

Shift Work and Employee Fatigue

Implications for Occupational Health Nursing

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ABSTRACT

Long work hours and irregular shifts are part of the nation's 24-hour society and contribute to employee fatigue. Factors affecting employee fatigue are circadian rhythm, sleep quality and quantity, individual health, the environment, and work tasks. Employee fatigue contributes to accidents and injuries, and affects occupational performance, safety, and health. These findings should be used by occupational health nurses to address fatigue management and develop comprehensive fatigue management programs. [Workplace Health Saf 2014;62(6):256-261.]

The number of employees working extended hours has increased over the past decade, with work schedules including overtime, on-call, and rotating shifts. Research has shown lack of sleep and disrupted sleep schedules affect employees, their families, employers, and communities. Shift work and demanding work schedules contribute to employee fatigue and place employees at risk for injury, risky health behaviors, and negative health outcomes. Fatigue can indirectly affect employees' personal relationships and family life. Employers may experience decreased productivity and quality of work and increased illness and injury costs (Uehli et al., 2014).

Indirect impacts on the community include more motor vehicle accidents and work errors, and rising illness and injury costs. To address the issue of fatigue, the occupational health nurse should discuss sources

of fatigue with new employees and update their health histories annually to identify both occupational and non-occupational causes of fatigue. The occupational health nurse should also consider providing employee education on topics such as coping with shift work, improving sleep hygiene, and managing fatigue as additional components of a comprehensive fatigue management program.

BACKGROUND

More than 21 million employees, or 17.7% of all wage and salary employees, work alternate shifts that fall outside of traditional daytime shift hours (McMenamin, 2007). Alternate shifts are those with work hours during the evening, night, or weekends, or requiring employees to work more than one shift (rotating shifts). Types of employees commonly affected by this work schedule are health care providers, first responders, firefighters, police officers, military personnel, miners, and construction, manufacturing, utility, transportation, service, and hospitality workers. Extended working hours are defined as working longer than 8 to 9 hours per day and more than 40 hours per week. In the United States, nearly one-quarter of the workforce is on the job more than the 40-hour traditional work week, and two-thirds of those employees work more than 49 hours per week (United States Bureau of Labor Statistics, 2012).

Both lack of sleep and insufficient sleep duration contribute to employee fatigue. The National Sleep Foun-

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TABLE 1
Current Work Hour Regulations and Recommendations

Worker Population	Regulation/Recommendation	Agency
Airline Pilots	Limits domestic flight time to 8 hours within a 24-hour period with at least 8 hours' rest in 24-hour period.	Federal Aviation Administration (2010)
Maritime Watch Officers	Rest period no less than 10 hours in any 24-hour period and 77 hours in any 7-day period.	International Maritime Organization (2010)
Medical Residents	Limits duty hours to 80 hours per week inclusive of in-house call and moonlighting.	Accreditation Council for Graduate Medical Education (2011)
Nuclear Power	Limits work hours to 16 hours in any 24-hour period, 26 hours in any 48-hour period, and 72 in any 7-day period.	United States Nuclear Regulatory Commission (2012)
Nurses	States with identified mandatory overtime restrictions in law: AK, CT, IL, MD, MN, NJ, NH, NY, OR, PA, RI, TX, WA, WV. States with mandatory overtime provisions in regulations: CA, MO.	American Nurses Association (2012)
Nurses	Prevents work hours by nurses providing direct patient care in excess of 12 consecutive hours or in excess of 60 hours in any 7-day period.	United States Department of Veterans Affairs (2004)
Railroad	Duty period not to exceed 12 hours or must have 10 consecutive hours off duty during prior 24 hours.	United States Department of Transportation (2011a)
Truck Drivers	Limits driving from 11 to 14 hours per day depending on timing of mandatory half-hour break.	United States Department of Transportation (2011b)

dation (2011) recommends the average adult should sleep 7 to 9 hours per day; however, a short sleep duration of 6 hours or less per day is reported by 30% of civilian-employed U.S. adults, or approximately 40.6 million workers, with nearly half of night shift employees reporting short sleep duration (Centers for Disease Control and Prevention, 2012). Short sleep duration and employee fatigue have been associated with accidents and injuries and impact employee health, including exacerbation of chronic diseases (Tucker & Folkard, 2012).

Fatigue has been shown to impair reaction time, attention, and coordination among medical residents driving vehicles before and after duty (Tornero, 2012). The Joint Commission (2011) found more errors in patient care, needlesticks and exposure to blood and body fluids, and occupational injuries among health care employees who worked extended shifts.

