

## SUPPLEMENTAL MATERIAL

### *Characteristics of Included Studies*

Reference	Study Design	Work place setting	Study participants	Country	Shift details	Interventions	Medium of intervention	Findings/ Recommendation
<b>Arora 2007</b>	Prospective cohort	Healthcare	1st & 2nd year medical residents	USA	ACGME limits: maximum 80 hours / week, 1 day off / week, 30-hour consecutive shifts q 4th day, 10 hours off between duty periods	SAFER sleep education program	Presented by faculty at lunch time conference	Study suggested the adoption of alternate scheduling practices, or countermeasures and promotion of a culture that facilitates healthy sleep habits are warranted. Duty-hour restrictions alone may not be effective to alleviate resident sleep deprivation.
<b>Baek 2015</b>	Prospective cohort	Non-specific	Healthy participants	Republic of Korea	Not specified	Blue light	Not specified	Study concluded that blue light helps in avoiding the post-lunch dip as it significantly improved cognitive performance, and reduced the EEG alpha activity, reflecting enhancement of vigilance.
<b>Barger 2016</b>	Prospective cohort	Fire Department	Firefighters, high ranking officers and fire department administrators.	USA	24-hour extended-duration shifts.	Fatigue management Risk Program- 30-minute training-sleep health education, incorporating caffeine re-education, and advice on dealing with shiftwork, as well as screening for common undiagnosed sleep disorders.	3 types of delivery: expert lead, train the trainer, online	Study suggested that expert-led programs had the greatest reach and effectiveness in educating and screening. It is imperative to implement SHP in safety-sensitive occupations, especially in those with non-standard work shifts.
<b>Boivin 2002</b>	Prospective non-blinded case control	Healthcare	Nurses	Canada	Permanent Night shift	Intervention group: Bright light during first 6 hours of 8-hour night shift + darkening goggles on way home to limit light exposure + sleeping period in darkened room: other group usual procedures	Light was as a group; home sleep was somewhat individualized	Study supports the efficacy of a practical intervention for promoting circadian adaptation to night-shift work under field conditions. It also underlines the importance of controlling the overall pattern of exposure to light and darkness in circadian adaptation to shifted sleep/wake schedules.

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<b>Bouchard 2016</b>	Pre-test, treadmill intervention, post-test	Healthcare	Nurses, dieticians	Canada	Not specified	Use of a treadmill workstation for 2 hours per work shift	Not specified	Study suggested that use of a treadmill workstation in sedentary office work settings brings about important health benefits, including longer sleep duration and better sleep quality.
<b>Boubekri 2014</b>	Observational	Non-specific	Office workers	USA	Day shift	Self-reported amount of exposure to daylight	none	Study suggested that architectural design of office environments should place more emphasis on sufficient daylight exposure of the workers in order to promote office workers' health and well-being.
<b>Bruno 2011</b>	Retrospective	University	Overweight/ obese employees	USA	not specified	Worksite weight loss & reduction of cardiovascular risk factors program: 12 weekly 50-minute education sessions	In-person or internet	Findings of this study demonstrated improvements in health-related quality of life as a result of this program. Can translate to improvements in work productivity and employee satisfaction and reduction in absenteeism, thus benefiting employer.
<b>Chen 2010</b>	Prospective and exploratory intervention study	Not specified	Working women with sleeping problems, type not specified.	Taiwan	Day shift	A 5-week sleep hygiene education program	Group or individual training given by nurse	Study revealed a significant improvement in sleep quality over the 5-week sleep hygiene program.
<b>Crain 2017</b>	Two Randomized, waitlist-controlled trials	Public Schools	School Teachers	Canada and US	Day shift	8-week 11 session (36 hours) program to increase mindfulness and self-compassion	Didactics, group practice and discussion, small-group activities and homework	Study suggested the implementation of workplace mindfulness training to improve both home and work life and unvalidated measures of sleep.
<b>Daurat 2004</b>	Cohort	Healthcare	Nurses	Norway	12-hour day / night shift	Naps at various times during work hours.	None	This study of spontaneous sleep-wake behavior confirmed that sleep length is strongly reduced during nightwork. It concluded that a long nap during nightwork (anchor sleep) and short daytime sleep, sometimes followed by a late afternoon nap may favor the maintenance of a diurnal orientation and the return to diurnal life.

