



# The Potential Effects of Sleep Loss on a Nurse's Health

Long shifts and overtime may adversely affect health as well as performance.

**OVERVIEW:** While much has been written about the effects of extended work hours on quality of nursing care, nurse burnout, and job attrition, the potential adverse effects of acute and chronic sleep loss on the overall health and well-being of nurses has received little attention. The author describes the acute and chronic effects of sleep loss on nurses, strategies nurses can use to increase the quantity and quality of their sleep, and institutional policies that can promote adequate rest and recuperation between work shifts for nursing staff.

**Keywords:** health, sleep debt, sleep deprivation, sleep loss, work schedule

While nurses play an important role in promoting the health of others, many inadvertently compromise their own health and safety by working shifts of 12 or more hours (and often exceed those hours by spending an additional 30 minutes on shift report), taking on rotating shifts, or clocking more than 40 hours per week. Nurses are known for voluntarily working overtime—either to complete documentation, admit a new patient, assist a colleague, increase their income, or compress a week's work into fewer days. In a study that randomly selected and surveyed 500 RNs working as hospital staff nurses in North Carolina and West Virginia, 34.9% of respondents reported voluntarily working overtime, 53.1% of whom regularly accrued more than 12 hours of overtime per week.<sup>1</sup> In addition to voluntary overtime, nurses in most states may be required to work in excess of their regularly established schedules to cover staffing vacancies.<sup>2</sup> Even in the 16 states that restrict or regulate mandatory overtime, hospitals don't always comply with regulations.<sup>1,3</sup> Some nurses, most often single

parents and nurses working more than one job, report working 15 or more hours per day, several consecutive days, and 60 or more hours per week. And of those who report working mandatory overtime, two-thirds say they have often had to do so with as little as two hours' prior notice.<sup>4</sup> Whether a nurse is motivated by altruism, a sense of responsibility and accountability, fear of job loss, or monetary gain, the results of overwork are likely to be the same: chronic exhaustion and sleep deprivation.

Although much has been written about diminished quality of nursing care as well as the fatigue, burnout, and attrition associated with working extended hours, little attention has been paid to the possible effects of acute and chronic sleep loss on the overall health and well-being of nurses. According to the National Institutes of Health, most adults need seven to eight hours of quality sleep per day to function optimally and feel refreshed,<sup>5</sup> but nearly 30% of U.S. adults sleep seven or fewer hours daily.<sup>6</sup> The Institute of Medicine estimates that 50 to 70 million

