FEATURE

Negative Impacts of Shiftwork and Long Work Hours

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Shift work; occupational diseases; occupational injury; occupational exposure; work schedule tolerance; circadian rhythms; job stress; overtime work; extended work shifts; sleepiness.

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Abstract

Purpose: Healthcare organizations often have to provide patient care around the clock. Shift work (any shift outside of 7 a.m. to 6 p.m) and long work hours increase the risk for short sleep duration and sleep disturbances. Thirty-two percent of healthcare workers report they do not get enough sleep. The purpose of the article is to give an overview of the wide range of risks to nurses, patients, and employers that are linked to shift work, long work hours, and poor sleep from other sources.
Findings: Shift work and long work hours increase the risk for reduced performance on the job, obesity, injuries, and a wide range of chronic diseases. In addition, fatigue-related errors could harm patients. Fatigued nurses also endanger others during their commute to and from work.
Conclusion and Clinical Relevance: The key strategy to reduce these risks is making sleep a priority in the employer's systems for organizing work and in the nurse's personal life.

Introduction

Scientific evidence is growing that adequate sleep is a biological need for life similar to the need to eat and drink and is critical to maintain life and health and to work safely (Everson, 2009). Sleep duration of 7–8 hours a night is associated with a lower risk of obesity, diabetes, high blood pressure, myocardial infarction, and cerebral vascular accidents as well as reduced risk for injuries and errors (Colten & Altevogt, 2006). Recent studies warn that a growing number of Americans are not getting enough sleep (CDC, 2008, 2011). Between the periods of 1985–1990 and 2004–2007, the percentage of healthcare workers reporting 6 or less hours sleep each day (a level considered too short by sleep experts) increased from 28% to 32% (Luckhaupt, Tak, & Calvert, 2010).

This trend for shorter sleep is likely linked to several factors. Nursing staff in facilities that operate around the clock are commonly exposed to shift work and long work hours. These demanding schedules can lead to difficulties with sleep because of the need to sleep at irregular times and at times that are out of phase with circadian rhythms. Misalignment of sleep with circadian rhythms leads to difficulties with falling asleep, more arousals during sleep, and early awakenings leading to poorer sleep quality and shorter sleep duration. Also, sleep duration may be shortened by insufficient time between work shifts and the competing demands of work and personal life. In addition, economic pressures could push healthcare workers to take on second jobs or

work longer hours. Another factor is lack of knowledge about the importance of sleep which can lead people to cut their sleep time for other activities (Colten & Altevogt, 2006). Of all industrial sectors, health care is the second highest sector for the number of workers reporting short sleep duration (5 million workers which is 32% of the total healthcare and social assistance workforce of 16 million Americans) (Luckhaupt et al., 2010). The purpose of this article is to give an overview of the wide range of risks to nurses, their patients, and employers that are linked to shift work, long work hours, and poor sleep from other sources.

Inadequate sleep linked to shift work, long work hours, and sleep disorders

Scientific evidence provides strong support for the link between sleep problems and shift work. A study of a representative sample from the Midwest found 32% of night-shift workers and 26% of rotating-shift workers reported long-term insomnia and excessive sleepiness (Drake, Roehrs, Richardson, Walsh, & Roth, 2004). Ingre & Åkerstedt (2004) studied 169 sets of monozygotic twins who were discordant on exposure to night-shift work. History of night shift significantly increased risk for sleep disturbances into retirement years. A meta-analysis by Pilcher, Lambert, & Huffcutt (2000) of 36 studies found that permanent day-shift workers slept an average of 7.0 hours per day, permanent and rotating evening-shift workers slept 7.6–8.1 hours, permanent night-shift workers slept 6.6 hours, and rotating night-shift workers slept the least, 5.9 hours.

In a review of studies examining extended work shifts, Knauth (2007) reported 13 studies showed shifts longer than 8 hours had negative effects on sleep, eight studies showed mixed results, and four studies showed positive effects. Long weekly work hours and overtime have been associated with shorter sleep duration or sleep disturbances in several studies (Hayashi, Kobayashi, Yamaoka, & Yano, 1996; Sasaki et al., 1999). Geiger-Brown et al. (2012) examined sleep duration in nurses across a series of work shifts and found a mean sleep duration of 5.5 hours between 12-hour shifts. Basner et al. (2007) conducted a study of a nationally representative sample of Americans and reported one additional hour of work a day was associated with one half-hour less sleep.

