

Review Article

Impact of shift work on excessive daytime sleepiness among healthcare professionals and its association with medical incidents: A review

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ABSTRACT

Sleep disorders, especially excessive daytime sleepiness (EDS), is a common complaint among medical professionals such as physicians and nurses. EDS is associated with decreased level of alertness in everyday life and thus leads to road accidents, workspace errors, and lack of concentration in people. We reviewed the literature to know the influence of shift work in the development of EDS and to scrutinize the relation between EDS and medical incidents. In association with EDS, shift work is defined as major risk factors. As health-care professionals are regularly involved in shift work to complete the 24 h services, they were more prone to experience EDS and may cause occupational incidents. Even though it is apparent that working in long shifts leads to sleep disorders, as the body clock is unbalanced, ample or apt research is required to collect reliable evidence. Various studies have reported occupational errors among nurses on comparatively longer work hours like drug administration errors, needlestick injuries, and operational errors in the past 12 months. In conclusion, these variables, that is, shift work, EDS, and occupational errors are directly related to each other. Further studies are required to explore the scenario between these factors.

Keywords: Sleep disorders, Excessive daytime sleepiness, Health-care professionals, Shift work, Medical incidents, Physicians, Nurses

INTRODUCTION

In a modern society, factors such as increasing pace, stressful lifestyle, and routine traveling have become entirely common in general public which ultimately leads to sleep perturbation. Medical conditions affecting regular sleeping ability are known as sleep disorders.^[1] As per International Classification of Sleep Disorders-3, there are seven categories of sleep disorders^[2] as follows:

1. Parasomnia defined as an unpleasant behavior of a nervous system that generally involves unusual movements, sentiments, thoughts, and dreams that occur while falling asleep, sleeping, between sleep stages, and during awakening^[3]
2. Sleep-related breathing disorders are a cluster of disorders defined as unusual respiration in the course of sleep^[4]
3. Circadian rhythm sleep-wake disorders defined as the misalignment between the internal sleep-wake rhythm and external light darkness cycle^[5]
4. Central disorders of hypersomnolence described as extreme daytime sleepiness, disturbing the quality of sleep and timing of a night's sleep^[6]

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5. Sleep-related movement disorders are a cluster of conditions that usually involve movements that affect sleep^[7]
6. Insomnia, common sleep disorder, defined as persistent trouble falling asleep or maintaining sleep, cause, early arousal, and non-restorative sleep that affect daytime performance^[8]
7. Other sleep disorders that cannot be properly classified.

It has been noticed that improper sleep can have an adverse influence on diurnal functions such as mood, attentiveness, and overall well-being of the individual.^[9] Excessive daylight sleepiness (EDS) can be described as the inability in retaining a preferred level of alertness, during the major waking happenings of the day. It is the most frequently recorded sleep complaint and associated with an extensive range of physical and psychological comorbidities.^[10] The etiology of EDS is multifarious, with possible risk already recognized as intrinsic sleep disorders such as narcolepsy and obstructive sleep apnea syndrome; circadian rhythm disorders such as shift work sleep disorder; extrinsic sleep disorders such as poor sleep hygiene and deficient sleep; and other causative factors related to lifestyle and health.^[11] While describing the manifestation of EDS, an individual sometimes uses subjective terminology such as languor, lethargy, inertness, and drowsiness. On the other side, individuals with EDS are at high risk of motor vehicle incidents, work-related happenings, and comparatively have wretched health status than other comparable groups.^[12]

On average, EDS may affect an estimated 20% of the population, which generally includes shift workers, the younger generation, and the geriatric population.^[13] Moreover, in a general population, the prevalence of EDS lies between 2 and 37%, whereas, in working populations such as nurses, physicians, shift workers, and other professionals, it falls in the range between 7 and 84%.^[14] It has already been published that protracted working hours and sleep distress affect both physical function and mental state, causing excessive daytime functions. Furthermore, reduced cognitive function related to EDS can influence the ability to uphold employment, because individuals with EDS may be misunderstood as inactive or unambitious.^[15] EDS is not only an additive symptom or risk factor for different physical and mental disorders but also associated with low productivity and various traffic or industrial misadventures caused by impaired alertness, judgment, languor, and self-esteem.^[16]