U.S. adults have chronic “sleep and wakefulness” disorders.<sup>7</sup>

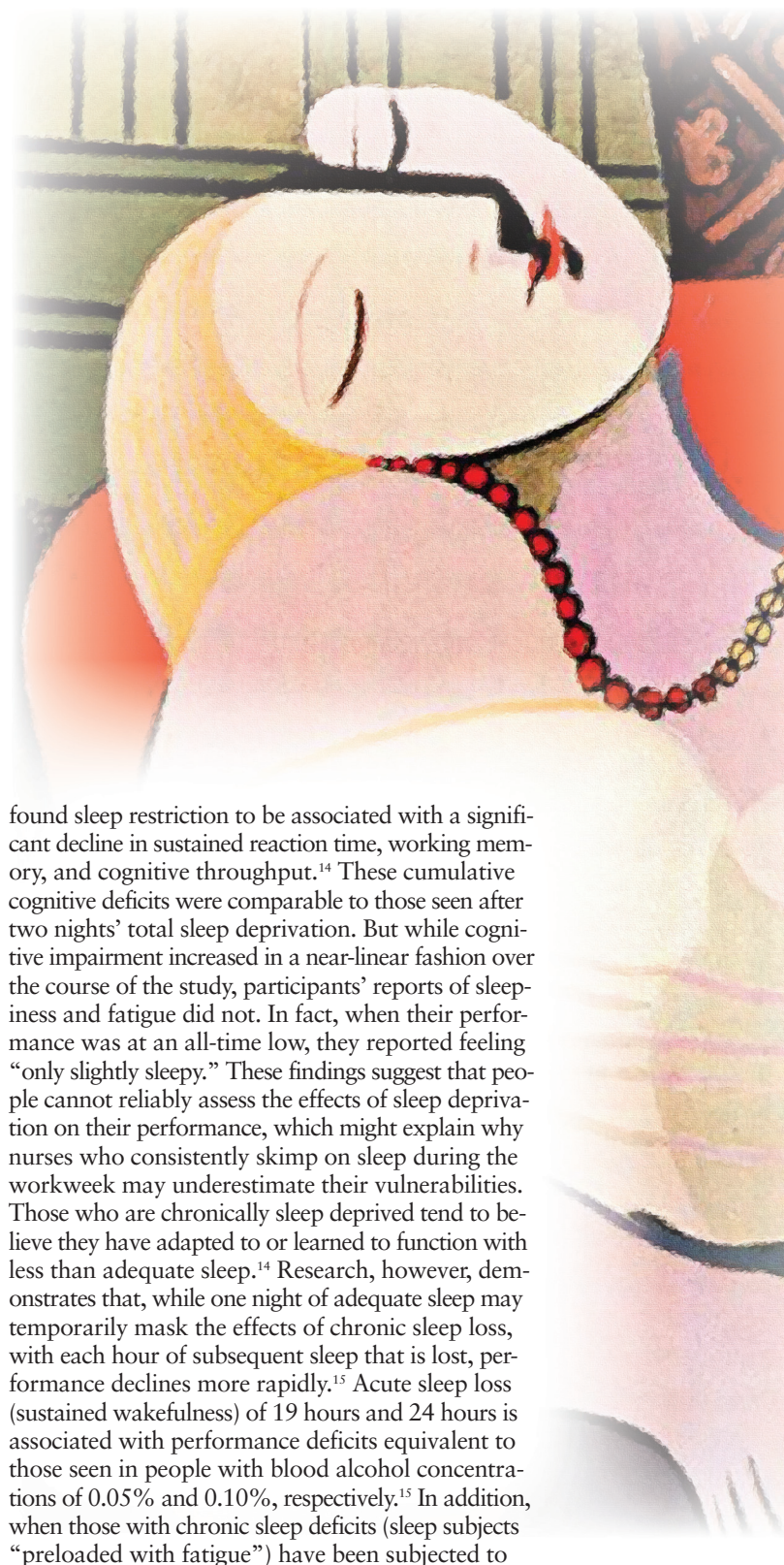
Nurses working extended hours (12 or more hours in a 24-hour period, or more than 40 hours per week) may be less likely than the general population to have an adequate amount of quality sleep. An analysis of data from the Staff Nurse Fatigue and Patient Safety Study suggests that only about 27% of the 393 hospital nurse participants slept at least six hours before starting every shift they worked during the four-week study period—and more than 29% of the 11,387 shifts studied were staffed by nurses who had slept fewer than six hours before starting work.<sup>8,9</sup> Similarly, data from a study by Geiger-Brown and colleagues revealed that daily sleep time for day- and night-shift nurses averaged 5.7 and 5.2 hours, respectively, following a first 12-hour shift, and 5.7 and 5.5 hours, respectively, following a second consecutive 12-hour shift.<sup>10</sup>

Despite the evidence that nurses sleep less than the general population and are more prone to mistakes when working extended hours, most report being satisfied with the scheduling practices at their hospitals.<sup>11</sup> The combined effects of long hours and insufficient sleep, however, are associated with serious health problems that can impair learning, memory, judgment, and performance, and can contribute to a wide variety of chronic diseases, such as obesity, diabetes, cardiovascular disease, and certain cancers.

In December 2011, the Joint Commission issued a Sentinel Event Alert identifying shift length and work schedules as significant factors affecting health care workers’ quality and quantity of sleep.<sup>12</sup> In September 2014, recognizing the dangers that “inadequate sleep and resulting fatigue” pose to both patients and nurses, the American Nurses Association (ANA) released a position statement calling for nurses and their employers “to carefully consider the need for adequate rest and sleep when deciding whether to offer or accept work assignments, including on-call, voluntary, or mandatory overtime.”<sup>13</sup> This article discusses the acute and chronic effects of sleep loss on nurses, strategies that can help nurses increase the quantity and improve the quality of their sleep, and policies that nursing leadership can implement to promote adequate rest and recuperation between work shifts for nursing staff.