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<b>Duncan 2011</b>	Observational cross-sectional study	Department of Defense hospital	Nurses, physicians, clinicians, support staff, and administrators	USA	Not specified	Ear acupuncture, acupressure, zero balancing	Complementary and alternative medicine wellness clinic	Study recommended that an alternative medicine clinic may provide additional coping resources to healthcare providers and related persons.
<b>Engelen 2017</b>	Observational ; pre-post design	University	Adults who were initially relocating to the new building.	Australia	Day shift	Subjects shifted to an open plan building	Not specified	Study noted that an active design building can have some physical health-promoting effects on occupants.
<b>Geiger-Brown 2016</b>	Prospective cohort	Hospital	Nurses	USA	Night shift	Implementation of a napping protocol in overnight nursing units	Not specified	Study suggested that napping is effective in helping nurses' function, and barriers to napping need to be overcome. This should be encouraged as a standard practice in health care settings.
<b>Grzywacz 2007</b>	Cross-Sectional and Longitudinal	Pharmaceutical company	Employees	USA	Day shift	Change in perceived workplace flexibility	Compressed work weeks, flextime, job sharing, remote or telework	Study suggested that workplace flexibility may contribute to positive lifestyle behaviors and may play an important role in effective worksite health promotion programs.
<b>Hayashi 1999</b>	Prospective experimental study	University	Students	USA	Day shift	20-min prophylactic nap at noon	Not specified	Study indicated that a short (20-min) nap at noon had partial positive effects on the maintenance of the daytime arousal level.
<b>Hilditch 2016</b>	Randomized controlled trial	Not specified	Healthy adults	Australia	Simulated night shift	10- 30 min naps	Not specified	Study showed that a 10-min (but not a 30-min) nighttime nap had minimal sleep inertia and helped to mitigate short-term performance impairment during a simulated night shift. This can be used to inform fatigue management guidelines for napping on shift to promote optimal cognitive performance and safety.

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<b>Holbrook 1994</b>	Pre- and post-intervention study	Law enforcement ; security	Law enforcement officers	USA	Rotating shifts	Self-management techniques for controlling insomnia	1-hour instructional workshop	Replacing misconceptions about effects of nicotine, caffeine, and hypnotics with awareness and knowledge of good sleep hygiene seems a preliminary step towards implementing a program promoting good health and improved performance for law-enforcement officers.
<b>Hori 2016</b>	Prospective open-label	Not specified	Healthy workers	Japan	Not specified	Walking 10,000 steps daily for 4 weeks	Pedometer use	Findings of this study suggested that a walking intervention can reduce the sleep latency and increase total sleep duration in working persons without exercise habits.
<b>Kakinuma 2010</b>	Controlled clinical trial	IT monitoring and support centers	System engineers and IT workers	Japan	Day shift	One-hour sleep hygiene education	One-hour lecture on therapeutic guidelines for treating sleep disturbances, and sleep goal setting.	Study demonstrated that instruction in good sleep hygiene can help workers achieve quality sleep despite limited mean sleep duration on weekdays as well as achieve improvement in sleep disturbances without the use of drugs.
<b>Kaku 2012</b>	RCT	Manufacturing industry	Non-variable shift employees with insomnia	Japan	Not specified	A combination of sleep hygiene and behavioral approach program.	individual in person	Study suggested that a combined approach of sleep hygiene and behavioral approach significantly improved sleep quality in workers.
<b>Lerman 2012</b>	GUIDANCE STATEMENT	NA	Occupational and environmental medicine (OEM) physicians	USA	Shift work	Fatigue risk management	Multiple	Fatigue Risk Management record management
<b>Macchi 2002</b>	Cross-over interventional placebo-controlled study (nap vs. sedentary activity)	Long-haul truck driving	Long-haul truck drivers	USA	Simulated night-shift by partial sleep restriction (5hours/night)	3-hour nap from 2-5pm (intervention) vs. 3-hour sedentary activity with sleep prohibited	Nap	Study indicated that pre-night shift naps may improve performance in long-haul truck drivers and other night-shift occupations.

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<b>Merrill 2011</b>	Single group pre-test post-test	Engineering, science, and operations company	not stated	USA	not provided	Worksite Wellness Program	unclear	Study demonstrated that wellness programs based on personal health assessment may improve employee wellness, including nights of restful sleep
<b>Nishinoue 2012</b>	Observational	IT monitoring and support centers	IT support workers	USA	Day shift	Group-based sleep hygiene education and individual behavioral training.	Face-to-face behavioral teaching	Study suggested that compared to sleep hygiene group education alone, addition of behavioral training significantly improves sleep quality.
<b>Papp 2004</b>	Observational	Academic health centers	Resident-physicians	USA	Various	Focus group-educational sessions	Not specified	Education about sleep as a core biological phenomenon and the potential deleterious effects of sleep loss and fatigue on performance should be clearly impressed on all incoming resident physicians.
<b>Purnell 2002</b>	Crossover study design	Airport	Aircraft maintenance engineers	New Zealand	2-day shifts followed by 2-night shifts followed by 4 rest days	20-minute nap opportunity from 0100-0300 vs. 20-minute break without a nap	Nap	Study suggested that a short duration nap taken in the workplace to counteract performance deficits
<b>Robbins 2015</b>	Qualitative, descriptive study	University	Employees	USA	Day shift	Utilization of focus groups and one-on-one interviews.	Employer-sponsored vanpool program	Study demonstrated that participation in vanpooling outweighed any disadvantages such as infectious hazards or disturbed sleep patterns.
<b>Rosekind 2006</b>	Observational	Public transport (Air, train, bus, cabs)	Airline pilots	Not specified	Trans-continental flights	CD based 3.5h educational program; fatigue basics, sleep basics, aviation and fatigue, circadian rhythms. 6 quizzes following modules.	Educational program: involved alertness strategies, healthy sleep, sleep scheduling.	Study suggested the development of educational programs for all airline employees including flight crews and ground crew.

