of topics and guidance (e.g., sleep disorders, drowsy driving) to promote sleep (National Sleep Foundation, 2021) and is readily available online for the general public through organizations such as the Centers for Disease Control and Prevention (Centers for Disease Control and Prevention, 2016), National Sleep Foundation (2021) and the NIOSH (2015). Yet, provision of information on basic sleep science and sleep hygiene (routines that promote falling and staying asleep [Centers for Disease Control and Prevention, 2016]) alone does not always translate to improved sleep for nurses. Because of the specific barriers nurses face to obtaining sufficient, quality sleep including challenging work schedules (Mazar et al., 2021; Nishinoue et al., 2012), emotional exhaustion, thought rumination from job stress, (Chin et al., 2015; Scott et al., 2014), in addition to individual characteristics, such as family life, advancing age, and personality type (Booker et al., 2018), specialized SET for nurses may be needed. Sleep hygiene content intended for the general public consumption has limitations for nurses who work shift work and may benefit from learning how to balance sleep schedules with work schedules and off-duty responsibilities (West et al., 2016). Specifically, sleep practices and fatigue mitigation strategies shift workers rely on, such as daytime napping and caffeine use, are counter to the sleep hygiene recommendations provided the non-shift working population (Shriane et al., 2020). While the evidence on SET programs for workers is promising, the wide variety of worker populations, potential bias in study designs, differing educational content, delivery modes, and sleep outcome measures make it difficult to determine the most salient components and outcome measures (Barger et al., 2018). This in turn creates challenges in identifying training components (e.g., sleep hygiene, shift work strategies) which could be adopted for nurses working in demanding

healthcare settings. As such, a review of literature on nurse-focused SET programs, would be useful for researchers to further build the evidence and clarity on which training characteristics may be most beneficial to nurses.

The purpose of this scoping review is to describe the content and delivery characteristics of SET programs specific for shift working nurses. We also report the sleep outcome measures used to test the effectiveness of these programs so that future studies can consider using the same outcome measures for cross-study comparisons. We intended to conduct a scoping review, as sleep education and training specific for nurses is still relatively rare. Additionally, SET research among other workers has demonstrated a heterogeneity of content and characteristics (Barger et al., 2018). Scoping reviews aim to map key concepts, describe existing literature and provide information about knowledge gaps to guide future research in this area (Arksey and O'Malley, 2005; Munn et al., 2018). Unlike systematic reviews, scoping reviews do not assess the quality of included studies (Munn et al., 2018).

2. Methods

This study was guided by Arksey and O'Malley's (2005) framework for conducting scoping reviews to systematically search, select and synthesize existing knowledge. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews (PRISMA-ScR) Checklist was used to ensure a robust reporting of this scoping review process (Tricco et al., 2018).

2.1. Search strategy

Search terms and strategies were developed in consultation with subject matter experts and by identifying key terms from the literature (Barger et al., 2018), CINAHL (EBSCO), SCOPUS, PubMed, and NIOSHTIC-2. The search was conducted October 2020 through September 2021. Main components of the final search involved words related to "nurse," "healthcare worker," "sleep hygiene," "shift work," and "education" (Appendix A). A quality assurance check of our search strategy was conducted using key seminal articles (Scott et al., 2010).

2.2. Study eligibility and selection

Included studies were limited to original research written in English and published in 2000 or later. The publication date was determined based on similar review publications about SET with other workforces (Barger et al., 2018), where few studies were found published prior to 2000. Additionally, the goal was to find the most relevant information on delivery components (e.g., technology-based training) to build upon. Our study population focused on nurses employed in shift work schedules, where "shift work" was defined as schedules covering all or most of the 24-h period (Akerstedt and Wright, 2009), or if not specified, work occurring within facilities providing 24/7 patient care. We focused specifically on the nursing population because, outside the European Union, nurses are rarely protected by work hour regulations, as medical residents are. In addition, in comparison to other health care workers in acute care settings (e.g. physicians, allied health professionals), the majority of nurses work shift schedules (Smiley et al., 2021). As such, focusing our search to sleep education and training intereventions among this specific population will highlight any gaps or needs to help prolong nurses' careers and wellbeing.

We restricted included studies to those that investigated sleep education, sleep training, or sleep hygiene as an intervention. This information will help future intervention efforts by identifying common content themes. We also concentrated on sleep outcome measures so that future studies can use the same measures to compare effects across studies. Title and abstract screening, and full text screening were both completed independently by two researchers (Author 1, Author 2) to determine whether articles met the inclusion criteria. Results were discussed as a group with a third researcher (Author 4), who acted as a tiebreaker where there were conflicting assessments.

