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Chapter

Physiological and Physical Effects of Sleep Disorder among Shift Work Nurses

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Abstract

Poor sleep quality as one of the mental problems caused by shift working can lead to psychological disorders (i.e., depression; adult attention deficit; memory, cognitive, and performance deficit; reduced job satisfaction, quality of life, and sex drive; and mood change) and physiological disorders (immune system, obesity, cardiovascular risks, hormone imbalance, fertility, and aging). The main scope of the proposed chapter is to describe the various dimensions of psychological and physiological disorders caused by poor sleep quality among shift-working nurses. Also, educational programs will be described for early detection of physiological and psychological symptoms of poor-quality sleep and improvement of sleep quality among shift-working nurses.

Keywords: nurses, sleep disorders, night shift work, circadian rhythm, health status

1. Introduction

Sleep plays a vital role in brain function and systemic physiology across many body systems [1]. Sleep is controlled by the Supra Chiasmatic Nucleus (SCN) of the hypothalamus, the endogenous clock that regulates the production of melatonin, a hormone that induces sleep [2]. Sleep plays an essential role in brain function, and also, the quantity and quality of sleep affect the systemic physiology of the body, including appetite regulation, metabolism, and the function of the immune, cardiovascular, and hormonal systems [3, 4].

Normal sound sleep is defined by adequate duration, good quality, suitable timing and arrangements, and no sleep disturbances [5]. Sleep is one of the most important parameters in night cycles, which plays a key role in restoring physical and emotional strength [6]. Around a third of human life is spent on sleep, and more than thirty percent of the world's people suffer from sleep disruptions because of mental-psychological illness, physical diseases, night work, second employment, and so on. The health care system is one of the most important areas of sustainable human health development where nurses are the main occupational group in the therapeutic system. Nurses usually make up forty percent of the hospital staff, and more than half of the total personnel costs are allocated to them [7–9]. At night, employees of public service-providing areas are working, so that 36.9% of the hospital staff are night-working individuals, and they are often nurses [10].

The results of decades of research have indicated that sleep disruption or insomnia is a widespread problem among people bearing depression; most of them complain of difficulty in starting and maintaining sleep, waking up early in the morning, difficulty in returning to sleep, and insufficient quality of sleep [11–13]. Problems with sleep are widely prevalent and include deficits in quantity and quality of sleep; sleep problems that impact the continuity of sleep are collectively referred to as sleep disruptions [1]. Sleep deprivation is used to refer to acute total sleep deprivation (typically short periods of wakefulness (<72 h) accompanied by a nearly complete loss (>90%) of both non-Rapid Eye Movement [REM] sleep and REM sleep). The non-REM sleep is often caused by occupational demands as experienced by emergency workers, shift workers, and medicine physicians on 36–48 h work shifts by clinical conditions or in military personnel due to insomnia [14].

Sleep disorders tend to occur in one of three ways: inability to obtain a sufficient amount or quality of sleep (called sleep deprivation), unable to maintain sleep durability (difficulty maintaining sleep, called disrupted sleep or sleep fragmentation, and middle insomnia), and what events happen during sleep (for example, restless legs syndrome or sleep apnea) [1, 3].

Sleepiness is the desire or inclination to sleep, whereas fatigue is the lack of desire or disinclination to continue performing the task at hand [15]. Numerous factors contribute to sleep disruption, ranging from lifestyle and environmental factors to sleep disorders and other medical conditions. Sleep disruptions have substantial adverse short- and long-term health consequences [1]. Several studies have shown that the mortality rate in people with a sleep time of fewer than 3.5 h and more than 8.5 h is higher than in those people with a sleep duration of 7 h a day [10, 16, 17].

Physiological systems that follow circadian rhythms like the sleep-wake cycle, hormone secretions, and core body temperature are influenced by signals from the environment especially light [18]. Altered circadian rhythm results in physiological and psychological variables [19, 20]. Shift work results in a conflict between days-oriented circadian physiology and the requirement for work and sleeps at the wrong biological time of day. Internally driven circadian biological clocks regulate the periods of sleepiness and wakefulness [20]. Sleep deprivation affects the ability of health workers who are involved in a multitude of life-saving tasks that need more attention and concentration. Quality of sleep is compromised in those who are frequently involved in extended working hours and shift work, which is found to be more common among nurses [21].