### INSUFFICIENT SLEEP AND SLEEP DEBT

Sleep debt, or chronic partial sleep restriction, occurs when a person sleeps for fewer hours than necessary over multiple days or weeks. When Van Dongen and colleagues examined the effects of insufficient sleep on 48 healthy young adults whose sleep had been restricted to four to six hours a night for 14 days, they



found sleep restriction to be associated with a significant decline in sustained reaction time, working memory, and cognitive throughput.<sup>14</sup> These cumulative cognitive deficits were comparable to those seen after two nights’ total sleep deprivation. But while cognitive impairment increased in a near-linear fashion over the course of the study, participants’ reports of sleepiness and fatigue did not. In fact, when their performance was at an all-time low, they reported feeling “only slightly sleepy.” These findings suggest that people cannot reliably assess the effects of sleep deprivation on their performance, which might explain why nurses who consistently skimp on sleep during the workweek may underestimate their vulnerabilities. Those who are chronically sleep deprived tend to believe they have adapted to or learned to function with less than adequate sleep.<sup>14</sup> Research, however, demonstrates that, while one night of adequate sleep may temporarily mask the effects of chronic sleep loss, with each hour of subsequent sleep that is lost, performance declines more rapidly.<sup>15</sup> Acute sleep loss (sustained wakefulness) of 19 hours and 24 hours is associated with performance deficits equivalent to those seen in people with blood alcohol concentrations of 0.05% and 0.10%, respectively.<sup>15</sup> In addition, when those with chronic sleep deficits (sleep subjects “preloaded with fatigue”) have been subjected to

additional acute sleep loss in experimental settings, the decline in performance “dwarfed the impairment induced by acute sleep loss alone in people who were not chronically sleep restricted.”<sup>15</sup>

### ACUTE EFFECTS OF SLEEP LOSS

Sleep is regulated by homeostatic and circadian processes, which work together to determine the onset of sleepiness and wakefulness. Failure to adhere to the needs for both adequate and appropriately timed sleep can result in an overall decline in the ability to learn, remember, use sound judgment, and perform tasks safely.

**Memory and learning.** The consequences of insufficient sleep go beyond just daytime sleepiness and fatigue. Over the short term, sleep loss—even as little as one hour per sleep period—can result in memory deficits, cognitive impairment, and reduced attentiveness. There is considerable evidence that sleep, learning, and memory are interrelated. While the acquisition of knowledge and recall occur when people are awake, those getting insufficient sleep are often unable to focus effectively, filter distractions, and learn new information. There is little research on how sleep loss affects learning among nurses, but according to Geiger-Brown, sleep-deprived nurses have displayed the reduced ability to learn such new information as pertinent facts regarding patient assignments or training in the use of new equipment.<sup>16</sup>

There is mounting evidence that sleep affects not only the acquisition of new information but also the stabilization of learning through the strengthening of neuronal connections.<sup>17</sup> In other words, during

sleep, information obtained during wakefulness is consolidated or preserved as long-term memories, and without sufficient sleep, it's more difficult to recall or retrieve newly acquired knowledge.

**Performance and judgment.** A survey of 3,604 postgraduate medical residents working in a variety of specialties and hospitals indicated that sleeping five or fewer hours per night was associated with the following events<sup>18</sup>:

- medical errors
- adverse patient outcomes
- being named in malpractice suits
- serious accidents or injuries
- conflict with colleagues
- increased use of alcohol
- use of medications to stay awake
- noticeable weight change
- working in an impaired condition

Even after one night of insufficient sleep, cognitive performance (completing tasks involving memory and reasoning) is reduced by as much as 25%.<sup>19</sup>

**Motor vehicular injuries and sleep loss.** In November 2013, the husband of a nurse who was killed in a car crash after falling asleep at the wheel following a 12-hour work shift sued the hospital for allegedly “working her to death.”<sup>20</sup> A descriptive study in which the sleep, sleepiness, fatigue, and cognitive-behavioral performance of 80 RNs were measured over three consecutive 12-hour shifts found that nurses accumulate a “considerable sleep debt while working successive 12-hour shifts.”<sup>16</sup> Fatigue, increased sleepiness, diminished ability to selectively process and retain information, slowed reaction time, and reduced vigilance can increase the risk of human error, the consequences of which can be costly in terms of personal health and well-being.