2.3. Data charting, data items, and system for synthesis of results

A data extraction table was developed and tested by the team with agreed upon data items specific to the study questions. Data were extracted by Author 1 and Author 2. To ensure accuracy, Author 1 and Author 2 reviewed each other's data extraction results. Data items included: 1) study author and publication year; 2) study design, population, and setting; 3) training intervention (i.e., employee, employee and management) and content; 4) training delivery characteristics (i.e., mode of delivery, length of training, frequency of interaction with training content); 5) sleep outcome measures (subjective and objective); and 6) study results specific to sleep outcomes. To address the specific study questions, data items were synthesized based on the type of content delivered, SET for employers and managers, delivery characteristics, training frequency, sleep outcomes measured, and reporting on SET effectiveness.

3. Results

The database search yielded 17,236 references (Fig. 1). While our database search did include dissertations, one reference (Garcia, 2020), a doctoral project paper, was not found in the peer-reviewed databases, but through a subject matter expert. After 2617 duplicates were removed, we conducted a title and abstract screening. We found many studies were about patient sleep, and those that focused on nurses as the study population were not intervention studies of SET programs, but instead only provided strategies for getting good sleep. As such, 14,578 studies were removed at this initial screening stage. In our full text screening we found that most were not formal studies of sleep education, but tips shared in trade magazines, or the study population did not include nurses (see Fig. 1). In the end, only nine studies met our inclusion criteria (Carter et al., 2013; d'Ettorre and Pellicani, 2020; Garcia, 2020; Geiger Brown et al., 2014; Lee et al., 2014; Morimoto et al., 2016; Omeogu et al., 2020; Scott et al., 2010; Sorensen et al., 2016).

A summary of data charting from the included studies is presented in Table 1. All articles were published within the last decade, with three from 2020. All nine studies conducted pre and post intervention testing, with three studies repeating data collection at multiple points after the intervention (Carter et al., 2013; Lee et al., 2014; Scott et al., 2010). Seven of the studies were conducted within the United States (Carter et al., 2013; Garcia, 2020; Geiger Brown et al., 2014; Lee et al., 2014; Omeogu et al., 2020; Scott et al., 2010; Sorensen et al., 2016). The remaining studies took place in Italy and Japan respectively (d'Ettorre and Pellicani, 2020; Morimoto et al., 2016). Study population sizes ranged widely from 9 (Carter et al., 2013) to 518 participants (d'Ettorre and Pellicani, 2020). Carter et al. (2013) recruited nurses working in a hospice facility, while all other studies were conducted in hospitals. Two studies recruited nurses with self-reported sleep issues: Omeogu et al. (2020) included nurses who self-reported moderately severe to severe insomnia via the Insomnia Severity Index and Lee et al. (2014) included nurses who reported poor sleep for the past month.

3.1. Education and training content

Although there was a variety of SET content provided in the nine identified studies, similarities were also noted. All nine studies in this review included sleep hygiene education depicting a wide variety of strategies, including strategic timing of caffeine intake (Carter et al., 2013; d'Ettorre and Pellicani, 2020; Omeogu et al., 2020; Scott et al., 2010), restricting exercise before sleep (Carter et al., 2013; Garcia, 2020), and reducing use of electronics before sleep (Garcia, 2020). Environmental controls to facilitate sleep, such as decreasing ambient temperature and sleeping in a darkened room, were also provided

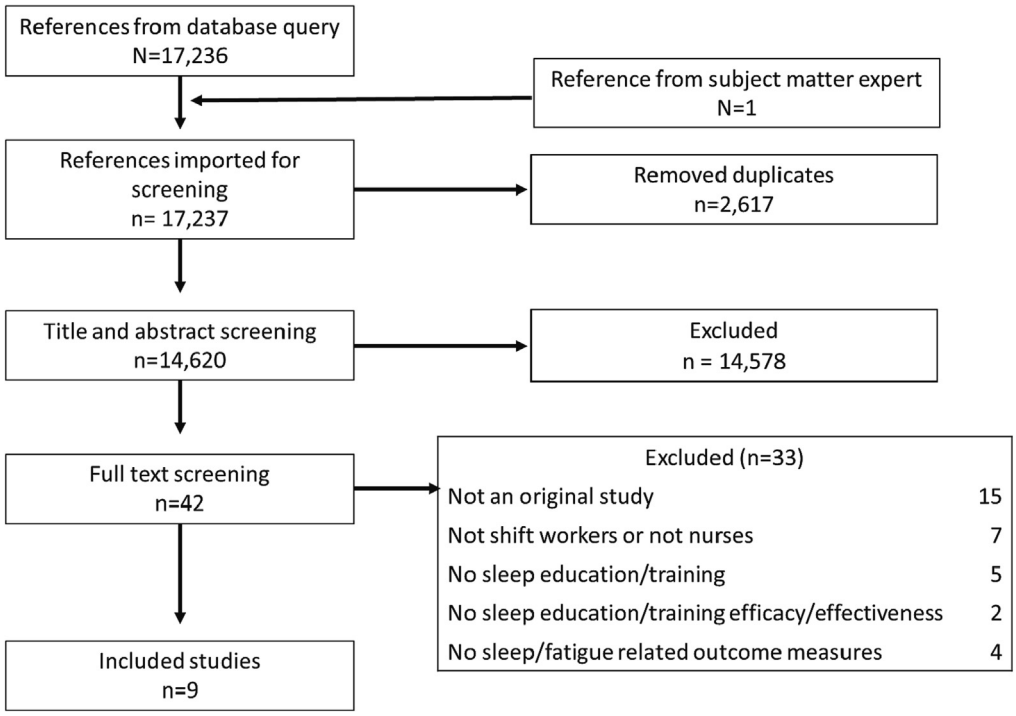

Fig. 1. Reference screening selection flowchart.

