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THE IMPACT OF NIGHT SHIFTS ON COGNITIVE PERFORMANCE AND HEALTH AMONG HEALTHCARE PROFESSIONALS

RESEARCH PAPER - LITERATURE REVIEW

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ABSTRACT

Introduction: night shifts are essential to ensure a 24/7 persistent patient care in healthcare, although interferes with body's circadian rhythm and sleeping patterns of its professionals. Cumulative sleep loss and fatigue subsequent influence the short-term performance and the health in the long-term. Night workers can experience slow thinking, poor concentration, and decreased of ability to handle complex tasks. In the long run, these consequences result in the increased risk of cardiovascular and metabolic diseases, mood disorders, and professional burnout.

Aims: The aim is to examine and describe the impact of night shifts on cognitive performance and health of healthcare professionals. It focuses on areas such like alertness, judgment, memory, and general consequences to the quality of sleep as well as the psychological well-being.

Methods: This literature review was conducted, analyzing articles of 2007-2025, search results in databases, including PubMed, ScienceDirect, MDPI, and Taylor & Francis. Systematic reviews, meta-analyses, randomized controlled trials, cross-sectional studies, and experimental studies, with the help of tools like actigraphy, psychomotor vigilance tests, and neuroimaging were incorporated in inclusion criteria. Population embraced mainly residents, nurses, and junior physicians working on different schedules.

Results: Night shift workers were persistently associated with a decreased sleep duration and quality, with considerable drop in attention, psychomotor speed, working memory, and complex reasoning after the shift. Neuroimaging findings expressed less activity of right dorsolateral prefrontal cortex after night duty. Loss of performance was related to an increased subjective sleepiness and a low alertness. The long shifts period was associated with an increase in attentional failures and critical medical errors. Higher risk of cardiometabolic, glucose intolerance, disproportionate hormonal synthesis and higher prevalence of depression and burnout were seen among those with prolonged work during the night. Shifts length that was limited to 16 hours reported positive outcomes in terms of vigilance and reduced change of error rates.

Conclusions: night shifts worsen cognitive performance and put health at risk in the long run. Since all these implications are inherent to staff's health and patient safety, institutional policies should focus on healthier scheduling, to promote healthy sleep and regular check-ups of night workers, to help decreasing negative consequences.

Keywords: night shift, cognitive performance, healthcare professionals, circadian rhythm, sleep deprivation, patient safety, health risk.

KOPSAVILKUMS

Ievads: Nakts maiņas ir būtiskas, lai nodrošinātu nepārtrauktu pacientu aprūpi veselības aprūpē visu diennakti, lai gan tās ietekmē organisma diennakts ritmu un speciālistu miega režīmu. Kumulatīvs miega zudums un nogurums attiecīgi ietekmē īstermiņa sniegumu un veselību ilgtermiņā. Nakts darbiniekiem var būt lēna domāšana, slikta koncentrēšanās spēja un samazināta spēja veikt sarežģītus uzdevumus. Ilgtermiņā šīs sekas palielina sirds un asinsvadu un vielmaiņas slimību, garastāvokļa traucējumu un profesionālās izdegšanas risku.

Mērķi: Aplūkot nakts maiņu ietekmi uz veselības aprūpes speciālistu kognitīvo sniegumu un veselību, pievēršot uzmanību tādām jomām kā modrība, spriestspēja, atmiņa un vispārējā ietekme uz miega kvalitāti, kā arī psiholoģisko labsajūtu.

Metodes: Šī literatūras apskata pamatā bija 2007.–2025. gada rakstu analīze, meklēšanas rezultāti datubāzēs, tostarp PubMed, ScienceDirect, MDPI un Taylor & Francis. Iekļaušanas kritērijos tika iekļauti sistemātiski pārskati, metaanalīzes, nejaušināti un kontrolēti pētījumi, šķērsgriezuma pētījumi un eksperimentāli pētījumi, izmantojot tādus rīkus kā aktigrāfija, psihomotorās modrības testi un neuroattēlveidošana. Pētījuma populācija galvenokārt aptvēra rezidentus, medmāsas un jaunākos ārstus, kas strādā dažādos grafikos.