Although some individuals may be less affected than others by the consequences of sleep loss, nurses may not fully appreciate that they are risking their health and safety when they are excessively fatigued or sleepy. Of particular importance is the fact that those who perform routine tasks requiring vigilance, such as driving, become significantly more error prone when wakefulness is prolonged.

Drowsy driving is well known to be a major cause of motor vehicle accidents and subsequent fatalities and nonfatal injuries. A 1996 focus group evaluation of 45 ICU nurses found that, during the year preceding the interviews, 43 (95.5%) had been involved in at least one accident or near accident while driving home from work.<sup>21</sup> In a 2007 survey of 895 hospital staff nurses, 596 (66.6%) reported having driven while drowsy at least once during the 28-day study period, and 30 (3.4%) said they drove while drowsy following every shift they worked.<sup>22</sup> Multiple studies have shown a significantly high risk of motor vehicle accidents or near misses among employees who work<sup>22</sup>

### How to Maximize Your Sleep Time For nurses.

- Use caffeine judiciously.
- Avoid nicotine, alcohol, and other chemicals that interfere with sleep, especially four to six hours before bedtime.
- Avoid heavy meals close to bedtime.
- Avoid watching television, working on a laptop computer, using a cell phone, or eating in bed close to bedtime.
- Establish a consistent sleep schedule and a soothing bedtime routine.
- Sleep in a dark, quiet, cool environment.
- During daylight hours, use break times to go outside.
- Take rest periods away from your work area.
- Learn to recognize signs of fatigue in yourself and others, and encourage colleagues to take breaks when necessary.

- more than 60 hours per week.
- irregular shifts.
- at night.

**Musculoskeletal injuries and sleep loss.** Of the 4,614 RNs who responded to the 2011 ANA Health and Safety Survey, 53% reported working mandatory and unplanned overtime, 55% said they worked more than 40 hours per week, and 62% reported having disabling work-related musculoskeletal injuries.<sup>23</sup> While it is well established that musculoskeletal injuries are a significant cause of morbidity among nurses, to date, only a small number of nursing studies have explored the relationship between this type of injury and extended work hours, sleepiness, and fatigue. Of the studies that explored these relationships and controlled for extraneous variables, such as physical demands, findings suggest a positive correlation.<sup>24</sup>

Using a longitudinal survey in which data were collected in three waves or rounds, Trinkoff and colleagues questioned 2,617 RNs about work schedule characteristics and musculoskeletal disorders. They found that nurses who worked long hours or mandatory overtime, were on call, or worked on days they had planned to be off were at a significantly high risk for work-related musculoskeletal injury, with low back pain or low back injury being the most frequently reported.<sup>24</sup> Results from a cross-sectional study of 655 RNs by de Castro and colleagues suggest that non-day shifts and mandatory overtime were significantly associated with occupational injury and illness.<sup>25</sup>

### CHRONIC EFFECTS OF SLEEP LOSS

In addition to maintaining normal brain functioning, sleep has an important role in controlling many bodily functions. A large body of evidence supports the assertion that sleeping fewer than seven hours per day may have wide-ranging adverse effects on endocrine, cardiovascular, immune, and neurologic body systems.<sup>26</sup>

**Obesity and sleep loss.** In addition to poor dietary habits, increased caloric intake, and lack of exercise, sleep loss is now considered a potential risk factor for obesity. Research suggests an inverse relationship between sleep duration and weight gain. Those who consistently sleep fewer than six hours in a 24-hour period are significantly more likely to have a higher body mass index (BMI).<sup>27,28</sup> Watson and colleagues examined 1,224 twins comprising 423 monozygotic, 143 dizygotic, and 46 indeterminant pairs to determine the relative importance of genetic and environmental contributions to inadequate sleep and weight gain. They found that voluntary curtailment of sleep, not familial factors, was associated with increased weight gain.<sup>29</sup> Spaeth and colleagues examined the effects of sleep restriction on weight gain, daily caloric intake, and meal timing in 225 healthy adults