(Carter et al., 2013; Garcia, 2020). Five studies shared shift work related sleep strategies for nurses, such as suggested sleep schedules for before and after shifts and napping guidelines for during shifts (d'Ettorre and Pellicani, 2020; Garcia, 2020; Geiger Brown et al., 2014; Lee et al., 2014; Scott et al., 2010). The SET program in Carter et al. (2013) provided psychological strategies specific for nurses experiencing difficulty falling asleep, or other symptoms of insomnia, in response to occupational stress from caring for sick patients. Three studies did not provide details on the sleep hygiene education other than topic titles such as basics of sleep, sleep habits, and sleep management (Morimoto et al., 2016; Omeogu et al., 2020; Sorensen et al., 2016). We attempted to obtain additional information by reaching out to the authors or searching other published articles on their SET programs, and only one (d'Ettore) replied. Two studies (Geiger Brown et al., 2014; Scott et al., 2010) used or adapted training content from other existing sleep or fatigued training modules for workers, such as the NIOSH "Training for Nurses on Shiftwork and Long Work Hours" (NIOSH, 2015), the National Aeronautics and Space Administration fatigue risk management training (Rosekind et al., 2006), and the Sleep, Alertness, and Fatigue Education in Residency Program (Arora et al., 2007).

In addition to sleep hygiene education, six studies (Carter et al., 2013; Garcia, 2020; Lee et al., 2014; Morimoto et al., 2016; Omeogu et al., 2020; Sorensen et al., 2016) included psychological and behavioral training methods, such as stress management, relaxation training, goal setting, or cognitive behavioral therapy for insomnia (CBT-I). CBT-I incorporates skills for managing insomnia symptoms, such as stimulus control (i.e., behavior to associate bed with sleep) and cognitive restructuring (i.e., identify and modify sleep beliefs that reinforce negative sleep habits) (Edinger et al., 2021). Three studies based their interventions on CBT-I principles, including cognitive restructuring and teaching skills on stimulus control (Carter et al., 2013; Lee et al., 2014; Omeogu et al., 2020). Relaxation techniques, such as progressive muscle relaxation through breathing techniques and guided imagery, were included in four studies (Carter et al., 2013; Garcia, 2020; Lee et al., 2014; Morimoto et al., 2016). To reinforce psychological training, four studies used behavioral change strategies, which included inviting participants to identify a sleep habit to change (Carter et al., 2013; Morimoto et al., 2016), optional meetings with a health coach (Sorensen et al., 2016), setting goals to achieve change, and tracking their progress and strategies employed in daily sleep diaries (Morimoto et al., 2016).

3.2. SET for employers

Several SET programs described in this review included training for nurses and employers. SET programs for employers were often combined with an organizational level intervention (e.g., changing administrative policies) to facilitate employee sleep. For example, d'Ettorre and Pellicani (2020) provided 8-h of training to nurse managers on scheduling strategies to support nurse sleep (e.g., utilizing a forward rotating shift work schedule and fast shift rotation). Geiger Brown et al. (2014) included the SET as part of a fatigue risk management system, which included implementing a night shift napping protocol, screening participants for sleep disorders, and evaluating a fatigue risk management software as a decision making tool. Scott et al. (2010) did not explicitly describe an organizational education program. Instead, researchers worked in partnership with administration and management to institute organizational policies supporting the strategies nurses were taught in the study training. Policy changes included abolishing existing policies to terminate nurses found sleeping on duty, allowing nurses to take naps during work shifts (as described in the training program), providing adequate staffing, and strategies to ensure nurses were given and taking full break periods. Sorensen et al. (2016) took a broader approach than other studies described by collaborating with nurse managers to incorporate SET into a larger healthy lifestyle and occupational health and safety program. Researchers engaged nurse managers to make training more accessible to staff (offering training on day and night shift) and to shift the organizational culture towards one that reinforces healthy habits through work policies and practices.

3.3. Delivery characteristics and training frequency

Education and training delivery modes varied among studies (e.g., in-person, remotely using various media, or a mix). Five of the intervention programs were delivered through in-person educational sessions (Carter et al., 2013; d'Ettorre and Pellicani, 2020; Morimoto et al.,

Table 1
Data extraction from nurses sleep training studies.