Rezultāti: Nakts maiņu darbinieki ir pastāvīgi saistīti ar samazinātu miega ilgumu un kvalitāti, ievērojami samazinoties uzmanībai, psihomotorajam ātrumam, darba atmiņai un sarežģītai spriešanai pēc maiņas. Neuroattēlveidošanas atklājumi uzrādīja samazinātu labās dorsolaterālās prefrontālās garozas aktivitāti pēc nakts dežūras. Veiktspējas zudums bija saistīts ar paaugstinātu subjektīvo miegainību un zemu modrību. Ilgas maiņas bija saistītas ar uzmanības traucējumu un kritisku medicīnisku kļūdu pieaugumu. Tika atzīti riski kā kardiometaboliskie traucējumi, glikozes nepanesība un nesamērīga hormonu sintēze, kā arī depresijas un izdegšanas sindroma izplatība starp tiem, kas ilgstoši strādā naktī. Maiņas, kas bija ierobežotas līdz 16 stundām, uzrādīja pozitīvus rezultātus modrības un kļūdu biežuma izmaiņu ziņā.

Secinājumi: Nakts maiņas pasliktina kognitīvās spējas un ilgtermiņā apdraud veselību. Tā kā visas šīs sekas ir saistītas ar personāla veselību un pacientu drošību, iestāžu politikai jākoncentrējas uz veselīgāku darba grafiku, lai veicinātu veselīgu miegu un regulāras nakts maiņas darbinieku pārbaudes, lai palīdzētu mazināt negatīvās sekas.

Atslēgas vārdi: nakts maiņa, kognitīvā veiktspēja, veselības aprūpes speciālisti, diennakts ritms, miega trūkums, pacientu drošība, veselības risks.

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INTRODUCTION

In the healthcare sector, night shifts are no exception to the job, someone must be available when the rest of the world is asleep to constantly cover patient needs. But it comes with a cost. Keeping yourself up late at night disrupts your body clock and sooner or later the restlessness takes its toll. It shows through in your energy, your mood and the clarity with which you can think. Research continues to identify the same issues: the concentration becomes more difficult. It becomes more challenging to make decisions and the capacity to multitask complicated tasks is lowered.

Although essential, working during the biological night is extremely problematic to the healthcare worker, as it impacts their performance and long-term health.

Night work breaks the circadian rhythm, the internal clock of the human body, which controls sleep, secretion of hormones, metabolism, and alertness. The light at night inhibits melatonin synthesis, changes circadian phase and decreases sleep quality.

Cumulative sleep debt is due to healthcare workers on night shifts getting less sleep and more fragmented daytime sleep than day workers (Deepalakshmi et al., 2017).

Such disturbances hamper cognitive functioning. Research indicates that attention and reaction time are less vigilant, and the number of attention failures is higher during night shifts (Weaver et al., 2023). In neuroimaging, lack of activity in the prefrontal cortex, which is connected to impaired reasoning and decision-making, is also found (Nishida et al., 2017). These impairments enhance the probability of medical errors particularly when operating under high-pressure.

The risks of obesity, diabetes, cardiovascular disease (Boivin et al., 2022), and increased levels of depression, anxiety, and burnout are risks that become evident in the long-term. Night shift work has been determined by the International Agency on Research on Cancer to be of probable carcinogenic quality because it is associated with breast and colorectal cancer.

The combination of cognitive impairment and long-term health issues demonstrates that it is essential to shape the night shift-related issues in the healthcare industry. Fatigue is a threat to the health of healthcare workers, as well as to the safety of patients due to the increased risk of making mistakes, prolonged duration of diagnosis, and decreased productivity (Rahman et al., 2021; Suozzo et al., 2011).

Since it is important to have night coverage, there has been a growing interest in mitigation strategies. There is evidence in favor of interventions like the restriction of consecutive night shifts, reduction of the length of the shift to ≤ 16 hours, scheduled naps, bright light exposure during shifts, and sleep hygiene.

NIGHT SHIFT WORK IN HEALTHCARE

Healthcare is one among the few industries where constant operation is a necessity. Patients need 24/7 monitoring, emergency departments should not be closed, critical care units should not be left unattended. This need is why shift work is particularly common in the fields of medicine and nursing as opposed to most other occupations. About 20-25 percent of the overall workforce in developed nations are in some sort of shift work and in the healthcare field this percentage is much higher with estimates showing that over half of the nurses and a significant percentage of physicians are habitual night shift workers.

1.1 Defining Night and Shift Work

Shift work can be defined as any work that is not carried out during the standard hours of 7am to 6pm. This involves evening, overnight, early morning and rotating schedules. Night shifts necessitate a long activity in the biological night, which the circadian system should favour sleepiness and rest. Healthcare personnel may have to switch daytime and night shifts, which may include weekly, biweekly, or monthly rotation. Some institutions rely on “night float” systems, whereby residents or nurses are assigned to nights for consecutive blocks, while others use rapid rotations, that alternate more frequently. Long-hour shifts (at times 24-30 hours in duration), have long been a standard of medical residency training.