### Policies That Promote Adequate Rest and Recuperation For nurse leaders.

- Avoid scheduling any one nurse for more than three consecutive workdays.
- Avoid rotating shifts.
- Allow for increased flexibility in scheduling (for example, permit nurses to choose between working eight- or 12-hour shifts and use part-time nurses to fill in the gaps).
- Encourage nurses to take breaks away from their work area during long shifts, and set up a “break area” where nurses may rest or take a short nap.
- Provide continuing education opportunities on the importance of sleep, fatigue management, sleep hygiene, and how to recognize signs of fatigue.
- Monitor nurses’ hours, including hours worked at a second job.
- Limit work to no more than 60 hours per week.

and found that sleep restriction was associated with weight gain.<sup>30</sup> They further noted that, among chronically sleep-restricted adults, those who went to bed late appeared more likely to gain weight, possibly owing to late-night meals and snacks. A cross-sectional secondary analysis of data from a survey of 2,103 female nurses suggests that irregular shifts, working extended hours, poor eating habits, and sleep insufficiency were related to obesity among nurses.<sup>31</sup>

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by as much as 25%.**

While there is a general consensus that chronic partial sleep restriction and adiposity are connected and influenced by eating behavior and environmental conditions, our understanding of the underlying physiologic processes is incomplete. Most laboratory studies have examined the neuroendocrine and metabolic abnormalities resulting from total sleep deprivation. Few studies have documented the impact of the more commonly occurring chronic partial sleep restriction on

hormones and body weight regulation, but those that have found abnormalities in the release and inhibition of hormones that control appetite and caloric intake.<sup>32</sup> Leptin, an appetite-suppressing hormone secreted by fat tissue, and ghrelin, an appetite-stimulating hormone released from the stomach, act in concert to control appetite by regulating hunger and satiety.<sup>33</sup> Sleep loss appears to alter the ability of leptin and ghrelin—particularly leptin—to accurately signal caloric need. Data from early studies investigating the relationship between sleep restriction and leptin have shown that sleep restriction significantly reduces serum leptin levels and increases self-reported appetite and hunger.<sup>34</sup> As leptin levels drop, the hypothalamus interprets the decline as a message that the fat cells need more calories and directs the body to eat more. Low levels of leptin and high levels of ghrelin have been associated with sleeping fewer than seven hours daily,<sup>33</sup> which may explain an increased hunger and craving for calorie-dense foods with high carbohydrate and fat content in those with insufficient sleep: people who are tired may have a tendency to consume more sugar and fat in an effort to boost their energy level.

system activity, all of which can affect the release and utilization of insulin.<sup>41</sup> In a study that assigned 11 healthy young men to 16 consecutive nights of sleep, starting with three nights of eight hours (11 PM to 7 AM; baseline), followed by six nights of four hours (1 AM to 5 AM; sleep restriction), and finally seven nights of 12 hours (9 PM to 9 AM; sleep extension), sleep debt reduced glucose tolerance and acute insulin response to IV glucose by roughly 30%.<sup>34</sup> Such studies suggest that chronic sleep loss may lead to persistent insulin resistance, resulting in excess plasma glucose and triglycerides, which ultimately increase the risk of both diabetes and heart disease.

**Cardiovascular risk.** Chronic partial sleep restriction has been shown to increase cardiovascular morbidity and mortality,<sup>42</sup> but as with obesity and diabetes, the pathways underlying the connection between chronic partial sleep restriction and increased cardiovascular risk are unclear. One potential mechanism may be activation of inflammatory processes during periods of sleep loss. A number of sleep studies have shown that multiple nights of short sleep can change immune cell function, resulting in elevations in the production of both proinflammatory cytokines and

## Long or consecutive shifts, reduced opportunities for quality sleep, and minimal recuperation time can have substantial adverse effects on the physical, cognitive, and emotional well-being of nurses.