Other sources of poor sleep and sleepiness are sleep disorders, other chronic diseases and certain medications (Smolensky, Di Milia, Ohayon, & Philip, 2011). Sleep disorders are common, afflicting 50–70 million Americans, but are often undiagnosed and therefore not treated (Colten & Altevogt, 2006). Insomnia increases with age. According to a National Sleep Foundation (2007) poll, sleep problems a few nights a week increased from 33% of women aged 18–24 to 48% of women aged 55–64. Sleepiness is a side effect of certain commonly used medications, such as benzodiazepines, narcotic analgesics, some antihistamines, some antidepressants, and prescription and over-the-counter medications used in the treatment of insomnia (Smolensky et al., 2011). Several chronic diseases can promote daytime sleepiness and comprise cognitive functioning such as, arthritis, asthma, chronic fatigue syndrome, chronic obstructive pulmonary disease, and rhinitis. See Smolensky et al. (2011) for more information.

Declines in neurocognitive functioning and performance

Laboratory studies provide evidence for a wide range of cognitive declines associated with sleep deprivation (Goel, Rao, Durmer, & Dinges, 2009). Without adequate sleep, people feel sleepy, are less alert, and can fall asleep involuntarily. Sleep deprivation increases pressure for the brain to fall asleep. The transition from wakefulness to sleep is abrupt and rapid and occurs in an on-off-type switch in the brain stem (Schwartz & Roth, 2008). This can lead to dangerous situations if the brain is under high pressure for sleep and the person falls asleep involuntarily during critical times, such as when driving or providing patient care. Involuntary episodes of microsleep, which are short periods of sleep a few seconds long, can also occur. During microsleeps, the person may appear to be awake (eyes open), but his or her brain will not process information and lapses in attention occur (Boyle, Tippin, Paul, & Rizzo, 2008).

A sleep-deprived person cannot reliably force him or herself to stay awake and alert. Studies of medical residents suggest that motivation, training, and longer experience living with restricted sleep do not make a person more resistant to the negative performance effects of sleep deprivation (Arnedt, Owens, Crouch, Stahl, & Carskadon, 2005; Van Dongen, Maislin, Mullington, & Dinges, 2003).

Sleep deprivation impairs many types of performance: reduces the ability to concentrate; slows reaction time; and reduces the ability to remember and learn new facts and motor skills (Goel et al., 2009). Sleep deprivation also leads to irritability, bad mood, reduced communication skills and ability to cope with the emotional demands of the

workplace. Researchers report that decision-making ability deteriorates and risk-taking behavior increases (Killgore, Grugle, & Balkin, 2012). In addition, reduced situation awareness can impair a nurse's ability to respond to patient care needs. Importantly, researchers found that sleep-deprived participants did not recognize how poorly they were performing: they tended to think they were doing better than they were (Van Dongen & Belenky, 2009).

Worker injury and errors

Declines in neurocognitive performance lead to higher rates of fatigue-related injury and worker errors. Certain work scheduling patterns are associated with higher risks for errors and incidents (Folkard & Lombardi, 2006). Compared with day shifts, risks are 15% higher for evening shifts and 28% higher for night shifts. When compared with 8-hour shifts, 10-hour shifts increased the risk by 13%, and 12-hour shifts increased risk by 28%. Risk increased by 17% for the third consecutive night shift and 36% for the fourth. Dembe, Erickson, Delbos, & Banks (2005) reported a possible "dose response": as weekly work hours increased, injury rates to workers increased. Folkard and Lombardi estimate the highest risk is for shifts that are both long and during the night.

Only a few studies have examined mandatory overtime but the evidence available raises concern. Studies of nurses linked mandatory overtime with higher risk for needlestick and other work-related injury, work-related illness, and missing more than 2 days of work because of these (de Castro et al., 2010; Gershon et al., 2009).

Poor health behaviors and metabolic syndrome

Research links shift work and long work hours to poor health behaviors. Bushnell, Colombi, Caruso, & Tak (2010) found that of nine work schedule patterns, the pattern predicted to be the most difficult (12-hour rotation shifts) was associated with the high rates of all five poor health behaviors examined: short sleep duration, smoking, obesity, low physical activity, and higher alcohol use. A systematic review by Frost, Kolstad, & Bonde (2009) concluded that smoking was generally more frequent in shift workers. Workers may be drawn to smoking as a countermeasure for the fatigue, sleepiness, and stress linked to demanding work schedules. A review of obesity and shift work by Antunes, Levandovski, Dantas, Caumo, & Hidalgo (2010) concludes that there is considerable epidemiological evidence for a link between shift work and obesity. A few studies have examined long work hours and obesity, and some report a significant positive relationship (Nakamura et al., 1998; Shields, 1999). The mechanism could be through poor-quality sleep and short sleep duration promoting an imbalance in appetite hormones that increase feelings of hunger and metabolic changes leading to obesity, insulin resistance, and reduced lipid tolerance (Spiegel, Tasali, Leproult, & Van Cauter, 2009).