1.2 Historical and Policy Context

The issues of the risk of long duty hours in medicine have been raised for decades ago. The duty-hour limits were originally introduced by the Accreditation Council on Graduate Medical Education (ACGME) in the United States in 2003 with 80-hour limits on the number of hours worked by residents in a week and a maximum of 28 hours in a shift. In 2011, additional changes meant that first-year residents would not work more than 16 hours a shift, but subsequent changes eased these limitations. The European Union introduced a Working Time Directive in Europe which restricted the number of hours worked per week to 48 hours and limited consecutive shifts, although these restrictions are not uniformly adhered to and enforced by each country. Such policies indicate the increased awareness that sustained wakefulness and circadian distortion are not only detrimental to physician well-being but also pose dangers to patient safety.

1.3 Common Scheduling Models in Healthcare

Various types of scheduling systems are generally met by nurses and resident physicians. Regular schedules provide the same night shifts regularly, long-lasting, which can be adapted to circadian in a way, but has a higher risk of social isolation and health risks in the long run. Rotating schedules alternate between nights and days; they are more socially acceptable but do not allow the body the chance to fully adapt and are more likely to cause fatigue and impaired performance. Another form of unpredictability is that emergency medicine physicians frequently have irregular schedules with different start times.

There are especially long shifts. It has been discovered that doctors who work over 24 hours without taking a break are prone to a high number of errors and also are at higher risk of accidents during commute. Weaver et al. (2023) discovered that patient safety outcomes were better than before when work-hour limits were implemented and mortality was reduced after ACGME reforms. However, it is still common in numerous institutions to have prolonged shifts due to staffing demands and discussions are still ongoing on the best balance on training requirements, continuity of care and fatigue management.

1.4 Demands of Continuous Patient Care

Unlike many industries, healthcare cannot simply suspend operations during the night. Close attention must be paid to ventilators and infusion pumps and sick patients in intensive care units. Emergency departments are the frontline to accidents, cardiac arrests and trauma, with instant decisions potentially being the difference between life and death. There can be also maternity wards and operating theatres that might need urgent attention at any time. This 24-hour shift makes certain that there is a level of night work that cannot be avoided. The challenge lies in designing timetables that minimize disruption to the clinician while maintaining safe coverage for patients.

1.5 Prevalence Among Healthcare Professionals

The biggest professional group that is impacted by the nocturnal work is nursing. It has been surveyed that 60 percent of hospital nurses rotate in shifts during the night and many spend a substantial portion of their career working outside regular hours. Training physicians are not an exception: residents of all specialties, such as internal medicine, surgery, paediatrics, and anaesthesiology, often do night float rotations or on-call. In radiology and emergency medicine, night shifts are an established component of routine practice. Even attending physicians in certain specialties continue to cover nights, especially in smaller hospitals.

1.6 The Emerging Recognition of Occupational Risk

With the mounting evidence pointing to night shifts as a cause of poor performance, health risk, and error, shift work in the medical industry has increasingly been perceived as an occupational hazard. Night shift work has been categorized into “probable carcinogen” by the World Health Organization due to its disruptive effects on circadian biology. There has been the argument of more sustainable work schedules, more encouragement of restful sleep, and more working conditions of night personnel by professional bodies and unions. Nevertheless, due to the necessity of constant care, night shifts are still a structural requirement, which emphasizes the need to address the ways to reduce the negative outcomes of night shifts.

2. CIRCADIAN RHYTHM DISRUPTION AND SLEEP DEPRIVATION

The circadian rhythm, an innate biological timing system, is the key regulator of sleep and wakefulness, coordinating a wide range of physiological processes according to the 24-hour light dark cycle. Its most basic aspect is the suprachiasmatic nucleus (SCN) of the hypothalamus, that synchronizes endogenous rhythms with environmental factors, being the most important one, light exposure. The SCN coordinates melatonin secretion from the pineal gland, cortisol release, fluctuations in body temperature, and the degree of alertness in the daytime. This synchronization is crucial to ensure restorative nighttime sleep and optimal daytime functioning.