Authors, article type	Study design, population, setting	Training intervention and content	Delivery characteristics	Sleep outcome measures	Study results
Carter et al. (2013) **Article Type:** Peer reviewed	**Design:** Feasibility study with five-week descriptive correlational design **Population and Setting:** Hospice nurses (N = 9), Texas, U.S.	**Employee Level:** CBT-I[a] with stimulus control, sleep hygiene, relaxation techniques	**Delivery mode**: In-person; **Frequency**: Two 1-h training sessions; **Week 1:** Baseline data collection; **Week 2:** One-hour education program; **Week 3:** Data collection; **Week 4:** One-hour content review and facilitating goal attainment; **Week 5:** Data collection	**Subjective:** PSQI[f] collected at weeks 1, 3, 5	Trends of improved sleep onset latency, total sleep time, and sleep efficiency noted at week 3, but not at week 5.
d'Ettorre and Pellicani (2020) **Article Type:** Peer reviewed	**Design:** One-group pretest-posttest **Population and Setting:** Hospital-based nurses (N = 518), Salento, Italy	**Employee Level:** Shift work risks to worker health and safety, sleep hygiene and pre-during-post shift sleep strategies; **Organizational Level**: Shift scheduling strategies to improve worker sleep (i.e., predictable schedule, forward rotating schedule, >11-h rest period between shifts)	Delivery mode: In-person; Frequency (Employee Level): 6-h total, unknown frequency; Frequency (Organizational Level): 8-h, unknown frequency;	**Subjective:** ESS[b]	Decreased sleepiness (ESS[b]) noted post-training
Garcia (2020) **Article Type:** Doctoral project document	**Design:** One-group Pretest-posttest **Population and Setting:** Night shift hospital-based nurses (N = 62), Texas, U.S.	Employee Level: Sleep education defined fatigue, sleepiness, and shift work disorder. Described factors contributing to night shift nurse sleepiness and fatigue, consequences of sleepiness and fatigue and countermeasures	**Delivery mode**: Intervention delivered via PowerPoint. No in-person contact. **Frequency:** Presentation emailed to participants. Participant engagement frequency was not measured.	**Subjective:** ESS[b], KSS[e]	Trend in decreased sleepiness (ESS[b], KSS[e]) noted post-training. No statistical comparison analysis completed.
Geiger Brown et al. (2014) **Article Type:** Peer reviewed	**Design:** Pilot study with pretest-posttest; randomized units for determining intervention units where nurses were recruited **Population and setting:** Nurses from 2 hospitals (N = 114), mid-Atlantic region, U.S.	**Employee Level:** Training content was from the NIOSH, *Training for Nurses on Shift Work and Long Work Hours* (NIOSH, 2015), including information on sleep physiology, risks of shift work to health and safety, shift work strategies to reduce risk **Organizational Level:** Night shift napping protocol, sleep disorder screenings, fatigue risk management scheduling software	**Delivery mode:** Web-based content, delivered in 8 modules **Frequency:** Nurses completed the 2.5–3-h training on their own timetable.	**Subjective:** Daily sleep diary collected for 4 weeks, ESS[b], KSS[e], GSDS[c] to measure sleep quality, quantity, and insomnia, Occupational Fatigue, Exhaustion and Recovery Scale, Qualitative feedback to evaluate the training	Unable to measure differences in sleep due to attrition at posttest data collection (only 2 of 30 participants approached responded). Nurses from the intervention group (n = 29) were asked to complete the NIOSH (2015) *Nurses Training*. Nurses reported it was helpful but took too long to complete.
Lee et al. (2014) **Article Type:** Peer reviewed	**Design:** Feasibility study with prospective longitudinal within-subjects design **Population and Setting:** Hospital-based nurses with "poor" sleep (N = 109), California, U.S.	Employee Level: **Active Control (Weeks 2–5)**: Shift work strategies (Sleep deprivation health effects, organizational issues related to shifts, sleepy hygiene, diet, exercise, relaxation, sleep–wake aids); **Intervention (Weeks 7–10)**: CBT-I[a] (cognitive restructuring, sleep restriction, sleep hygiene, relaxation, stimulus control);	**Delivery mode (Active control):** Participants read 5 chapters, completed daily sleep diary, document study activities **Frequency (Active control):** Weekly reading assignments over 4-weeks **Delivery mode (Intervention):** Reading and daily auditory relaxation modules, daily sleep diary, document study activities **Frequency (Intervention):** Weekly readings, auditory content beginning from 15–45 min over 4- weeks **Week 1 (T1):** Baseline data collection; **Week 2–5:** Active control; **Week 6 (T2):** Data collection; **Week 7–10:** Intervention; **Week 11 (T3):** Data collection	**Objective:** Wrist actigraphy collected at weeks 1, 6, and 11 **Subjective:** PSQI[f] and GSDS[c] collected at T1 (week 1), T2 (week 6), T3 (week 11)	Improved sleep quality (PSQI[f]) at T3, decreased sleep disturbance (GSDS[c]) at T3, decreased sleep disturbance at T2 to T3 and T1 to T3
Morimoto et al. (2016)	**Design:** Pilot study with 2-group non-randomized pretest-posttest	**Employee Level:** Sleep education included sleep hygiene content with	**Delivery mode (control and intervention):** 90-min in-person education class	**Subjective:** PSQI[f] (Japanese version), ESS[b] (Japanese version)	Improved composite sleep quality scores (PSQI[f]) in intervention group