Diseases associated with shift work

Along with sleepiness, disturbances to sleep also promote mood disturbances and gastrointestinal complaints (Sack, 2010). Shift workers commonly complain of gastrointestinal symptoms including abdominal pain, gas, diarrhea, constipation, nausea, vomiting, change in appetite, indigestion, and heartburn (Caruso, Lusk, & Gillespie, 2004; Knutsson & Boggild, 2010). A variety of stomach and digestive disorders have been reported in shift workers. Schernhammer et al. (2003) reported an increased risk of colon cancer in nurses working three or more nights per month for 15 or more years. Possible mechanisms for gastrointestinal disturbances include disturbances to circadian rhythms involved in eating and digesting food, sleep deprivation leading to stress response, changes in immune function, or the types of foods that are available during these shifts (Caruso et al., 2004; Knutsson & Boggild, 2010). Shift workers commonly report psychological complaints including bad mood, depression, irritability, anxiety, personality changes, and difficulty with personal relationships (Rohr, Von Essen, & Farr, 2003).

Shift workers are at somewhat higher risk for cardiovascular disorders. A review by Puttonen, Harma, & Hublin (2010) reported that epidemiologic data support a possible link with cardiovascular disease, including myocardial infarction, chest pain, and high blood pressure. Brown et al. (2010) recently reported an increased risk for ischemic strokes. The mechanism could be through metabolic changes and smoking. Frost et al. (2009) concluded there is evidence that workers are at higher risk for metabolic disturbances and increases in smoking after starting shift work.

In 2007, the International Agency for Research on Cancer of the World Health Organization announced sufficient evidence supports that shift work with circadian rhythm disruption is a probable carcinogen (Straif et al., 2007). They concluded data from human studies suggest

the link is possible, while the evidence from animal studies is sufficient. The most studied cancer in shift workers is breast cancer. A meta-analysis of 13 studies reported night work increased cancer risk by 48% (Megdal, Kroenke, Laden, Pukkala, & Schernhammer, 2005). According to Bonde et al. (2012), statistically significant increases in risk for breast cancer were seen in people working night shift for 20 years or more, but it is not clear from existing studies whether or not there is risk for shorter durations. They also suggest that "women with previous or current breast cancer be advised not to work night shifts because of strong experimental evidence demonstrating accelerated tumor growth by suppression of melatonin secretion." Two of three studies found an increase in prostate cancer (Conlon, Lightfoot, & Kreiger, 2007; Kubo et al., 2006; Schwartzbaum, Ahlbom, & Feychting, 2007). Costa, Haus, & Stevens (2010) discuss mechanisms that could possibly lead to cancer: repeated shifting of the times of sleep and activity; depression of immune surveillance; and exposure to light at night reducing melatonin levels.

Shift work is associated with adverse reproductive outcomes for women. A review by Frazier & Grainger (2003) reported that shift work was associated with a modest increase in spontaneous abortion, preterm birth, and reduced ability for women to become pregnant. Shechter, James, & Boivin (2008) reported increased medical office visits for menstrual cycle symptoms and cycles that were shorter, longer, or irregular.

People with chronic diseases may have more difficulty managing their symptoms and disease progression when working shift work. Some medications have changes in effectiveness across the circadian cycle which can lead to more difficulty in determining the appropriate dosage and time for administration when working rotating or night shifts. Shift work can also interfere with treatment regimens that involve maintaining regular sleep times, avoiding sleep deprivation, and controlling amounts and times of meals and exercise. Sood (2003) warned that the following conditions could get worse with shift work: heart disease, high blood pressure, stomach and intestinal disorders, sleep disorders, insulin-dependent diabetes, seizure disorders, asthma requiring medication, psychiatric diseases, and alcohol/drug abuse.