Most of the previous studies used the Epworth sleepiness scale (ESS) to evaluate the subjective manifestation of sleepiness as it was difficult to measure objectively. It is one of the most commonly used scales to assess patient dozing in eight common situations.^[17] ESS consists of 8 items that describe everyday situations and each question is graded from “0” (low sleepiness) to “3” (high sleepiness). It is a self-administered

questionnaire generating score between 0 (indicates low sleepiness) and 24 (indicates high sleepiness) with a score less than 10 (ESS <10) categorize as normal whereas, more than 10 (ESS >10) as suffering from EDS. The ESS score was calculated as normal when lies in a range between 0 and 9, mild EDS in the range between 10 and 12, whereas, 13 and 14 indicates moderate EDS and > 14 indicates severe EDS.^[18] The questions used to evaluate ESS are given in [Table 1]. An online survey was conducted by New Zealand among 3273 nurses aged more than 50 years concerning their experience with shift work; and they established that shift work is linked with EDS and wretched sleep quality.^[19] Besides, several studies have been conducted to look into the effect of shift work among doctors on sleep and daytime performance. A study revealed that the protracted job of residents and interns caused sleep deprivation and linked with EDS and medical incidents.^[20]

This review aims to study the impact of shift work on EDS and how EDS emerges as a risk factor for medical errors among doctors and nurses. The key question is to identify the correlation between shift work, EDS, and medical incidents among health-care professionals (HCPs) such as physicians and nurses.

CLINICAL CONSEQUENCES OF SHIFT WORK ON EDS

Shift work is an essential part of most specialties and a common term in sleep medicine. However, there is no precise definition for shift work, and it has been described as working hours involving two or more groups having different work schedules of their starting and ending times. When it comes to health care, shift work is defined as a repeating

Table 1: Epworth sleepiness scale.

<p>0=No chance of dozing off 1=Slight chance of dozing off 2=Moderate probability of dozing off 3=High chance of dozing off</p> <p>In the following situations, rate the prospect you will doze off:</p> <p>Lie down and read Watching TV Inactive sitting during a public place (e.g., during a theater, at a meeting) As a passenger in a car riding for an hour without breaks Lie down in the afternoon, if circumstances allow Sit and converse with someone Sitting quietly after lunch without alcohol In a car, while traffic stopped for a couple of minutes</p> <p>Add above for overall score</p> <ol style="list-style-type: none"> 1. Less than 8: Indicates revealed normal daytime alertness 2. 8-11: Slight sleepiness 3. 12-15: Displays mild sleepiness 4. 16-24: Shows severe sleepiness
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and alternating shifts in which an individual professional or multiple professionals work at different times to cover 24 h.^[21] It is already known that HCPs such as physicians and nurses perform 2–3 distinct day to day shifts as a half-time or full-time work. Moreover, shift work in health-care settings might be a notable factor that disrupts nighttime sleep. It also affects daytime functioning by causing EDS and fatigue. Besides, a recent study found that shift workers (particularly night shift workers) have a shorter sleep period and wretched sleep quality.^[22] It is quite surprising that HCPs tend to disparage the importance of sleep disorders during consultation and does not talk much about routine sleep issues. Many other studies have reported the correlation of sleep disturbances with EDS due to shift work.^[23,24] Moreover, shift workers are more susceptible to have insomnia, low-quality sleep, and EDS. In general, shift work influences, elements related to the lifestyle such as food intake, physical inactivity, and also metabolic patterns along with deprivation of actual sleep hours. It has been noted that long-term stress on shift workers may increase the chances of a co-manifestation of various individual health risk factors, such as high blood pressure, sedentary lifestyle, and increase cholesterol level that further leads to chronic diseases.^[25]

Physicians who worked in hospitals tendered to have a higher number of days of on-call or overnight work than the others. A study reported that the prevalence of EDS was higher among physicians who were more usually worked on-call and overnight, those who could not achieve sufficient amount of sleep due to sleep deprivation, short sleep period, and those who could not achieve sufficient rest due to sleep deprivation.^[26] Concerning each department, the previous studies reported that >20% of surgeons were on-call or work all night more than 4 times in a month, followed by pediatricians where more than 10% were working on-call or overnight once in a month or once every few months.^[27] Among obstetricians and gynecologists, >40% were on-call or overnight shift for 4 times a month, and 23% were on-call or overnight ≥ 8 times in a month. However, $\geq 80\%$ did not work on-call or overnight among ophthalmologists, dermatologists, and otorhinolaryngologists.^[28] Moreover, the working hours of surgeons were significantly longer than those of all other physicians followed by orthopedicians. The previous studies reported that the prevalence of EDS among the general population and non-shifters lies in the rates ranging from 6.3 to 22.6% and 5.9 to 44.8% in shift workers, respectively. However, the ESS score of 7.8 reported both in the academic and private practice physicians.^[29] In another study, it has been noted that the adjusted odds ratio for EDS was significantly lower among female physicians than male physicians. Likewise, the adjusted odds ratio for EDS was significantly higher among physicians who were being on-call and worked all night around 2–3 times every month or sometimes ≥ 8 times every month as compared to those

who were neither on-call nor worked all night. Furthermore, the adjusted odds ratio for EDS was also high among those who slept under 6 h each night and those who reported insufficient rest due to lack of sleep.^[28]