(continued on next page)

Table 1 (*continued*)

Authors, article type	Study design, population, setting	Training intervention and content	Delivery characteristics	Sleep outcome measures	Study results
	Population and Setting: Hospital-based nurses (N = 25), Japan	application education **Control** (n = 15): Sleep education as listed **Intervention** (n = 10): Sleep education as listed plus stress management and self-help therapy techniques for identifying sleep habits to change. Participants kept a sleep diary to document sleep, behavior change, and stress.	**Frequency:** 2 classes, 2 weeks apart		Improved sleep latency and sleep disturbance scores noted among participants with poor sleep quality at pre-test
Omeogu et al. (2020) **Article Type:** Peer reviewed	**Design:** Proof of Concept Study with one-group pretest-posttest **Population and Setting:** Hospital-based nurses with insomnia (N = 17), U.S.	**Employee Level:** CBT-I[a] content included sleep hygiene, sleep education, relaxation training, stimulus control, sleep restriction, relaxation training, and cognitive therapy.	**Delivery mode:** Smart phone app **Frequency:** Self-administered over 6- weeks	**Subjective:** ISI[d] collected at weeks 1, 3, 6	Decreased insomnia (ISI[d]) at 0 to 3 weeks and 0 to 6 weeks
Scott et al. (2010) **Article Type:** Peer reviewed	**Design:** Feasibility Study with one-group pretest-posttest with repeated measures **Population and Setting:** Hospital-based nurses (N = 62), Michigan, U.S.	**Employee Level**: Included fatigue, sleep, circadian rhythm, sleep deprivation health effects, misbeliefs on sleepiness. Provided strategies on decreasing fatigue, increasing alertness, duration, and sleep quality with naps, caffeine, as well as scheduling strategies to promote sleep health. **Organizational Level:** Study team worked with management to ensure nurses could implement on-the-job fatigue mitigation strategies (i.e., adequate breaks, naps) taught in the education program.	**Delivery mode (Individual Level)**: 60 min in-person program **Frequency (Individual Level)**: Once **Delivery mode (Organizational Level):** In-person support for organizational mitigation strategies (i.e., scheduling, staffing, full break periods, and naps during breaks) **Frequency (Organizational Level):** Unknown	**Subjective:** PSQI[f], ESS[b], Self-report (via log twice per day) sleep duration, vigilance, accident/injury risk, short-term memory, and problem solving/coping. Collected at weeks 1–2, 4–7, 15–16	Improved sleep quality (PSQI[f]) at 12 weeks; decreased severe sleepiness (ESS[b]); increased sleep duration, vigilance, problem solving (logbooks); decreased reported motor vehicle accidents, workplace errors, drowsiness (logbooks)
Sorensen et al. (2016) **Article Type:** Peer reviewed	**Design:** Proof-of-concept study using a mixed-methods, pretest-posttest **Population and Setting:** Patient care workers (i.e., Nurses, licensed practical nurses, patient care assistants) working on 8 inpatient hospital units, (Focus group arm, N = 25 nurses; Quantitative arm, N = 482 patient care workers) Massachusetts, U.S.	**Employee Level:** Sleep educational session; social media page containing additional content; access to health coaching **Organizational Level:** Consultations were conducted with management to address physical environment, work organization, and policies impacting health outcomes (including sleep)	Delivery mode: In-person **Frequency:** One-time sleep related training (approximately 35 min) as part of a larger 8-month. Education programming was presented onsite once per month on day shift and once per month on night shift	**Subjective:** sleep deficiency as measured by PSQI[f]; focus groups to evaluate facilitators, barriers, and improvement to training	Pre-post sleep measures improved with small effect size. No significant difference was noted between control and intervention groups. In focus groups, participants identified: 1) work factors (i.e.,12- h shifts, night shifts, stress) impacting their sleep and 2) patient care and work time constraints did not always allow for a break to attend training sessions.

[a] Cognitive Behavioral Therapy for Insomnia (CBT-I).
[b] Epworth Sleepiness Scale (ESS).
[c] General Sleep Disturbance Scale (GSDS).
[d] Insomnia Severity Index (ISI).
[e] Karolinska Sleepiness Scale (KSS).
[f] Pittsburgh Sleep Quality Index (PSQI).