Some people have many symptoms, do not get relief from medical therapies, and appear unable to adjust to shift work. Harrington (2001) estimated 20% of workers who tried shift work were unable to adjust. The reason is not fully understood, but it may be due to an inherited tendency to be more sensitive to sleep loss and disruption of circadian rhythms (Van Dongen & Belenky, 2009).

Diseases associated with long work hours

The number of studies examining the influence of long work hours on health has been growing recently but is substantially less than the number examining shift work. Several studies report long work hours are associated with increased fatigue, poor mood, poor recovery from work, and reduced perceived health (Caruso, Hitchcock, Dick, Russo, & Schmit, 2004; Ettner & Grzywacz, 2001; van der Hulst, van Veldhoven, & Beckers, 2006; Siu & Donald, 1995). Men and women working long hours showed higher prevalence of depression and anxiety disorders (Kleppa, Sanne, & Tell, 2008). Similarly, Suwazono et al. (2007) reported better scores for depression and fatigue when work hours were less than 12 per day and 58 per week. Long work hours increase the risk for coronary artery disease by 40% according to a recent systematic review and meta-analysis by Virtanen et al. (2012). Long hours are associated with high blood pressure and diabetes, although not all studies consistently report a significant increase (Caruso et al., 2004). A systematic review identified eight studies with controls for physical demands that linked long work hours to adverse musculoskeletal disorders (Caruso & Waters, 2008). This may be due to longer exposure to physical demands and less recovery time between work periods. Possible adverse reproductive outcomes include increased time to pregnancy (Tuntiseranee, Olsen, Geater, & Kor-anantakul, 1998). A meta-analysis of six studies suggested a possible weak relationship with preterm birth (Mozurkewich, Luke, Avni, & Wolf, 2000).

Impacts to healthcare organizations and community

Fatigue-related impairments can lead to reduced job performance which in turn negatively impacts the employer and the community. Evidence is growing that long work hours and shift work are linked to errors in the delivery of patient care and vehicle crashes on the commute.

Stimpfel, Sloane, & Aiken (2012) examined data from four states of nurses, their hospitals, and their patients. They reported that shifts greater than 13 hours were linked to patient dissatisfaction. Specifically, patients reported that nurses were not communicating well, their pain was not controlled, they did not get help as soon as

they wanted, and they would not recommend the hospital. In this study, nurses with shifts greater than 13 hours had over double the risk for burnout and job dissatisfaction.

Rogers, Hwang, Scott, Aiken, & Dinges (2004) measured the working hours of nurses and their errors or near-errors during work. They found nurses had over three times the odds of making an error when working 12 or more hours, compared with 8.5-hour shifts. Similarly, Scott, Rogers, Hwang, & Zhang (2006) found the risk for patient care errors almost doubled when critical care nursing shifts lasted longer than 12.5 hours. In addition, more than 40 hours per week increased care errors by 46%.

Looking at fatal patient care outcomes, Trinkoff et al. (2011) reported hospitals with higher patient mortality rates had higher rates of nurses working long hours, having lack of time away from work, working while sick, and having higher weekly work hour burden. Staffing and hospital characteristics were controlled in the analysis indicating these schedule features had an independent impact on patient outcomes. Also, Landrigan et al. (2004) and Barger et al. (2006) found that interns working long hours made more serious medical errors.

Circadian, a shift work consulting company, estimates fatigue-related accidents, lost productivity, and health care expenses costs U.S. employers $116.5 billion per year (Sirois, 2007). Similarly, Rosekind et al. (2010) estimated annual fatigue-related productivity losses for four employers were almost $2000 per employee. As discussed above, shift work and long work hours are linked to a wide range of health risks which can lead to more sickness absence. Employers are also at risk for loss of nurses because they become disabled and unable to work (Tüchsen, Christensen, Lund, & Feveile, 2008). This can lead to higher insurance and workers compensation rates. Failure to retain nurses increases costs for healthcare organizations: shift work and long work hours were major reasons for leaving the nursing profession in a study by Peter D. Hart Research Associates (2001). This remains a top concern according to a recent study by the American Nurses Association (2011): 74% of the nurses said their number one concern was acute or chronic effects of stress and overwork.

Fatigued nurses can endanger others during their commute home. Drowsy driving experts identify shift work and long work hours in the top five factors that increase risk for a motor vehicle crash (National Sleep Foundation, n.d.). An estimated 20% of all roadway crashes have been linked to drowsy driving (Connor et al., 2002; Horne & Reyner, 1995). A survey by the American Nurses Association (2011) found one in ten nurses reported a motor vehicle crash which they believed was related to fatigue or shift work.