This equilibrium is interfered by night shift work. Healthcare professionals are subjected to circadian misalignment by practicing at the biological nighttime, and sleep during daytime. Artificial nighttime lighting inhibits the secretion of melatonin, phases off circadian rhythm, and an attempt to sleep during the day is suppressed by lower melatonin concentrations, elevated core body temperature, and noise. As a result, night workers accumulate a chronic sleep debt marked by a shorter sleep period, reduced slow-wave sleep and frequent awakenings.

2.1 Mechanisms of Circadian Misalignment

There are two mechanisms that explain the negative consequences of night work, circadian phase shift and homeostatic sleep pressure. To begin with, when wakefulness extends into the night, the endogenous circadian drive for alertness declines while the biological drive for sleep peaks. This lack of coordination results in too much sleepiness and performance lapses. Second, daytime naps are incompatible with circadian cues of wakefulness and result in a reduced and interrupted sleep. Circadian misalignment impacts the system, which is established by experimental evidence, where it is shown to exhibit changes in gene expression, endocrine rhythms, and metabolic pathways.

The study by Molzof et al. (2019) compared the intensive care nurses by sequential night shifts and discovered that their core body temperature rhythm was increasingly disrupted in accordance with behavioural sleep-wake patterns. This desynchronization was closely related to a decrease in vigilance and reaction time, demonstrating that circadian biology has a direct negative effect on cognition in practical health care.

2.2 Empirical Evidence of Sleep Loss

The field research has indicated consistently that the number of hours that healthcare professionals who work at night get is less as compared to those working at the day. Nurses with rotating shifts usually get less than six hours of sleep after a night shift, with reduced efficiency compared to daytime rest. The daytime sleep is proved to be shorter and lighter by actigraphy and polysomnography and has less slow-wave and REM sleep. These changes interfere with memory consolidation and emotional control, exacerbating fatigue.

Kazemi et al. (2018) have shown that control room operators that worked seven-night shifts in a row, reported better sleep quality and cognitive performance compared to those who worked

four, suggesting that partial circadian adaptation can occur if shifts are extended long enough to allow adjustment. Nevertheless, this type of adaptation is not common in majority of facilities that have frequent rotations, as the workers they include are always in a continuous state of circadian antagonism.

2.3 Neuroendocrine and Hormonal Effects

Circadian disruption extends beyond sleep architecture to affect hormonal balance. The exposure to light at night dilutes the nocturnal secretion of melatonin, whereas daytime sleep is during the circadian peak of melatonin, and therefore, it is less effective in inducing rest. Furthermore, degenerations within cortisol circadian rhythms, characterised by impaired morning peaks and higher evening concentrations, are some of the reasons that contribute to the disruption in glucose metabolism and an additional cardiovascular load.

These effects have pointed out by molecular based laboratory investigations. Boivin et al. (2022) reviewed evidence showing that nocturnal working alters the expression of clock genes in peripheral tissues, initiating the process of metabolic dysregulation and systemic inflammation. These biological disruptions provide a mechanistic explanation of the higher risk for obesity, diabetes and cardiovascular disease in long-term shift workers.

2.4 Cognitive Consequences of Sleep Deprivation

There are some direct consequences of sleep deprivation regarding cognitive performance. The immediate outcome of acute restriction, usually following a night shift, is a slower psychomotor speed, compromised vigilance and worst attentional failures. Comparative studies between post call residents and well rested controls have proven to have a lower accuracy in clinical tasks and executive functioning. Deepalakshmi et al. (2017) concluded that, when comparing nurses who got enough sleep, with nurses sleep deprived, last ones scored much worse in cognitive tests, assessing working memory and numerical reasoning, indicating an occupational hazard. Neuroimaging has been used to chart the neurobiological foundations of these deficits.

Medical residents' right dorsolateral prefrontal area is less active after working an overnight shift, being associated with worse reasoning and decision-making, according to Nishida and his colleagues (2017). These findings suggest that acute circadian disturbances may impair the higher-order cognitive control, a crucial ability for making safe clinical judgments.

2.5 Accumulated Sleep Debt and Chronic Fatigue

Single night shifts can impair performance. However, continued exposure accumulates into chronic sleep debt. Employees tend to develop irregular patterns of sleep recovery during days off, which may reduce fatigue by half but often does not achieve complete circadian readjustment. This eventually causes chronic fatigue, mood disturbances and reduced resilience against stress. Weaver et al. (2023) integrated evidence for the relationship between prolonged work duration and elevated medical error as well as near-misses, observing that the impairments caused by fatigue matter most during the circadian trough during the early morning hours.