Fatigue was also found to be a causal factor in several industrial accidents, including the 2005 Texas City BP oil refinery explosion (Chemical Safety and Hazard Investigation Board, 2005), the 2009 Colgan air crash (National Transportation Safety Board, 2009), the Challenger and Columbia space shuttle disasters, and the Chernobyl and Three Mile Island nuclear disasters (Mitler et al., 1988). Another indication of the effect of fatigue in the workplace is higher accident and injury rates during evening (18%) and night (30%) shifts compared to day shifts (Smith, Folkard, Tucker, & Evans, 2011). Annual fatigue and health-related productive-work time costs are shown

to range from \$1,200 to \$3,100 per employee (Rosekind et al., 2010).

Several academic organizations and government agencies have developed guidelines addressing sleep, work, and employee fatigue (Tables 1-2). The National Institute of Occupational Safety and Health (2013) has developed several publications, informational webpages, MMWR releases, and blogs about how fatigue and sleep affect employee health and safety. The Harvard School of Medicine Division of Sleep Medicine (2009) is dedicated to training, public policy, research, clinical practice, and medical education. Government agencies regulating air and maritime traffic, federal emergency response, railroads, the nuclear industry, and medical residents have mandated work and rest hours. The American College of Occupational and Environmental Medicine's 2012 Guidance Statement (Fatigue Risk Management in the Workplace) addresses the safety and health risks of fatigue in the workplace and emphasizes the role of occupational and environmental physicians in developing fatigue risk management programs (Lerman et al., 2012).

REVIEW OF RELEVANT LITERATURE ON WORK SCHEDULES AND EMPLOYEE POPULATIONS

Although average working hours have remained constant throughout the past two decades, 24/7 work has placed unusual demands on employees. Work schedules have changed as a result of the decline in U.S. manufacturing and the rise of the service industry. Extended work

TABLE 2
Online Resources

Source	URL
American College of Occupational and Environmental Medicine Fatigue Risk Management in the Workplace Guidance Statement	https://www.acoem.org/uploadedFiles/Public_Affairs/Policies_And_Position_Statements/Fatigue%20Risk%20Management%20in%20the%20Workplace.pdf
Canadian Aviation Fatigue Management Resources	http://www.tc.gc.ca/eng/civilaviation/standards/sms-frms-menu-634.htm
Federal Aviation Administration Fatigue Management Resources	http://www.faa.gov/about/initiatives/maintenance_hf/fatigue/links/
Harvard Medical School Division of Sleep Medicine Sleep and Health Education Program	http://healthysleep.med.harvard.edu/portal/
National Institute for Occupational Safety and Health Overtime and Extended Work Shifts: Recent Finding on Illness, Injuries, and Health Behaviors	http://www.cdc.gov/niosh/docs/2004-143/
National Sleep Foundation	http://www.sleepfoundation.org/

hours are expected of many employees, from those in managerial and professional positions to lower wage occupations, with schedule flexibility increasing in higher earning positions (Luckhaupt, Tak, & Calvert, 2010). In higher earning positions, longer work hours are associated with increased productivity and job advancement. In lower earning positions and for the working poor, longer work hours are associated with occupations such as cashiers, truck drivers, sales personnel, wait staff, cooks, and janitors, where pay and advancement are not affected (Luckhaupt et al., 2010). Long work hours are associated with firefighter and law enforcement personnel for whom 12- to 24-hour shifts are the norm (United States Bureau of Labor Statistics, 2014). Health care workers, including nurses and medical residents, work 12- to 24-hour shifts and may take calls that can extend on-duty hours to 24 or more (United States Bureau of Labor Statistics, 2014). According to Szoland (2010), shift work affects 20% to 25% of all employees. In the National Health Interview Survey of 2010, the prevalence of U.S. adults who worked non-standard shifts (defined as regular or rotating shifts other than day shifts) was found to be 28.8% (National Institute of Occupational Safety and Health, 2013).

SCIENCE OF SLEEP

The sleep cycle includes five repeating stages. Stages I through IV are classified as non-rapid eye movement sleep and comprise 75% of the sleep cycle (National Sleep Foundation, 2011). These first four stages of sleep progress from light sleep to onset of sleep to deep and restorative sleep. Stage V comprises approximately 25% of the sleep cycle, occurs approximately 90 minutes into the sleep cycle, and is characterized by rapid eye movement sleep, during which the brain is active and in a dream state (National Sleep Foundation, 2011). Basal sleep need for an adult ranges from 7 to 9 hours and varies among populations, but sleep debt occurs when sleep is lost due

to awakenings, environmental factors, or poor sleep habits (National Sleep Foundation, 2013).