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<b>Sallinen 1998</b>	Cohort	Oil refinery	Process operators	Not specified	Four-morning shifts, one day off, four-night shifts, one day off, and four evening shifts.	Nap	Nap	A short nap is a feasible countermeasure to improve alertness to a certain extent during the first night shift.
<b>Sasseville 2009</b>	Observational	Post distribution center	Permanent night shift workers	Canada	Night	Blocking short wavelengths of light below 540 nm. (workers had to wear blue-blockers glasses, either just before leaving the workplace at the end of their shift)	Use of blue blocker glasses	Study indicated that blue-blockers seemed to improve daytime sleep of permanent night-shift workers.
<b>Scott 2010 b</b>	Observational	Healthcare	Full time staff nurses in acute care	USA	Full-time staff nurses (working at least 36 hours /wk.) on selected medical-surgical units	Fatigue counter-measures program for nurses (FCMPN).	Focus group sessions	Although FCMPNs are feasible and sustainable in healthcare, a paradigm shift may be needed for a robust implementation of an effective FCMPN that improves patient safety.
<b>Scott 2010a</b>	Prospective observational design	Healthcare	F/T staff nurses in acute care	USA	F/T staff nurses working at least 36 hours per week; predominantly 12-hour day shifts	Fatigue counter-measures program for nurses (FCMPN).	60 min education and training	Preliminary findings suggest that it is possible to implement fatigue countermeasures that have potential to mitigate fatigue, improve sleep, and reduce errors among hospital staff nurses.
<b>Silberman 2011</b>	Retrospective , within-subjects design	Various backgrounds	Various	USA	Day shift	Web-Based Worksite Health Promotion Program	Web-based	Use of Web-based health promotion programs was associated with reductions in productivity impairment and improvements in employee health followed by reductions in direct health care costs.
<b>Stucky 2009</b>	Observational	Teaching hospital	Interns, residents, and attending physicians	USA	Multiple shifts	Stress assessment	EMA tool	Residency programs should target education in stress and sleep and readdress workload distribution by training level.

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<b>Sullivan 2017</b>	Prospective randomized, field-based intervention.	Emergency response systems-including Firefighters, paramedics, weather	Firefighters	USA	Extended shifts and long work weeks	Mandatory educational sessions: eye masks and ear plus were distributed at education sessions. Also voluntary sleep disorders screening.	In person education by sleep researcher to group,	Study suggested that providing a "targeted sleep health program" consisting of sleep health education and sleep disorders screening will reduce injuries and disabilities.
<b>Suzuki 2008</b>	Randomized controlled trial	Other	Full or part time employment	Japan	Day shifts	Basic education on sleep and ways to improve sleep, maintenance of a "sleep e-diary", daily personalized automatic messages to encourage each participant's behavior changes for better sleep, and weekly self-monitoring of the effects of the participants' behavior changes on sleep quality that incorporate both visual presentation and personalized advice summaries.	Online self-help program	An internet-based self-help program is effective for improving subjective sleep quality among adult workers.
<b>Sveinsdottir 2006</b>	Cross-sectional observational	Hospital	Nurses	Iceland	Combinations of shifts	Short rest period provided for between evening and morning shifts.	A self-administered questionnaire, measuring occupational health, quality of sleep, the illness experience, job satisfaction and working environment.	Nursing directors are advised to look more closely at the organization of nurses' work during night shifts, as well as the rest period for nurses changing from evening to day shifts.

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<b>Takahashi 1998</b>	Prospective cohort	Not specified	Healthy volunteers	Japan	Nonspecific shift, consisted of naps following 7h nocturnal sleep	Random assignment to one of 3 post lunch nap conditions - 0, 15 min and 45 min	Planned nap	Data demonstrated that a brief nap after lunch was effective for enhancing subsequent alertness and performance after normal sleep the previous night.
<b>Takahashi 2004</b>	Pre- and post-intervention study	Manufacturing industry	Factory workers	Japan	Day time shift	Post-lunch nap	15-minute nap in a break room, with an eye mask and ear plugs.	Data demonstrated that a brief nap after lunch could be one of the practical solutions to promote alertness in day time workers.
<b>Talvi 1999</b>	Prospective case/control of sampled populations	Other	Oil refinery workers	Finland	Shift workers and daytime workers	For sleep, they met with a psychologist for "discussion and follow-up". No further details provided	In person	Health promotion should be established as a continuous process rather than a single project. Long-term effects can be achieved if the programs are supportive and continue long enough.
<b>Vehvilainen 2016</b>	Observational	Office	Not specified	Finland	Day shift	Ventilation of office rooms	Not specified	Comprehensive, anthropocentric planning of space is needed as well as instructions and new kinds of reference values for the design and realization of office environments.