Protracted working hours are common in most residency programs in hospitals. It may be noted that physicians had at least some level of awareness about sleep quality problems, but the dispute is that several were unwilling to accept or were unaware of the presence of their EDS manifestations. To examine ESS, a study was conducted where respondents were asked to self-report their probability of falling asleep under different environmental conditions and over 25% admitted that they had a slight or greater chance of falling asleep while stopped in traffic.^[30] Several epidemiological studies have scrutinized the association between work and sleep conditions among resident physicians. One study reported that when working more than 80 h, there was almost 1.7 times greater chance of developing EDS. It also suggests that limiting work hours to 80 h per week are associated with lower levels of EDS. Comparing both EDS and no EDS group found that no EDS group had significantly more sleep in an average week, spent significantly more time in bed on an average night, and took significantly less time to fall asleep.^[14] Alami *et al.* revealed sleepiness using ESS among the physician training in emergency medicine and found that around 2/3rd of them suffered from EDS.^[31]

It is well known that nurses are involved in assuring continuous patient care around the clock. Moreover, the factors such as extended working hours, family responsibilities, and long commutes may deprive time for adequate sleep among nurses.^[32] The American Academy of Sleep Medicine and the Sleep Research Society state the duration of healthy sleep for adults would be a minimum of 7 h per night.^[33] Furthermore, because of advances in medical care and technology, nurses have to work under stressful conditions which further require a higher level of occupational skills. In nurses, EDS is a universal problem and also considers as a risk factor for physical and mental disorders. Moreover, insufficient sleep period increases the risk of a range of health disorders, such as cardiovascular syndrome, increase BMI, and type 2 diabetes mellitus.^[34] Normally, nurses with insufficient sleep duration more commonly rank their health status as poor when compared with those with adequate nighttime sleep. Poor sleep quality and inadequate sleep among nurses appeared in acute or chronic exhaustion and sleepiness. The prevalence of EDS among nurses is in the range of 24–26%.^[35] Night shift nurses revealed that sleepiness reaches at its peak usually at the end of the shift work that is around 7 am which further imposes a serious community health risk because of the increased chance of traffic accidents.^[36] In a study, Cheng *et al.* examined the relationship between night shift work and sleep disorders among nurses and reported that night

shift work resulted in a reduction in sleep and deterioration of sleep quality among nurses.^[37] In addition, the two other previous studies marked that nurses who worked night shift work and irregular shifts tended to fall into a light sleep unintentionally more often while driving or working compared with those who worked normal day shifts.^[38,39] Hence, it is theorized that there is a clear association between EDS and shift work system, job strain, and short sleep period among nurses who worked in shifts. Some remarkable previous studies with reported sample size, their findings, and the elaborated causes of EDS among HCPs are compiled in Table 2.

RELATIONSHIP BETWEEN EDS AND MEDICAL INCIDENTS

Medical incidents are defined as a case of any action, omission, or error in medical practice in providing professional medical care to the patient which further affects patient safety.^[40,41] It is important to understand the fact that occupational errors or incidents in health-care settings have a direct serious influence on a patient's life. Moreover, the ramifications of the sleep issues among health-care professionals can have a dangerous impact on individuals because of their life-saving responsibilities.^[42] A study conducted by Bollu *et al.* revealed the effects of EDS on retention, awareness, daytime functioning, accidents, and job errors.^[43] A study conducted in the United States of America (USA) revealed that sometimes the impact of sleep

disorders on HCPs is so severe that it leads to professional errors, especially by doctors and nurses.^[44]

It is well known that nurses work in a mentally stressful atmosphere and can perform a crucial responsibility of maintaining patient safety. However, fatigue and sleepiness among nurses may result in errors with negative ramifications. When compared to nurses with an appropriate sleep schedule, sleep-deprived nurses with shift lengths of 8, 10, and 12 hours have a higher risk of drug administration errors.^[45] In another study, occupational errors were evaluated using a questionnaire which consists of three categories i.e. drug administration errors, needlestick injuries, and incorrectly performed procedures. The risk factors associated with occupational errors that were strongly linked to drug administration errors were the shift work mainly night or irregular shift work; for incorrect performed procedure was EDS and for needlestick injuries, it was age.^[46]

Research conducted among resident physicians reported that protracted shift work hours cause sleep deprivation associated with fatigue. This further initiates a higher incidence of medical incidents, percutaneous injuries, accidents, and had an impact on neurocognitive functions such as increased irritability, depression, and reduced motivation.^[47] Galea *et al.* documented in another study among surgical residents that reducing working hours is one strategy to raise the quality of life outside work.^[48] However, a study carried out in the US among 2737 medical residents revealed that an inverse relationship exists between long-

Table 2: Some studies analyzing the highlighted causes of EDS among health-care professionals.