Circadian rhythms are present in all organisms, affected by light and darkness, and controlled by the suprachiasmatic nucleus (a group of nerve cells located in the brain affecting individuals physically, mentally, and behaviorally) (Chokroverty & Avidan, 2012). In humans, circadian variability is slightly longer than 24 hours, with bimodal increases in sleep drive late at night and smaller increases in the early to late afternoon (National Sleep Foundation, 2011). Circadian rhythm plays a role in the release of hormones (e.g., cortisol, ghrelin, and leptin), body temperature, and sleep-wake cycles, and has been linked to sleep disorders, illnesses, depression, and insomnia (National Institutes of Health, 2013).

HEALTH EFFECTS

Employee health can be affected by fatigue due to shift work, irregular work hours, and sleep deprivation and disruption. Employee fatigue may contribute to the onset of some diseases and exacerbate existing chronic conditions. Continuous or occasional sleep disruption may affect workers' normal body clocks, causing circadian rhythm disorder. Shift work sleep disorder is a common circadian rhythm disorder affecting individuals who frequently rotate shifts or work nights. Shift work sleep disorder is characterized by periods of sleep interruption that result in excessive sleepiness and insomnia, difficulty concentrating, headaches, lack of energy, nervousness, irritability, anxiety, and depression (Cleveland Clinic, 2013; Costa, 2010).

Differential diagnoses of other sleep disorders include narcolepsy, sleep apnea, and drug and alcohol dependency (Costa, 2010).

Following review of epidemiological evidence on shift work and the development of cancer in both humans and animals, the International Association for Research on Cancer concluded that shift work resulting in circadi-

an rhythm disruption was likely carcinogenic for humans (Wang, Armstrong, Cairns, Key, & Travis, 2011). They reported positive associations between the development of breast cancer and sleep disruption among flight attendants who experienced disrupted sleep and nurses who worked night shifts, prostate cancer and sleep disruption in men who worked rotating shifts, and colorectal cancer and sleep disruption among nurses who worked night and/or rotating shifts for more than 15 years. The International Association for Research on Cancer (2010) has classified shift work as a Category 2A carcinogen, "probably carcinogenic to humans."

Shift work and circadian rhythm disruption are linked to gastrointestinal disorders, peptic ulcer disease, decreased gastric emptying, constipation, irritable bowel syndrome, and increased prevalence of *Helicobacter pylori*, primarily due to the timing and frequency of food consumption and meal content (Costa, 2010). Several research studies have suggested a link between shift work (i.e., increased stress and disruptions in circadian rhythm, hormone release, and metabolism) and increased cardiovascular diseases, specifically myocardial infarction, hypertension, and ischemic heart disease (Costa, 2010; Szoland, 2010; Tucker & Folkard, 2012; Wang et al., 2011).

Metabolic syndrome is characterized by central obesity, elevated blood pressure, abnormal lipid values, and elevated fasting blood glucose levels. Impaired fasting blood glucose is a hallmark of diabetes mellitus, and both are considered a public health epidemic contributing to cardiovascular disease. Higher numbers of metabolic and nutritional disturbances have been found among night shift employees and attributed to circadian rhythm disruption, changes in lifestyle behaviors, stress, and sleep, and digestive disturbances (Costa, 2010). Szoland (2010) found correlations between shift work and insulin resistance, metabolic syndrome, impaired glucose metabolism, elevated triglycerides, increased adipose tissue, and elevated body mass index. Although shift work may be a risk factor for disease etiology, studies have also linked chronic circadian rhythm misalignment from shift work to exacerbation of diseases such as epilepsy, asthma, and diabetes mellitus (Litinski, Scheer, & Shea, 2009). Circadian rhythm disruption coupled with decreased absorption and efficacy of medications is thought to affect the body's dose response (Ohdo, Koyanagi, Matsunaga, & Hamdan, 2011).

WORKLOAD AND ENVIRONMENTAL FACTORS

External factors affecting employee fatigue include scheduling, staffing, workload, and environmental factors such as ergonomic stressors, temperature, and humidity. Three staffing issues affect shift work and employee fatigue: an imbalance between workload and staffing levels, scheduled and unscheduled employee absences, and changes in workload (Lerman et al., 2012). Research has been published on 8-hour versus 12-hour shift durations, pattern of consecutive workdays versus non-work days, and fixed shifts and forward rotations. Accident and injury rates increased after employees worked four consecutive night shifts compared to working consecutive day shifts (Tucker & Folkard, 2012).