2. Shift work

Rotating and scheduling are the main characteristics of shift work, and nurses are largely locked into schedules that provide 24-h care and include night-shift work [22, 23]. The “shift workers are creators and victims at the same time” of this new work organization [24].

Nursing professionals being one of the most vulnerable populations with chronic work stress due to the high degree of relationship between nurses and patients and the strong emotional involvement that this requires [25]. Nursing is inherently a stressful profession requiring comparatively high levels of physical and mental activity [26]. There are several stressful situations in the nursing profession that can cause problems, including dissatisfaction, low efficiency, and retirement. These situations result in physical and mental health issues that irreversibly damage the

nursing system [27]. Previous studies have shown that high stress among nurses has affected their quality of professional life [28, 29].

Continuous and extended work in close proximity to patients, numerous and strenuous work shifts, poor levels of independence, dissatisfaction with occupational responsibilities, and unprepared to deal with emotional events are some specificities innate to the work of nursing technicians and nursing assistants that make them more prone to developing sleep disorders [30]. Shift work disorder is distinguished as a sleep disorder specified by insomnia in a person's daily scheme [31]. Working on the night shift has been inverse to human nature and induces various disturbances in the nighttime rhythm (circadian rhythm: biological clock) and other undesirable health effects, such as digestive disorders, cardiovascular disorders, and reproductive system disorders, and raises accident rates and decreases efficacy among employees [32, 33]. The nature of the nursing job and their occupational stress, along with the harmful physical factors, are the reason for sleep disorders and drowsiness during the daytime [34].

In addition to adverse health consequences and diminished quality of life at the individual level, shift work disorder incurs significant costs to employers through diminished workplace performance and increased accidents and errors [35]. Recent scientific findings have provided insight into individual differences in tolerance for shift work and expanded cure options for persons with shift-related work disorders. At the same time, attempts to diminish the burden of shift work among employees are still at an early stage. Despite the insufficient data, from an organizational standpoint, reducing the costs related to shift work has the potential to generate significant financial benefits [35]. Furthermore, occupational demands are frequent causes of insufficient sleep and may elevate the risk of accidents at work [36].

Cognitive impairment leads to fatigability and a decline in attention and efficiency in the workplace, which puts nurses' health and patients' health at risk. Cognitive performance is impaired among shift-working nurses, due to poor sleep quality and decreased alertness during the wake state [20]. Night work worsens the well-being of the employee and accelerates the accumulation of fatigue, which is the cause of lower quality and efficiency of work and numerous absences of the employee. Working at the night shift is attended by excessive stress, which makes it very hard to rest and sleep adequately [37, 38]. The result of this is the occurrence of many diseases, including diabetes, hypertension, ischemic heart disease, neurosis, anxiety disorders, and depression, which subsequently lead to various sick leaves, occupational burnout, and incompatibility with the environment and with families [39].

Working at night disrupts all of the physiological processes of the body, as well as causes an increase in the stress hormones adrenaline and cortisol, which are the main representatives of glucocorticoid hormones. Sleep deprivation raises the level of cortisol in blood serum, which subsequently arranges the body to a constant state of readiness. Because of this, higher levels of cortisol hormone cannot go back to normal levels in spite of sleeping at night [38]. It is thought that a long-term adaptation to night-shift work is extremely restricted or even inevitable [40].

3. Psychological disorders

Nurses work rotating shifts and extended hours, which can change the circadian rhythm, occasionally leading to abuse of caffeine and benzodiazepines and nurses needing to use their days off and free time to recover from lost sleep hours. On the other hand, the consequences that arise from nurse burnout are numerous, such

as absenteeism; lack of motivation; concentration difficulty; poor organization; increased errors; decreased patient safety; lack of energy; and feelings of frustration, anxiety, and depression; and insomnia. This scenario leads to poor sleep quality, which plays a critical role in emotional regulation and mental well-being, creating a cyclical issue underlying nursing work [25, 41].

One of the responsibilities of a nurse is prescribing the right drug on time to the right patient by the correct route. Therefore, it is obligatory that nurses clarify obscure orders; have the requisite knowledge and strength of character to question orders that are inappropriate; doubly and triply verify the medicinal product, dosage, and identity of the patient; administer the drug at the correct time and through the right route; and carefully monitor the patient [42]. Administering drugs is part of everyday nursing practice. Patient safety is a key concern in today's healthcare delivery systems. Errors in medication administration can pose a threat to patient outcomes and patient safety [43].