Harris et al. (2024) demonstrated that new shift workers had sleep quality deterioration and worsted mental health during the first year since the initiation of night work, and higher vulnerability at the beginning of career. This increases the cumulative burden of young physicians and nurses who do not have a stablished adaptation mechanism established yet.

2.6 Implications for Healthcare Professionals

Not only has the disruption of the circadian rhythm been a simple physiological interest for clinicians but a literal occupational hazard. Drowsiness may put patients at risk more significantly in high-stakes environments, such as emergency rooms, ICU facilities, and operating rooms. Furthermore, sleep deprivation becomes a chronic situation impacting the well-being of the medical staff, leading to exhaustion and burnout. That restorative normal sleep has not been achieved representing an individual health concern and a systemic problem in healthcare providing.

3. COGNITIVE EFFECTS OF NIGHT SHIFTS

One of the most obvious and immediate impact of circadian misalignment and sleep deprivation is the cognitive consequences of night shift work. Healthcare professional is one of the occupations requiring a higher level of cognitive function. Clinicians need to process a lot of information in a short period of time, sustain attention in an unpredictable environment, and make complex decisions under stress. Night work disrupts such capacities causing work inefficiency and risk of mistakes. Night shift has a negative impact a wide range of cognition, especially attention, vigilance, working memory, executive function, learning, and decision-making, as demonstrated by many empirical studies, such as psychomotor vigilance tasks, neuroimaging studies, and clinical case reporting of mistakes.

3.1 Attention and Vigilance

Alertness and vigilance are extremely sensitive to sleep deprivation and circadian cycle disruptions. Standard for assessing alertness lapses during night shifts has been the psychomotor vigilance test (PVT). Weaver et al. (2023) gathered evidence proving that longer work shifts promote slower reaction time as well as higher number of attention failures. Same goes for nurses, with attentional failures occurring more frequently at the end of night duties than during the day shifts. Most importantly, these deficiencies reach a peak during the morning early hours sharing the time with the circadian trough of alertness. Observations in the field reinforce laboratory observations.

Deepalakshmi et al. (2017) have established that nurses working in continuous night shifts had a slower response time and reduced accuracy in tasks that need more attention. Molzof et al. (2019), also indicated that the degree of circadian mismatch, determined based on body temperature rhythms, had a direct correlation with the poorer vigilance amongst the staff working in intensive care units. These impairments have a direct clinical implication. Loss of vigilance lead

to a higher probability of overlook patients' conditions red flags, vital signs wrong interpretation, or lack of quick reaction time to alarms.

Neurobiological evidence points out these mechanisms. Functional imaging studies indicate that night duty is associated with reduced activation of regions essential for attention control, like prefrontal and parietal cortices. The study conducted by Nishida et al. (2017) found out that medical residents demonstrated a reduction of dorsolateral prefrontal cortex activity and after overnight shifts, reasoning tasks errors rates became higher. The results shown here indicate that attention deficits occurring at night shifting are not merely because of the subjectivity of fatigue but rather as evidenced by the objective variation of brain activity.

3.2 Working Memory and Executive Function

In addition to vigilance, night shifts might be really harmful to working memory and executive processes. Role of these mental capabilities in information integration, prioritizing and planning a clinical intervention is very important. Sleep deprivation has also been shown to impair prefrontal cortex functioning and its connection with parietal networks, causing a decrease in the short-term memory storage and manipulation.

Post-night duty residents and nurses usually show a worse performance in the n-back and continuous performance tests, which measure both the working memory capacity and sustained attention in control studies. This is consistent with the literature of Kazemi et al., (2018) that demonstrated that workers working on numerous night shifts showed slowed cognition. In agreement, Deepalakshmi et al. (2017) also determined that accuracy and memory speed relating tasks were compromised, showing the effect extent of moderate sleep deprivation on performance.

Executive function, comprising cognitive flexibility, inhibition and decision making is highly sensitive to circadian disruption. Neuroimaging research findings can support dysfunctional prefrontal activity when solving complex problems after night shifts. This is clinically significant once that impaired executive control means an incapacity to prioritize treatment process, high susceptibility to cognitive bias, and flaws in emergency or acute setting.

3.3 Learning and Decision-Making

Professionals' reasoning, decision making and learning ability are badly influenced by night shifts work. Memory consolidation relies on slow wave and REM sleep, which is interrupted since rest happens during daytime. This could make night shift workers in the healthcare sector unable to store newly learned information or use clinical thinking efficiently.