**Diabetes and sleep loss.** Over the past three decades, there has been an observable decline among Americans in average sleep times and an alarming rise in diabetes. While obesity is a major risk factor for type 2 diabetes, researchers now believe chronic partial sleep restriction may impair glucose metabolism, thereby increasing the risk of diabetes independent of changes in BMI. Multiple laboratory studies have shown a causal effect between chronic sleep loss and measurable changes in glucose metabolism, hormone levels, and autonomic system response, any of which may contribute to obesity, visceral fat accumulation, and diabetes.<sup>35-40</sup> In addition to its effects on leptin and ghrelin, chronic sleep loss has been associated with increased levels of insulin and insulin resistance,<sup>33</sup> which enhances the storage of fat in the liver, muscle, and adipose tissue, and also inhibits the utilization of fat as an energy source. Additionally, short sleep duration appears to alter the secretion of growth hormone, elevate cortisol levels, and increase sympathetic nervous

C-reactive protein.<sup>43,44</sup> In addition, there is evidence that these immunologic changes are not restored completely by a few nights of recovery sleep. Thus, a prolonged condition of insufficient sleep may lead to chronic, low-level inflammation, a well-known precipitant of cardiovascular disease.<sup>45</sup>

**Cancer risk.** The scientific community has long accepted that sleep is needed to regulate cellular activity and repair damaged DNA. Therefore, it's not unreasonable to hypothesize that chronic sleep deprivation could influence the growth of certain cancerous cells. Schedules that require people to work more than 12 hours per day or more than 40 hours per week significantly decrease the likelihood of obtaining adequate sleep and may expose some to unnatural rhythms of light and dark. By reducing sleep time and destabilizing circadian rhythms, such lifestyles may play a role in oncogenesis.<sup>46</sup> Melatonin, a hormone produced by the pineal gland from the amino acid tryptophan, appears to be involved in immune system function and suppression of tumor growth.

Its secretion is dependent on darkness. A series of studies have linked reduced levels of melatonin, which occur with sleep deficiencies and disruption of circadian rhythm, to increased risk of breast, colorectal, and prostate cancers.<sup>47-49</sup>

hours in a 24-hour period<sup>52</sup> and nursing management should consider altering schedules to make them more compatible with circadian rhythms (see *Policies That Promote Adequate Rest and Recuperation*).

## Sleep-deprived nurses have displayed the reduced ability to learn such new information as pertinent facts regarding patient assignments or training in the use of new equipment.

### CONCLUSIONS AND RECOMMENDATIONS

Twelve-hour shifts remain an accepted norm within nursing and health care organizations, despite a growing body of evidence that long or consecutive shifts, reduced opportunities for quality sleep, and minimal recuperation time can have substantial adverse effects on the physical, cognitive, and emotional well-being of nurses and may subsequently reduce the quality of patient care.<sup>10, 50</sup> While an environment that fosters health-promoting behaviors among nurses is optimal, modifying conventional attitudes and practices is not always easy. And although it's crucial to address the antecedents and consequences of acute and chronic sleep loss, increased awareness does not necessarily lead to change.

The health-related behaviors of nurses may be influenced by the culture, structure, and policies of the organization in which they are employed and by such personal factors as age, gender, marital status, emotional support, psychological makeup, overall physical health, perceived health, perceived benefits or barriers to health, and perceived confidence in the ability to effect change. A comprehensive approach that takes all variables into account is more likely to inspire health behavior change among nurses. Continuing education on the importance of sleep, fatigue management, and sleep hygiene is one way to promote behavioral changes that can improve the quality and quantity of sleep among nurses. There are also a variety of practices that can help nurses maximize the time they do spend sleeping, even if they must work extended hours or non-day shifts (see *How to Maximize Your Sleep Time*). In addition to providing information about the importance of sleep, fatigue management, and sleep hygiene measures, nursing leaders should reexamine policies to ensure that all nurses have "a work schedule that provides for adequate rest and recuperation between scheduled work."<sup>51</sup> To that end, scheduling should not exceed 12

### FUTURE DIRECTIONS FOR NURSING RESEARCH

Research is needed to determine nurses' awareness of the adverse effects on personal health of acute and chronic sleep loss, their willingness to prioritize sleep, and their confidence in their ability to improve their sleep hygiene. Although many studies have addressed nurses' attitudes toward 12-hour shifts, more research is needed to determine current scheduling trends. If the 12-hour shift remains the norm, more controlled trials are needed to determine optimal work schedules and effective countermeasures to sleepiness and fatigue in the health care workplace. ▼

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