Research conducted among night-shift residents' and nurses reported that poor concentration hindered their efficient, decision-making capacity and also caused increased error rates. Better cognitive ability was reported among nurses who had never been exposed to shifting work compared to those who had been exposed to sleep deprivation, altered circadian rhythm, and extended shift work duration [11, 44]. Chronic fatigue, emotional exhaustion, cognitive anxiety, and worse sleep quality are more common among shift-work nurses than other nurses, and it is associated with the duration of their work shift. In other words, the increase in days of rest for 12-h shift nurses does not seem to be sufficient to neutralize the accumulation of adverse effects during extended workdays [45]. Due to the high incidence of medical mistakes and significant gaps in healthcare quality (medication errors and patient deaths), patient safety is a key concern of today's healthcare delivery systems, and medication administration errors are frequently used as an indicator of patient safety. Several studies have shown that failure to obtain adequate sleep is an important contributor to medical errors, and sleep deprivation can make many healthcare workers, including nurses, more susceptible to irritation and anger toward those they care about. It often causes feelings of guilt, depression, and anxiety and more sleep disorders. Difficulty in sleeping significantly increases the risk of depression even in someone who hasn't had a history of depression before [32].

Several studies have investigated the effect of sleep loss on the development of these neurons [46]. Disruption of sleep for one night appears to have little effect on the rate of cell production, but chronic sleep restriction or disruption of sleep has cumulative effects that lead to a reduction of neuronal development [47, 48]. Additionally, sleep restriction interferes with the normal increase in neurogenesis that occurs with hippocampus-dependent learning tasks (e.g., spatial learning) [49]. It is hypothesized that decreases in cell production are related to a decrease in REM sleep commonly seen in total sleep deprivation and sleep restriction [50].

Partial sleep deprivation reduces response inhibition during the night shift and frontal-lobe vulnerability. Working memory and episodic memory are related to temporal-lobe function, and therefore, relative sleep deprivation has detrimental effects on the psychiatric health of nurses on duty, which is responsible for impaired memory, concentration, and thinking ability [20]. A medical error is defined as a situation when a healthcare professional chooses the wrong method of care or a situation in which the healthcare professional selects the right method of care but performs it incorrectly; so medical errors are frequently described as human errors in the healthcare system [51, 52]. Shift work leads to experiencing circadian disturbance,

particularly working overnight shifts or rotating shifts; also, shift work schedules increase the risk of accidents and injuries [53]. Working during the evening or night can lead to aggravating fatigue in employees because the circadian cycle is disrupted, and on the other hand, fatigue can increase the rate of human errors as a part of medical errors [54]. The cognitive deficits associated with total sleep deprivation have been well described by many studies.

Various studies have continually shown a deleterious effect of total sleep deprivation on vigilant attention. Other cognitive domains aside from attention have also been found to deteriorate with total sleep deprivation. These include spatial working memory, verbal memory, constructive thinking, and cognitive throughput [55–58]. Total sleep deprivation can result in task perseveration with reduced creative thinking and an inability to perceive the likelihood of making errors [57, 59]. Results of previous studies revealed that wrong time and wrong rate were the most frequent medication errors committed by nurses. These errors may be due to either oral or written miscommunication, name confusion, similar or misleading container labeling, or performance or knowledge deficits [15, 60]. People's instability starts when the biological mechanisms affecting the sleep initiation process interfere with cognitive functions. This makes cognitive functions more variable and dependent more and more on intentional efforts to stay awake. The aftereffects of state instability are manifested by increasingly frequent errors of commission (responding when not required) and errors of omission (not responding when it is required) [50, 61].

The most frequent complaints among nurses have been reported as insufficient sleep, short sleep duration, and insomnia [62]. External, environmental, and social factors may also act as predisposing factors for poor sleep. During periods of stressful events and changes in routine, sleep quality may be negatively affected [63]. Sleep plays a fundamental role in learning, memory consolidation, and motor learning, as well as in the immune system and cardiovascular and liver metabolism [25]. Deficits in attention, learning & memory, sensory perception, emotional reactivity, and higher-order cognitive processes, such as executive function and decision-making, have all been documented following sleep disruption in humans [14].

Short-term consequences of sleep disruption include increased stress responsivity; somatic problems; reduced quality of life; emotional distress; mood disorders and other mental health problems; cognition, memory, and performance deficits; and behavior problems in otherwise healthy individuals [1].