2016; Scott et al., 2010; Sorensen et al., 2016). d'Ettorre and Pellicani (2020) provided 6-h of training completed over an unknown time (i.e., either in a single sitting or in smaller loads over multiple occasions). Morimoto et al. (2016) provided a 90-min in-person educational class. Scott et al. (2010) and Sorensen et al. (2016) each presented a single 60-min program, however Sorensen et al. (2016) supported training content with additional social media and optional health coaching. The remaining education interventions were completed remotely via various technology methods. Garcia (2020) emailed presentation slides to participants for reviewing. Training content in the Geiger Brown et al. (2014) study was a 3-h web-based program. Three of the studies using CBT-I (Carter et al., 2013; Lee et al., 2014; Omeogu et al., 2020) delivered trainings using 3 different methods: in-person, mobile application, and audio modules. Carter et al.'s (2013) in-person SET presented two 1-h sessions, the first hour providing content and the second practicing relaxation strategies and other cognitive-behavioral strategies. Lee et al. (2014) delivered training content via reading material and audio modules. Participants were given a daily schedule of which materials to engage with during the study period. The CBTi Coach app required participants to engage with education content over 6 weeks (Omeogu et al., 2020), during which participants received individualized sleep tips based on sleep patterns from self-reported measures.

3.4. Sleep outcome measures

Sleep-related outcome measures to assess the SET effectiveness included sleep duration, sleep quality, insomnia and sequelae from sleep disturbance (i.e., sleepiness, fatigue, vigilance). Various methods were chosen to measure outcomes and included subjective (e.g. self-assessments) and objective measurements (i.e., actigraphy). The most

common sleep outcome measures described in the included studies were self-reported scales: the Pittsburgh Sleep Quality Index (PSQI) (Buysse et al., 1989) and Epworth Sleepiness Scale (ESS) (Johns, 1991). The PSQI (Buysse et al., 1989) is a 19 question self-assessment that measures sleep quality and sleep problems over the past 30-days. Although most studies analyze the composite PSQI score for sleep quality, Carter et al. (2013), Lee et al. (2014), and Sorensen et al. (2016) also analyzed the PSQI sub-scores (e.g., sleep onset latency, sleep efficiency). The ESS quantifies daytime sleepiness through eight questions assessing the likelihood of dozing off in different situations (Johns, 1991). Other self-reported scales used in other studies include: General Sleep Disturbance Scale (Lee, 1992), Insomnia Severity Index (Bastien et al., 2001), and the Karolinska Sleepiness Scale (Åkerstedt and Gillberg, 1990). Wrist actigraphy was used in only one study as an objective measure of sleep duration (Lee et al., 2014). Sleep diaries were completed by participants in 2 studies (Geiger Brown et al., 2014; Scott et al., 2010) to record sleep duration and other study specific measures (e.g., patient care errors, commute time).

3.5. Reported effectiveness of sleep education and training programs

While most of the studies in this scoping review were pilot studies measuring SET program feasibility, most reported improved trends in sleep and sleep-related (e.g., sleepiness) outcome measures with the education and training. For SET centered on psychological and behavioral methods, improvements were noted in sleep duration (Carter et al., 2013), global sleep quality scores (Carter et al., 2013; Lee et al., 2014; Morimoto et al., 2016), sleep latency (Morimoto et al., 2016), sleep disturbance (Lee et al., 2014; Morimoto et al., 2016) and insomnia (Omeogu et al., 2020). Participants in the sleep knowledge training program, used by Garcia (2020), noted decreased self-reported sleepiness scores at post-test. Among the 47 participants that completed the study, implementing SET program in conjunction with a fatigue risk management system was found to significantly reduce self-reported sleepiness, improve PSQI scores, and show a decline in self-reported motor vehicle crashes and workplace errors over the 4 and 12-week post-intervention study period (Scott et al., 2010). d'Ettorre and Pellicani (2020) reported significantly decreased sleepiness among study participants between pre- and post-training measures. However, multiple interventions (i.e., schedule changes, SET) were applied simultaneously, and the authors did not disentangle the effects of each intervention separately. Thus, precluding the ability to conclude if significant effects were due to one intervention, or an interaction of the combination. Two studies in this scoping review did not report improvements in sleep measures (Geiger Brown et al., 2014; Sorensen et al., 2016). Geiger Brown et al. (2014) was not able to assess pre- and post-training differences due to participant attrition at post-measure data collection period. The authors reported, while nurses appreciated the training, they thought it took too long to complete. In the Sorensen et al. (2016) study, nurses reported during focus groups that the on-site training was not easily accessible, since workload and patient care timing did not always allow for a break to attend the training sessions.