Rahman et al. (2021) compared residents working on distinct schedules and found out that those limited to ≤ 16 hours per shift showed better results in diagnostic reasoning, as well as fewer mistakes, than the ones working extended shifts. Similarly, Weaver et al. (2023) also found that the long working hours also increased the probability of misdiagnosis and delayed intervention. The results translate the direct impact of cognitive impairment on patient safety.

There is also high risk taking and a wrong risk appraisal which makes night decisions more complicated. When sleep deprived, staff starts looking forward for quick, less ideal solutions

instead of long better term results. Neurobehavioral research indicates this can be due to an impairment of the reward process in the striatum and decreased regulation of prefrontal region.

These tendencies in healthcare can culminate in an inadequate prescribing, missed differential diagnosis or premature in diagnostic reasoning. Emergency medicine residents who were subjected to circadian disruption showed lower accuracy in diagnosis and more fatigue (Rahman et al., 2021).

3.4 Implications for Clinical Practice

Decline of attention, alertness, working memory and decision-making, experienced during night shifts carry clinical implications. Commission mistakes, including wrong medication administration and omission errors like failed vital signs monitoring or missed changes, tend to occur more frequently if cognitive capacities are compromised. Limitations like this are intensified in high-acuity setting, when decisions need to be made fast and accurate. Besides this, recurrent night shifts accumulate sleep deficits. After several days of consecutive shifts, staff develop mental exhaustion, fatigue, lack of concentration, and cognitive overload. More troubling, is that these experiences not only compromise patient's outcomes but professional dissatisfaction and burnout as well.

Awareness of these dangers explains why institutional factors such as restricted shift length, rest periods integration, and encouraging measures to maintain cognitive functioning under night duty are required.

4. HEALTH RISKS AND PHYSIOLOGICAL CONSEQUENCES

Even though cognitive decline is one of the major immediate implications of night work, long-term effects of circadian imbalance and sleep deprivation also have their issues. Studies have continually proven that night shifts are related to a higher prevalence of metabolic, cardiovascular, mental, and oncologic problems. These findings indicate that night work consequences extend way beyond the acute fatigue and are a big threat to practitioner's health in the long-term.

4.1 Metabolic and Cardiovascular Risk

Night shifts disrupt metabolism homeostasis since they interfere with glucose metabolism, insulin sensitivity and lipid regulation. Epidemiological research revealed that obesity and metabolic syndrome and Type 2 diabetes is more prevalent in the night workers compared to their counterparts who work during the day. Boivin et al. (2022) synthesized the evidence to believe that circadian misalignment alters the clock gene expression in peripheral tissues, which facilitates systemic inflammation and metabolic dysregulation. Harris et al. (2024) further observed that new shift workers experienced weight gain and impaired glucose tolerance within the first year of transitioning to night duty.

Cardiovascular consequences are also very well documented. Hypertension, diminished heart rate variability and elevated risk of coronary artery disease are related to shift work. Meta-

analyses establish the fact that night work at long term increases the rates of myocardial infarction and stroke, which highlights the clinical significance of circadian regulation in heart diseases. Long-term effects of irregular sleep-wake patterns are also increased activity of the sympathetic nervous system, which also increases the chronic increase in blood pressure and vascular malfunction. Shift work has also been broadly recognized as a contributor to metabolic and cardiovascular dysfunction (Caruso, 2014).

4.2 Mental Health

The situation with night work is detrimental to psychological health as more instances of depression, anxiety, and burnout have been experienced among healthcare specialists who worked in shifts. Czyz-Szypenbejl and Medrzycka-Dabrowska (2024) showed that medical staff working rotating shifts suffered from worse sleep quality and high stress rates than day workers. Harris et al. (2024) demonstrated the beginning of shift work to be associated with an early reduction in mood and well-being, especially among young clinicians. Individual variability also plays a role, as some healthcare workers demonstrate a greater vulnerability to insomnia and excessive sleepiness when exposed to irregular schedules (Booker et al., 2021).

Sleep disruption is also aroused in being in emotional regulation, irritability and lack of coping strategies. All this, combined with occupational stressors inherent to healthcare, puts pressure on the risk of psychological disorders. Emotional exhaustion, depersonalization, and lack of a sense of personal achievement are the symptoms of burnout that are more widespread among night workers and place a high risk of retaining employees. Extended night shifts are further linked with elevated risks of sleep disruption and poor psychological well-being (Caruso, Baldwin, & Berger, 2020; Caruso et al., 2019).