Stress and emotional tension from exhausting working conditions can cause burnout syndrome. Burnout is an emotional disorder with symptoms such as stress, fatigue, and physical exhaustion resulting from very stressful work associated with a high degree of responsibility or competitiveness [64]. Burnout groups also show greater sleep fragmentation, lower sleep efficiency, less slow wave and Rapid Eye Movement sleep, lower delta power density in non-REM sleep, and finally lower subjective sleep quality [65].

Burnout can have severe impacts on patients and healthcare professionals. This not only leads to negative mental and physical health outcomes, absenteeism, poor morale, and lack of incentive among personnel but also results in a decline in the quality of care delivered by the affected personnel, resulting in inferior consequences for patients [66].

Inadequate sleep or circadian changes can reduce mental performance and cognitive function, decrease levels of concentration and attention, slow down complex coordination, increase the risk of accidents, increase psychiatric morbidity,

impair the cardiovascular autonomous response system, and also increase physical fatigue [67, 68]. Sleep anxiety can also mediate between depressive symptoms and sleep disorders. Sleep anxiety can be defined as a 24-h phenomenon originating from worries created by insufficient and uncontrollable sleep. Another noteworthy finding is that emotional exhaustion and sleep anxiety have successively caused the association between sleep disorders and depressive symptoms [44, 69]. Previous studies confirm that there is a significant relationship between low earnings and stress in clinical workplaces and the rate of medication errors.

Patient safety outcomes, including medication errors, have been related to occupational burnout in nurses, which is related to staff shortage, unfavourability of nurse-physician relations, and further work-life factors [43, 70].

Emotional exhaustion, job dissatisfaction, and depersonalization are significant factors that influence sleep disorders. Emotional exhaustion, which causes burnout, significantly affects the occurrence of sleep problems. Exhaustion can make work at night more tiring, while the body's ability to regenerate worsens, which may directly cause health problems [38]. Emotional exhaustion is an enduring state of physical and emotional depletion that is caused by personal demands, excessive work, and continuous stress [71]. Clearly, providing services or care, like nursing, can be a very challenging profession, and of course, emotional exhaustion is a usual response to this job overload [72]. Emotional exhaustion is a stress-related and social problem, whereas depression is a pervasive and individual problem [73]. Emotional exhaustion can be an important mediator in the relationship between sleep disturbance and depressive symptoms. Empirical studies have shown that sleep disturbance leads to increased emotional exhaustion. Emotional exhaustion represents the basic individual stress dimension of burnout, which is defined as a psychological state resulting from prolonged emotional or psychological stress on the job [70].

Nurses also typically travail from high workloads and face problems balancing work and family life. These personal workplace conflicts lead to the formation of occupational stress and burnout. In addition, the aftereffects caused by the prevalence of burnout among nurses are multiple, including lack of motivation; reduction in work performance and communication between co-workers; increased absenteeism; grown errors; deficient organization; loss of energy; reduction in patient safety; feelings of frustration, depression, and anxiety; and insomnia [73]. Several studies show that sleep pattern disorders, daytime sleepiness, and burnout are more common among shift-working nurses with 12-hr shifts or more and discontinuous or badly organized shifts than other nurses. These variables are most influenced by the fixed night shift and the rotating shift [25, 74].

Sleep deprivation raises your risk of depression, even for someone without a history of depression. Depression is a syndrome with multiple symptoms, in particular changes in one's behavior (isolation), mood (guilt and sadness), thinking and perception patterns (less focus and lower self-respect), physical complaints (sex, sleep, and hunger), and a high potential of suicide [75]. Previous studies reported significant correlation between sleep parameters and sleep quality, as well as daytime impairment [31, 76]. Several studies have demonstrated that sleep disturbance leads to symptoms of worry, which later develop into depressive symptoms and mood disorders [77, 78]. Generally, the self-reported mood is also affected by sleep deprivation. In the majority of sleep deprivation studies, there is an increase in negative mood states, with reports of fatigue and confusion as well as reduced energy and enthusiasm. Sleep restriction also affects mood [79] and sociability and has been found to exacerbate psychosomatic symptoms, including feelings of muscular pain,

nausea, headache, and generalized body pain. As such, sleep restriction may degrade long-term well-being [80].