4. Discussion

The purpose of this scoping review was to explore the scientific literature on SET specific to shift working nurses. Despite a robust search, there was a paucity of SET studies, and among those studies, there was a heterogeneity of intervention characteristics and measures. These findings have made drawing significant conclusions challenging and subsequently, a descriptive account of the literature is presented. The search strategy resulted in over 17,000 articles, however, only 9 fit inclusion criteria. There is little consistency among SET content, frequency and mode of delivery and outcome measures between the 9 studies. These findings are similar to other reviews on the broader workforce (Barger et al., 2018; Redeker et al., 2019), While all the studies included some sleep hygiene education content, some studies incorporated psychological and/or behavior change components (Carter et al., 2013; Lee et al., 2014; Morimoto et al., 2016; Omeogu et al., 2020; Sorensen et al., 2016) and others included organizational level education or support (d'Ettorre and Pellicani, 2020; Geiger Brown et al., 2014; Scott et al., 2010; Sorensen et al., 2016). While most studies concentrated on piloting SET programs or testing feasibility, two studies (d'Ettorre and Pellicani, 2020; Morimoto et al., 2016) assessed training effectiveness, providing promising evidence that SET may improve nurse sleep.

This review identified skill-based training included with sleep hygiene education content, which may have a positive effect on improving sleep among shift working nurses. For example, behavioral change-based training (e.g., setting sleep-related goals) may be helpful for nurses to develop strategies to obtain adequate sleep and allow for social recovery (Carter et al., 2013; Morimoto et al., 2016). Similarly, nurses may require additional skills to address job stress and trauma which can negatively impact sleep (Deng et al., 2020; Lee et al., 2021). Skills may include those designed to alleviate psychological distress, such as relaxation techniques (Carter et al., 2013; Lee et al., 2014; Omeogu et al., 2020). CBT-I has been found to be effective at reducing stress symptoms, intrusive, repetitive thoughts, and symptoms of depression and has been used successfully to improve sleep issues, insomnia and related symptoms among nurses and workers from other occupations (Cheng et al., 2020; Jang et al., 2020; Kaku et al., 2012; Nishinoue et al., 2012).

Strategies rooted in behavioral change science may be a beneficial addition to sleep hygiene education. Behavioral change strategies such as tracking or charting progress have been demonstrated to be effective at incorporating other healthy behaviors such as physical activity in the workplace (Jirathananuwat and Pongpirul, 2017). As such, tracking sleep behavior may also have similar benefits for nurses to incorporate health sleep behaviors in their daily lives. Since nurses sometimes find it difficult to prioritize their own health and self-care over others (Ross et al., 2019), behavioral change strategies may help them to recognize habits that disrupt their sleep, and use evidence-based methods to modify behavior, resulting in enhanced sleep.

This review found that while most SET programs were specifically aimed at nurses, some also involved nurse managers. Management training included organizational level changes to support healthy sleep among nurses, such as scheduling strategies (d'Ettorre and Pellicani, 2020; Scott et al., 2010). This type of SET programming may need to be prioritized within organizations. Occupational fatigue and poor sleep stems from a number of organizational and individual factors. Therefore, a multi-faceted approach to manage fatigue and improve sleep is needed. The first line of controls for fatigue risk management are organizational controls that provide workers adequate time off to obtain sufficient, quality sleep (Dawson and McCulloch, 2005). Without adequate time off, workers implementing behavior changes to improve sleep may still find themselves falling short of health sleep goals. For example, a prior study of SET programming for medical residents found that while residents improved their sleep-related knowledge scores at post-training, there was no increase in sleep duration as per actigraphy measures (Arora et al., 2007). The authors suggest the lack of sleep duration was largely attributed to the extended work hours required of medical residents, which were not altered. Other industries, such as aviation, have successfully incorporated SET for workers and management as part of a comprehensive fatigue risk management system, demonstrating improved sleep and alertness among pilots (Rosekind et al., 2006). This training partnership between workers and management on addressing occupational sleep issues and fatigue aligns with fatigue risk mitigation recommendations from occupational health scientists (NIOSH, 2015; Wong et al., 2019) and nursing professional organizations (American Nurses Association, 2014; Caruso et al., 2019). A recent position statement from the American Academy of Nursing suggested that by adopting fatigue risk

mitigation policies and practices, healthcare organizations can foster healthy sleep habits among workers, strengthening the broader workplace health and safety culture (Caruso et al., 2017).

SET programs in this review offer a wide variety of delivery platforms and training frequency, including a mobile application, paper-based reading and tracking content, prescribed audio recordings, online presentation slides, and in-person training. While none of the studies in this review directly compared in-person training with tech-based training, we found that in-person SET programs involved less frequent interaction with nurses, compared to tech-based training. Evidence supports that regular engagement with a health coach provides supportive, personalized benefits to improve worker health (Edman et al., 2019; Teall and Mazurek Melnyk, 2021; Wong et al., 2019). Yet, there is some evidence that tech-based training as a form of self-directed learning may be preferred by some nurses (Fitzgerald and Townsend, 2012; Govranos and Newton, 2014; Lee et al., 2021). A multi-modal educational landscape may be needed to engage a diversity of adult learners (Felknor et al., 2020). The use of multiple SET methods should be considered in future research to examine for effectiveness and nurses' preferences.