IN SUMMARY

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Implications for Occupational Health Nursing

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- 1 More than 21 million U.S. employees work shifts and one-quarter of the workforce spends more than 40 hours per week at work. Shift work and long or irregular work hours have been linked to negative health outcomes for employees and increased accidents, injuries, and worker's compensation costs.
- 2 Adverse health outcomes include cardiovascular disease, cancers of the breast and prostate, depression, gastrointestinal disorders, and exacerbation of chronic diseases including epilepsy, diabetes, and metabolic syndrome. Circadian rhythm disruption and impaired hormone release are thought to be affected by irregular sleep patterns and lack of nighttime sleep.
- 3 Occupational health nurses can address fatigue in the workplace through implementation of a Fatigue Risk Management Program that includes employee education, health screenings, and an engaged management to provide adequate staffing, reasonable scheduling, and regular breaks. It should also include review of accident and injury data to identify trends related to shift duration, number of consecutive shifts scheduled, and time of day.

Other factors contributing to worker fatigue are time-on-task, length of time on duty, amount of time into work shift, and driving time to work. These factors can be further aggravated by time awake prior to start of work, timing of breaks, and scheduled shift (Williamson et al., 2011). Williamson et al. further identified work quotas, lighting, job differences, and the nature of the work performed as also affecting worker fatigue. Short, frequent rest breaks including the use of relaxation techniques and respite activities such as napping, relaxing, and socializing have been found to lessen job stress and subsequently reduce fatigue (Tucker & Folkard, 2012).

IMPLICATIONS FOR THE OCCUPATIONAL HEALTH NURSE

Occupational health nurses have many opportunities to reduce the negative impact of shift work and employee fatigue, primarily by developing a Fatigue Risk Management Program, including primary, secondary, and tertiary interventions. As a brief review, primary preventive interventions are those designed to promote health or prevent illness or injury. Secondary interventions are those designed to

identify risk factors, early disease, or injury to halt or slow progression. Tertiary interventions are those implemented after the disease or event occurs and are designed to prevent further damage and maintain or restore quality of life.

Pre-placement and annual physical examinations are one method of identifying employees at risk for sleep disruption and fatigue. Updating job-related health histories to include current health problems, family health history as allowed by law, and consideration of other risk factors can provide a clear picture of potential work-related challenges that employees may encounter. Education on effective sleep hygiene, the need for adequate sleep, stress reduction, healthy diet, regular exercise, and healthy weight maintenance are also components of this program. Within the workplace, occupational health nurses can educate employees about the need for adequate rest periods to maintain a healthy work and life balance and manage work-related hazards, including overscheduling.

Knowing that shift work is linked to several diseases, employees should be encouraged to follow U.S. Preventive Services Task Force recommendations regarding age-appropriate screenings for diabetes mellitus, cancers, and cardiovascular disease. Education for employees on ways to minimize health hazards associated with shift work and irregular hours should be offered along with early identification of possible health conditions that may be exacerbated by irregular or stressful work schedules. Addressing ergonomic issues within the workplace, lighting, and temperature are additional methods to reduce employee fatigue throughout their shifts. Occupational health nurses can lobby management for a place where employees can take regular breaks and provide accommodations for restorative napping and relaxation.

Finally, occupational health nurses must identify individuals with compromised health status, whether from a chronic disease or injury aftermath that may be exacerbated by shift work and irregular sleep patterns. Coordination of care with employees' current health care providers is encouraged. Employees may benefit from keeping a log or diary of food intake, sleep, and other relevant data such as blood pressures, glucose values, or mood fluctuations. Within the workplace, the occupational health nurse may collaborate with safety personnel to identify trends in Occupational Safety and Health Administration 300 log accident and injury data based on time of occurrence and staffing variability.

Resources to assist occupational health nurses in addressing shift work, sleep disruption, and employee fatigue are outlined in **Tables 1-2**.

CONCLUSION

Occupational health nurses must advocate for the health and well-being of employees, especially shift workers and those working irregular and extended shifts. This advocacy can be accomplished through continued review of research and data regarding adverse health effects attributed to sleep disruption. However, providing health promotion interventions and education to both employees and employers on ways to mitigate this workplace hazard is paramount to nurses' roles.

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