The impact of sleep disturbance on depressive symptoms has been strongly mediated by emotional exhaustion. Furthermore, sleep disorders were related to sustaining and emotional exhaustion [81, 82]. The increase in sleep disorders has been sequentially associated with increased emotional burnout and sleep-related anxiety, leading to elevated depressive symptoms. Nurses who rotated between day and night shifts were found to have more health complaints and were less satisfied with their working hours than their colleagues who worked 8-h shifts. The positive correlation between depression and the frequency of medication errors, in a way, indicates the increase of medication errors with the increase in depression [15]. These symptoms are often underestimated by professionals, who self-medicate instead of asking for help in medical or psychological consultation. Furthermore, it has a strong impact on the quality of care [83].

To increase productivity at work, a minimally stressful work environment is necessary. To deal with job stress, temperament control, intervention with control of depressive symptoms and mood, and good sleep quality of a worker, particularly for female nurses, might create an improved and more efficient work environment [84]. Female physicians, like nurses, are at risk of increased occupational stress. An increased workload can lead to severe psychological problems, such as sleep disorders and depression among female doctors, and subsequently affect their occupational and personal lives [85]. In general, shift work can lead to problems in the personal and professional lives of female workers due to the need to work at unusual hours and increased physical activity at work. As a result, woman shift workers have a higher risk of stroke than other workers [86].

4. Physical disorders

The tendency to sleep is regulated by the interaction between a “homeostatic pressure” to sleep and a “circadian alerting signal” that encourages wakefulness. The homeostatic pressure for sleep increases with each hour of wakefulness and dissipates with sleep. Also, the circadian alerting signal is controlled mainly in the suprachiasmatic nucleus of the anterior hypothalamus. This intrinsic coordinator of the circadian rhythm lasts approximately 24.2 h, which regulates not only sleep and wakefulness but also variable physiological functions such as blood pressure, body temperature, and hormone secretion (cortisol and melatonin) [35].

The natural light-darkness cycle is the strongest controller of the circadian rhythm. After light waves enter the eye (or through closed eyelids), photic stimuli are transmitted to the suprachiasmatic nucleus through the retinogeniculo-hypothalamic and retinohypothalamic pathways in the hypothalamus, and this suppresses the secretion of melatonin from the pineal gland [87].

Following nighttime work, these two opposing processes are uncoupled, and the balance of sleep and wakefulness is disturbed. It means that working at night or artificial “day” is not compatible with low melatonin secretion and high alertness. For instance, night-shift workers often fall asleep during the daytime, while at the same time, the circadian alarm signal is at its highest. Therefore, daytime sleep is fragmented and short, resulting in a lack of homeostatic sleep and low circadian excitement at night. In contrast, night work is expected to occur exactly when circadian alerting signals are weakest and sleepiness is at its strongest [35, 88].

Medical complications include increased risk for cardiovascular disease [89]; cerebrovascular events and stroke [86]; obesity [90] and metabolic disorders [91]; gastrointestinal complaints [92]; poor sexual health, including reduced fertility and problems during pregnancy [93]; and multiple forms of cancer [94]. The night shift has been associated with a higher incidence of varicose veins, appetite disturbance, and sleep disorders. Sleep deprivation has considerable consequences on people's personal life as they often postpone many personal and social activities. Inadequate sleep may jeopardize health professionals' efficacy to handle critical situations. Poor-quality sleep has been identified as a risk factor for nursing turnover [40].

The distress associated with sleep loss can create additional stress to maximize sleep, which, in turn, contributes to worsening (rather than improving) sleep disruption. Insomniacs have been shown to have increased EEG activity, abnormal hormone secretion, increased metabolic activity, and increased sympathetic nervous system activity throughout the day and night [1, 95].

The greatest change in blood pressure during the sleep period among those who work shifts is a relevant finding because blood pressure is expected to decrease during the sleep period, called a drop [96]. The lack of a drop and the severity of blood pressure is linked to sleep apnea, autonomic dysfunction, nightly overload, increase in mortality, decreased myocardial diastolic function, developing lesions in target organs like left ventricular hypertrophy, and increase in the prevalence of diabetic retinopathy and subsequent decline of glucose tolerance [97].

Sleep abnormalities affect immune function in a reciprocal manner, leading to changes in pro-inflammatory cytokines, such as tumor necrosis factor, interleukins 1 and 6, and C-reactive protein. During both brief and extended arousals during sleep, increased metabolism is evidenced by increased oxygen consumption and carbon dioxide production. Chronic persistent insomnia is associated with increased secretion of adrenocorticotrophic hormone and cortisol, which is present throughout a 24-h sleep-wake cycle [98–100].