Sleep outcome measures identified in this review varied widely with the most prominent being sleep quality and duration via the PSQI (Buysse et al., 1989) and sleepiness via the ESS (Johns, 1991). Despite the common use of the PSQI and ESS, there are currently not enough studies to draw a conclusion on which SET programming effectively improves nurse sleep. The mixture of outcome measures in this review focused on either sleep or the sequelae of sleep loss (i.e., sleepiness, fatigue) was similar to those found in SET programs for other worker populations (Arora et al., 2007; Barger et al., 2018). While including measures on nurse sleep and the impacts of sleep loss are essential to determine SET effectiveness, a consistency of measures would be helpful for comparing which SET characteristics are most beneficial.

A consideration should also include whether sleep will be measured using objective (i.e., actigraphy) versus subjective tools. All the studies in this review, except one, used self-reported measures of sleep. While there are advantages and disadvantages (e.g., costs, burden to participants) to using self-reported versus objective measures, there is potential for actigraphy to be helpful in measuring sleep and circadian alignment with work hours in the occupational setting (Depner et al., 2020). As the science is evolving around actigraphy and wearables, a combination of both self-reported and objective measures may be helpful in assessing SET effectiveness (Depner et al., 2020).

4.1. Future steps and implications for research

This scoping review found multiple gaps in the literature, leaving opportunities for future research. Sleep hygiene appears to be a common component of SET for nurses; however, few training programs also provided employer level education to develop opportunities for nurses to obtain adequate, quality sleep (Dawson and McCulloch, 2005) and as recommended by experts (Wong et al., 2019). As such, more SET should include both worker and employer components, and studies are needed to evaluate this method of shared responsibility among nurses and employers to improve nurses' sleep. Further research is also needed to support the addition of psychological (e.g., CBT-I) and/or behavioral change strategies (e.g., goal setting), as such strategies have been found helpful to other worker populations (Kjørstad et al., 2021; Reilly et al., 2021), and may be useful to nurses when trying to enhance sleep. Additionally, comparison studies are needed to identify effective delivery frequency and modes. The use of uniform subjective and objective sleep outcome measures in future studies would facilitate more effective comparisons of training content, frequency, and delivery platforms. This would allow for a more salient understanding of what training content and characteristics are most beneficial to address the diversity of nurse sleep barriers.

4.2. Strengths and limitations

To our knowledge, this is the first scoping review of nurse SET content, delivery methods, and outcome measures. The increase in the number of studies published in the past 10 years suggests this is a growing area of interest to monitor. This study design included the use of a scoping review framework to guide the process, a large variety of search terms to obtain multiple search results, a systematic method for screening results and incorporated quality assurances in the data extraction process. There are several limitations that should be considered with this scoping review. Despite conducting a broad search of the nurse SET literature, a limited number of studies were found. Although this review excluded studies published prior to 2000, the majority of studies found were published in the past ten years, similar to other review papers about SET among broader worker populations (Barger et al., 2018; Redeker et al., 2019). This suggests expanding to earlier dates may not have yielded additional studies. A paucity of studies, lack of efficacy in research designs, and the heterogeneity of study outcomes precluded the ability to grade the evidence for a systematic review and draw conclusions about the most effective training components. Again, this is similar to the findings for other worker populations. Barger et al. (2018) attempted a meta-analysis of shift worker SET programs. Redeker et al. (2019) attempted a systematic review of the literature on interventions (including SET) to enhance worker sleep but had to revert to a narrative review due to the heterogeneity of study design and outcomes. In addition, little information was gained on nurse preference for training frequency and/or delivery method. Limiting studies to those published in the English language may have resulted in publication bias, as English language journals tend to be focused on significant findings. Despite these limitations, this review has provided a descriptive report of existing training characteristics for future study considerations.

5. Conclusion

The role of sleep among nurses working in nonstandard schedules is critical to the health and safety of the nurses and patients. As sleep is important to optimal health and well-being (Office of Disease Prevention and Health Promotion, 2020), provision of SET to individuals most at risk for poor sleep, such as nurses and other shift workers, may impact the health and safety of workers and the public. This review described delivery content, characteristics and outcome measures of the existing literature on SET for shift working nurses. While trainings differed significantly, some overlap was found among sleep hygiene content, organizational level training, and psychological and behavioral intervention methods. This suggests that occupational fatigue and improved sleep can stem from a variety of organizational and individual factors and effective approaches may require a multi-faceted approach that includes a shared responsibility among workers and organizational managers. Considering the wide variety of factors contributing to sleep disruption as well as potential for varied learning preferences among the nursing workforce, multiple SET methods may be more effective at reaching a wider nursing audience. As such, there are many promising future research directions for the development of SET for shift working nurses in the U.S. and other similar healthcare settings.

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CRediT authorship contribution statement

B.H.: Conceptualization, methodology, investigation, writing-original draft, review and editing, visualization; **J.H.:** investigation, writing-original draft, review and editing, visualization; **S.F.:** methodology, validation, investigation, writing-review and editing, visualization; **I.W.:** conceptualization, methodology, investigation, resources, writing-review and editing, supervision.

Declaration of Competing Interest

None.

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