4.3 Cancer Risk

According to evidence, circadian disruption (resulting in increased cancer risk) is considered by the International Agency of Research on Cancer (IARC) to be a probable carcinogen (Group 2A) because of night shift work. Epidemiological studies have connected long term night work to a higher occurrence of breast and colorectal cancer, especially in women on rotating shifts. It has been hypothesized that nocturnal melatonin suppression and disrupted hormonal regulation, which promote tumorigenesis, is affected in a mechanistic manner. Even though causality is still in the experimental phase, animal models and human trials are growing in favour of the correlation between broken circadian rhythms and oncogenesis. The International Agency for Research on Cancer has classified night shift work as a probable carcinogen (IARC, 2019).

4.4 Other Long-Term Consequences

In addition to cardiometabolic and oncological risks, shift work has also been linked with gastrointestinal problems, including peptic ulcer disease and functional bowel disorders, probably due to the abnormal eating habits and disturbed microbiota.

There is yet active research ongoing about the impact that night shifts may have on neurodegenerative processes. Preliminary evidence suggests that might be a connection between the extended shifts length with a higher risk of cognitive decline later in life, raising concerns about the effects of its cumulative exposure.

4.5 Implications for Workforce Sustainability

Workforce sustainability is directly affected by the long-term health risks of night work. High rates of morbidity cases among medical workers result to absenteeism, early retirement and also staff shortage, increasing pressure on healthcare systems. These risks recognition is essential to alleviate practitioner's schedules, increase resting time opportunities and regular health check-ups, from the responsible organizations.

5. PATIENT SAFETY IMPLICATIONS

Conjugation of poor thinking with deteriorated staff health culminates in a big risk for patient safety. Many studies have demonstrated fatigue and circadian dysregulation as leading preconditions for medical errors, near-misses, and adverse outcomes. Lapses from cumulative fatigue can be fatal during a clinical setting where a fast and precise decision needs to be made.

5.1 Medical Errors and Adverse Events

Extended working hours and night shifts have persistently been associated with increased levels of medical errors. A meta-analysis by Weaver et al. (2023) demonstrated that the probability of diagnostic mistakes, treatment delay and procedure's complications increases significantly with a working schedule of more than 16 hours. It was also discovered that a restrictive ≤ 16 hours shift improved vigilance and reduced errors rate among residents (Rahman et al., 2021). These outcomes demonstrate that mistakes caused by fatigue are not an isolated incident but more like a systemic adverse effect of excessive work. Other studies have also associated duty-hour restrictions with the change in patient safety outcomes in the past (Weaver et al., 2019).

5.2 Patient Mortality and Morbidity

Evidence suggests that patient outcomes are directly related to accountability of clinicians working schedules. In many studies, patient mortality and postoperative complications fell after going through ACGME-style type of the reforms, regarding duty-hours, as an effort to prove the benefits of limiting shift lengths. On the other hand, has been discovered that long night shifts were related with higher mortality, longer hospitalization and readmission.

5.3 High-Risk Clinical Environments

Certain clinical environments are particularly susceptible to night work effects. In intensive care units, the lapses in vigilance may lead to a late identified life-threatening deterioration. The risk of misdiagnosis in the case of emergency departments is higher during night shifts when the capacity of decision-making is reduced. Theatres are also not spared as evidence has shown that

surgeon fatigue has increased complication rates. The risks posed by beleaguer state of mind are increased because high-stakes decision-making is concentrated in the night.

5.4 Commuting and Occupational Safety

Risk of cumulative fatigue are not limited to patient care. Professionals who drive home after working overnight are more likely to being involved in motor accidents. Studies have reported higher number of crashes of post-call residents, in comparison with control. Working incidents such as needle punctures and falls are also more common during nighttime, showing a sign of poor coordination and decrease alertness. Similar patterns of fatigue-related adverse outcomes in healthcare staff have been reported, including increased accident risk (Barger et al., 2017).

5.5 Systemic Implications

Cumulative effects of fatigue-related errors and adverse outcomes are not only confined to practitioners and patients but also the whole healthcare system. Higher error rates lead to more expensive litigations, longer hospital stay, and harm of reputation. More importantly, they destroy people's trust and confidence in healthcare institutions. Circadian misalignment has also been recognized as a cause for increased medical errors, through disrupted timing mechanisms (Booker et al., 2021). Policy reforms, organizational changes and individual level support strategies are needed to manage the systemic effects of night work on patient safety.