Author, Country	Population	Sample size (n)	Detected ESS score >10 (%)	Main result
Mastin <i>et al.</i> , India	Medical residents	350	47.4	The physicians who worked >80 h were more likely to report EDS due to inadequate sleep patterns (Mastin <i>et al.</i> , 2012)
Chen <i>et al.</i> , East Virginia	Attending physicians	180	23	Short sleep duration, despite actual no. of hours worked was associated with increased sleepiness (Chen <i>et al.</i> , 2008)
Attarian <i>et al.</i> , United States	Attending physicians	315	15.9	Daytime sleepiness was correlated with prolonged working hours, napping, and a lack of sleep (Singh <i>et al.</i> , 2011)
Kaneita <i>et al.</i> , Japan	Physicians	3486	3.5	EDS reported due to short sleep time along with inadequate rest and a high number of on-call/overnight work (Kaneita and Ohida, 2011)
Chaiard <i>et al.</i> , Thailand	Nurses	233	49.5	Short sleep duration nurses experienced more sleepiness and exhaustion during the day (Chaiard <i>et al.</i> , 2018)
Suzuki <i>et al.</i> , Japan	Nurses	4407	26	A strong correlation has been observed over the past 12 months between EDS and medical incidents among nurses (Suzuki <i>et al.</i> , 2005)
Sultan <i>et al.</i> , Saudi Arabia	HCPs	510	-	Nurses and doctors doing shift work have slightly higher ESS scores compared with non-shift work HCPs (Alshahrani <i>et al.</i> , 2017)

term work shifts and available sleep duration.^[28] As the protracted period shifts work increased among medical residents, there was a reduction in sleep available for them, leading to increased chances of medical errors. Another study with 3604 medical residents revealed that extended work hours and insufficient sleep duration were linked to medical errors and trouble with colleagues.^[49] Likewise, a study of 102 medical residents conducted in Japan revealed counter association between sleep period and working hours and also mentioned that short sleep periods were further linked with daytime drowsiness. Besides, it suggested that the only way to decrease the risk of attention failures in ICU and medical errors was to decrease the number of working hours among medical interns.^[50]

In addition, other studies have investigated the work and sleep situations of physicians. A study reported that physicians being on-call mostly 1 or 2 days per week and there were no significant differences between private and academicians physicians. Besides this, there were no differences between the worked hours and those working more than 80 h per week or in hours slept when on-call or not on call in academicians and private practitioners.^[29] However, the overall ESS score was statistically similar between both the physicians, whereas, the ESS score was nearly 11 or more in private physicians as they were more prone to the higher rate. Furthermore, the working hours per week were higher in surgery attending physicians that are around 72 h than those with primary care physicians who worked nearly 62 h.^[51] A study found that total respondents were screened in different areas and there were 19% who had a history of experiencing medical incidents, whereas, the prevalence was highest among young physicians, employees, and physicians who worked in hospitals. Moreover, the prevalence rate of medical incidents was greater among those individuals who were on-call or worked all night 2 or more times in a month or who worked for protracted hours and those with less number of holidays or who experienced lack of rest due to deficient sleep.^[49]

CONCLUSION

It can be concluded from the above-reviewed literature that long working hours or shift work is a major problem in health-care settings. It increases the risk of EDS among health-care professionals, especially in night shift workers and all this happens due to inappropriate sleep patterns. Besides, the nurses and physicians who were attending a higher number of on-call/overnight work were at higher risk of an increased ESS score. The ESS related to the number of hours slept while on shift and not on shift. However, in our opinion, these factors are positively correlated and contribute to each other. Protracted working hours may lead to EDS and it is well known that EDS itself considers as a risk factor that ruins the daytime functioning. As health-care professionals are chiefly involved in patient safety, these described factors

in the paper can increase the risk of drug administration error, improper operational procedure, and needlestick injuries among nurses. Furthermore, studies are required to explain this issue between the existing association of EDS and medical incidents.

Declaration of patient consent

Patient's consent not required as there are no patients in this study.

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Conflicts of interest

There are no conflicts of interest.

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