Long-term consequences of sleep disruption in otherwise healthy individuals include hypertension, dyslipidemia, cardiovascular disease, weight-related issues, metabolic syndrome, and Type 2 diabetes mellitus. The increased activity of the sympathetic nervous system that is associated with sleep deprivation has substantial long-term consequences for adults and adolescents. Adults who experience sleep disruption have elevated blood pressure and an increased risk of developing hypertension. Sleep loss appears to affect energy metabolism primarily by impairing insulin sensitivity and increasing food intake. Disrupted sleep has been associated with weight gain and other weight-related issues. Sleep fragmentation can alter glucose homeostasis and decrease insulin sensitivity [1]. Shift work is also associated with a disturbed lipid profile; high triglycerides and low HDL levels are often noticed among shift workers. High triglycerides and low HDL cholesterol findings among shift workers are associated with metabolic syndrome compared to non-shift workers [91, 101].

Previous studies have documented the numerous gastrointestinal signs and disorders related to shift work for over two decades, including gastritis, dyspepsia, colitis, indigestion, peptic ulcer, appetite disorders, constipation, pain, heartburn, abdominal rumblings, inconsistent bowel movements, gastro-duodenitis, and flatulence [92, 102]. Several factors may be involved in the gastrointestinal symptoms reported among shift workers: altered circadian rhythm of stomach functions (enzyme activity, gastric secretion, and intestinal motility), drugs, types of foods eaten, psychosocial stress, and changed menstrual cycle (in women) [103].

Inflammatory markers such as C Reactive Protein (CRP) and leukocyte counts are higher in shift workers and are associated with cardiovascular diseases, atherosclerosis, stroke, and Type 2 diabetes mellitus (T2DM) [104, 105]. An increase in leukocytes is a major risk factor for ischemic stroke and a risk and prognostic indicator for cardiovascular diseases [106, 107]. Nightwork is one of the risk factors for diabetes management since A1c hemoglobin is higher in night shift workers with T2DM than in daytime workers [108]. Several studies have been published for investigating the probabilistic effects of shiftwork on the cardiovascular system without providing deterministic results [109]. Some studies have pointed out that night-shift workers have a higher relative risk of cardiovascular diseases than day workers [89, 110]. In a cohort study, it has been shown that mortality due to various causes, including cardiovascular diseases, among female rotating night-shiftwork nurses was higher than that among day-work nurses, which reflects the potentially adverse effects of rotating night shift on health and life expectancy [111]. A decade ago, the International Agency for Research on Cancer (IARC) confirmed that there was sufficient evidence to consider shift work along with circadian rhythm disturbance as a possible carcinogen (breast cancer) [112].

The occurrence and prevalence of breast cancer among woman shift workers are higher than woman daytime workers. The reason for that is the suppression of melatonin secretion due to excessive exposure to light during the night shift, and considering that the secretion of melatonin at night has an antioxidant role in the pathological and physiological functions of the body, it will ultimately lead to the susceptibility of women shift workers to breast cancer [113]. The biology and growth of normal breast tissue are controlled by genes affected by the circadian rhythm, so a disturbance in the circadian rhythm can cause breast cancer [114]. Female shift workers are at a higher risk of breast cancer compared to non-shift workers because of the disturbance of their circadian rhythms. The decrease in the secretion of cortisol and melatonin hormones causes the diffusion of a series of inflammatory indicators like as TNF- α , IL-1, and IL-2 and subsequently makes women prone to breast cancer [114, 115]. Light exposure at night among shift workers suppresses the normal release of melatonin from the pineal gland and can also stimulate the production of estrogen from the ovaries, which, in turn, can result in breast cancer [10]. Prolonged work as a shift worker is a risk factor for the occurrence of breast cancer due to circadian rhythm disturbance [116].

However, a cohort study reported that there was no significant difference in cortisol levels and any of the immune system indicators between daytime and shift workers [117]. Women are more susceptible to breast cancer if they begin shift work at a very early age and work for a long time period [118].

5. Operational and educational suggestions

The sleep disorders cause burnout in nurses who work shifts. This science can be used to develop strategies to prevent sleep disorders and burnout in nurses, which will also better the quality of nursing services. Identifying the key factors affecting nurse burnout can play an important role in countering this destructive phenomenon by carrying out targeted treatment actions. An efficient system of monitoring shift working schedules should be set up to decrease the occurrence and prevalence of burnout and sleep disturbances. Monitoring the statistic of night shifts, forbidding

nurses from working the day after the night shift, and controlling the long adequate rest breaks all can be effective in reducing the adverse effects of night work as the major reason for sleep disorders and insomnia among shiftwork nurses [38].