U.S. National Public Health Goals and The Joint Commission

Recognizing the widespread negative impacts of poor sleep on the person as well as the workplace and community, a growing number of organizations in the U.S. Department of Health and Human Services are targeting sleep health. These include the National Center for Sleep Disorders Research of the National Institutes of Health, Healthy People 2020, the Centers for Disease Control and Prevention (CDC), and National Institute for Occupational Safety and Health (NIOSH, an institute within the CDC). For decades, NIOSH has recognized shift work and work-related sleep loss to be a hazard in the workplace and has carried out an active research program to address this hazard. A goal of NIOSH's National Occupational Research Agenda (NORA, 2009) for Healthcare and Social Assistance is that healthcare organizations adopt best practices of scheduling and staffing that minimize excessive workload and other factors associated with fatigue.

Healthy People 2020 (2010) launched a new chapter for Sleep Health which includes three objectives for adults: (1) increase the proportion of adults who get 7 or more hours sleep per day; (2) increase the proportion of adults with sleep apnea who seek medical evaluation; (3) reduce the rate of vehicular crashes attributed to drowsy driving. Healthy People 2020 (2010) recognized that strong scientific evidence links sleep health to reduced rates of disease, injury, disability, and premature death.

Frieden (2010), the director of the CDC, identified "winnable battles" for meaningful and measurable progress over the next 1 to 4 years. Two are relevant to sleep: reducing obesity and motor vehicle crashes.

In December 2011, The Joint Commission issued a Sentinel Event Alert about healthcare worker fatigue and patient safety. In the alert, The Joint Commission gave suggestions for healthcare organizations to reduce risks from fatigue: examine and improve work schedules, staffing, hand-off process, and consider fatigue in all adverse events; involve staff in the design of their schedules; create and implement a fatigue management plan; educate staff about sleep and fatigue; support staff who work long shifts; and for organizations who allow sleep breaks

during the work shift, provide a good sleep environment and adequate release from work responsibilities.

Concluding remarks

Substantial scientific evidence supports that insufficient sleep can lead to broad-reaching negative health and safety risks to the sleep-deprived person and can also endanger others around them. Employers, nurse managers, and staff nurses all share in the responsibility of adopting strategies to reduce these risks. The key strategy to reduce these risks is making sleep a priority in the employer's systems for organizing work and in the nurse's personal life.

To promote progress, education and training programs for managers and staff nurses would help increase their appreciation and knowledge about the demands of shift work, long work hours, and related sleep and fatigue issues. Strategies for managers and employers include improving the design of their work schedules, promoting frequent breaks during the work shift, fostering good coworker and supervisor relationships, and establishing policies and systems that reduce the risk for fatigue and related health problems. In addition, workplaces can conduct periodic assessments to examine the influence of work schedules on factors on- and off-the-job including performance, alertness, sleep, unintentional injury, worker errors, near misses, illnesses, and off-the-job responsibilities. An anonymous, no-blame reporting system can collect reports on incident and near misses and assess if fatigue was a contributing factor. Strategies for staff nurses include allowing enough time for sleep and adopting good practices and behaviors to maximize sleep and alertness. Nurses with sleep problems or excessive work time sleepiness can seek an assessment and treatment from a sleep disorders specialist. Staff nurses also will benefit from educating their family about their special needs to gain their support and reduce conflicts between work and home demands.

NIOSH's topic page for work schedules has a number of resources to help nurses and healthcare organizations become better prepared to reduce risks linked to work-related sleep loss (http://www.cdc.gov/niosh/topics/workschedules/). NIOSH has drafted online training materials to help educate managers and nursing staff. When these are finalized, they will be available on this website.

Key Practice Points

- Shift work and long work hours put nurses at risk for short sleep duration and sleep disturbances.
- Insufficient sleep increases the risk for reduced performance on the job, injuries, obesity, a wide range of chronic diseases, and fatigue-related errors which could harm patients and other people.
- Education and training programs for managers and staff nurses would help increase their appreciation and knowledge about the demands of shift work and long work hours and provide them with strategies to reduce these risks.
- Recognizing the widespread negative impacts of insufficient sleep on the person as well as the workplace and community, a growing number of U.S. public health organizations target improving sleep health including The Joint Commission and several organizations in the U.S. Department of Health and Human Services.

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