In many cases, it is impossible to change the work team's organization; thus, it is necessary for these professionals to adopt measures to reduce variations in the sleep-watch rhythm, using a system of daytime naps and adjusting their personal and family rhythms to their varying work schedules and days of payment. The relationship between sleep and burnout must be taken into account to improve nurses' working conditions. Developing tunicity strategies that limit alternate in circadian rhythm and improve sleep quality can be positive [25]. The distinction between scheduled and unscheduled time worked (time that is planned in advance versus time that is unanticipated) may be more important than the actual number of work hours [15].

Shift work schedules, choosing proper nurses for shift work, and how they remedy them are main factors in the management of shift worker issues. A half-hour nap helps to effectively reduce stress levels of nurses, which allows them to return home safely at the end of their shift with less sleepiness. Making proper work schedule policies among nightshift-working nurses and their implementation can provide better healthcare to the patients and also give better sleep quality and a healthy working environment to nurses [119].

An organized ergonomic turnaround can be less detrimental to the health of nurses and more beneficial for healthcare providers. A 2×12 rotation (day-night) had fewer sleep disorders, and the duration of sleep was more balanced and less segmented than in the rotation of 3×8 (AM-PM-AM). In addition, it appears that a clockwise rotation 2×12 provides better recovery, in spite of 50% increase in the turnaround time. A night shift in the weekly schedule does not change the circadian rhythm and nature of cortisol level of the nurses. Sleep disturbances are especially reported among nurses in morning shifts with a 3×8 turnaround pattern. Shift rotation pattern, if it coincides with travel time, causes the deprivation of needed rest and sleep. In the case of an early-phase rotation (afternoon, morning, night, rest, rest, rest), difficulties related to tiredness and anxiety are linked to the fear of waking up in time the next morning [120].

Using warmer lights during night shifts can be of significant help in hospital work environments, as white light can play a key role to improve sleep quality. Furthermore, if possible, the fixed night shift should be eliminated due to its adverse effects on circadian rhythm [25]. Exposure to daylight at least 3 h a day was found to cause less stress and higher satisfaction at work. Daylight exposure has a curative effect on burnout parameters because there are a lot of studies reporting this effect of daylight on mood disorders [121].

Insomnia can be treated pharmacologically; melatonin can help in the facilitation of normalizing the aberrant circadian rhythm. Benzodiazepine receptor agonist response is good among several insomniac patients, and remission rates are very low. The National Institute for Occupational Safety and Health (NIOSH) guides workers on how to cope with stressful work-related situations and manage their daily healthy physical and mental health [119, 122].

Related mental health promotion services, such as mind-based intervention and cognitive control strategies, can be useful for improving the sleep and mental health of nurses during their work [44]. According to the principles of occupational health, proper sleep as an important category should be included in the plans to improve the workplace. Screening for sleep disorders can be utilized to triage nurses to an acceptable level of treatment based on risk (for example, clinical assessment or public health

education). In this regard, health services for night-shift workers should be provided by the employer during night-shift hours. This can help healthcare providers correctly diagnose the occurrence of shift-work disorders. Treatments that focus on increasing circadian adaptation, reducing sleepiness, and improving sleep can improve the quality of life in shiftwork disorder patients. Clinicians are strongly advised to incorporate family and social support to maximize patient adherence [35].

Disturbance in the circadian rhythm can lead to insufficient sleep and subsequently to cognitive impairment and poor work performance, and to overcome it, good social support and providing a supportive work environment can be used. Preventive acts to minimize psychosocial stress at workplaces like social support, family support, and providing a favorable work environment can reduce sleep problems and also increase worker efficiency within working hours. Stress management training and techniques can help cope with sleep disturbance in certain professions such as nursing. This training can last longer and be beneficial for one's future professional career life. Controlling self-temperament and a cooperative environment among employers, employees, and colleagues can help to decrease sleep disturbance and can increase the work performance and life quality of workers. Switching night work and rotational work can improve sleep disturbances, compared to sticking to the same shift schedule. Blood pressure control and napping can also play an important role in the management of hypertension related to shift work.

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