6. MITIGATION STRATEGIES

Strategies to mitigate the adverse outcomes of nighttime work have become a research interest as well as policy subject, given the inevitability of night shifts in healthcare.

Evidence suggests that targeting scheduling practice, restorative sleep, light exposure and education can significantly decrease fatigue, enhance cognitive performance and safeguard long-term health. The effectiveness of these approaches differs, yet combined, they constitute a toolbox of approaches that an institution may employ to strike a balance between an organisation-focused approach that prioritises the well-being of the staff members and the patient-focused approach of delivering continuous care to the patients.

6.1 Shift Scheduling

One of the most direct levers that can be used to minimize fatigue is scheduling. It is particularly effective in limiting the length of shift. Rahman et al. (2021) proved that the residents confined to ≤ 16 -hours shifts were more vigilant and error-free of serious medical mistakes than those having long hours. Likewise, Weaver et al. (2023) discovered that the implementation of changes related to the limitation of long duty hours was closely linked to patient mortality and adverse outcomes.

Rotating schedules that frequently alternate between days and nights do not allow complete adjustment to the circadian rhythm and are related with bigger fatigue. There is evidence that forward-rotating (morning to evening to night) schedules are better tolerated compared to the

backward ones, as they align closer to the natural circadian phase. The consecutive night shifts can be partially adapted to, but prolonged night shifts can cause increased social disruption and health risks in the long term. Therefore, the institutions should balance the trade-offs between the biological adjustment and the social feasibility when designing rosters.

6.2 Strategic Napping and Breaks

Night duty strategic napping has become a successful counter of fatigue. Zhang et al. (2025) were able to show that nightshift napping restored functional connectivity in cognitive-relevant brain systems, such as central executive and salience networks, and increased neurocognitive functioning by using resting-state fMRI. Short naps of 20-40 minutes have been found to lower attentional lapses and reaction times, and longer naps (up to two hours) could be more restorative but have the possibility of a state of sleep inertia on awakening.

The practicality of napping in clinical practice is determined by the level of staffing and the workload. Certain hospitals have opened special rest areas to the night staff with indications of a change in the performance and morale of the staff. Shifts also reduce fatigue when allowed to take short breaks during the shift especially when accompanied by the ability to hydrate, eat and have short physical activities.

6.3 Light Therapy

The most potent zeitgeber (time cue) of circadian rhythms is light and being exposed to bright light during night shifts has been determined to enhance alertness and shift circadian phase. Booker et al. (2021) conducted a systematic reviewed that found that brightness light intervention among nurses decreased subjective sleepiness and enhanced performance in tasks of vigilance. The exposure to 2,000-10,000 lux 30-60 minutes at the beginning or middle of a night shift is especially effective. Additional circadian adjustment is achieved by combining light therapy with darkness in daytime sleep (blackout curtains, eye masks).

Timing of light exposure is critical. Improperly timed interventions may exacerbate circadian misalignment. Thus, to establish a system that helps to avoid burnout, institutional procedures are recommended to offer some systematic information and guidance about the timing and use of light therapy based on the schedule of the staff.

6.4 Sleep Hygiene Education

Educating healthcare professionals about sleep hygiene and circadian health helps them to implement personal strategies that will mitigate fatigue. Interventions may involve counselling about the importance of regular sleep routines, an optimal sleeping environment creation, reduction of screen and caffeine intake before bed, and relaxation strategies. Cushman et al. (2023) established that residents who were proactive in strategic measures such as sleep banking and increasing their sleep time before going on night shifts, performed significantly better during night shifts than those who did not. Awareness of the risks associated with fatigue is also facilitated by sleep hygiene programs, which encourage the staff to rest instead of working in exhaustion.

6.5 Caffeine and Pharmacological Aids

Caffeine remains the most widely used stimulant for sustaining alertness during night work. Its effectiveness in improving vigilance and reaction time is well established, though timing and dosage are important to minimize subsequent sleep disruption.

Central nervous system stimulants, like modafinil, have been in particularly interest of some studies, as they promote wakefulness. However, they provoke some concerning side effects such as dependency and therefore, for ethical reasons, the widespread adoption in healthcare is limited.

6.6 Organizational and Policy-Level Interventions

System changes are compulsory along with additional personal interventional strategies. Institutions should encourage healthier scheduling arranging, provide safe rest periods, and fatigue risk management systems. Policies restricting long shift length and the necessity of rest intervals between shifts have strong evidence of outcomes improvement. Organizational culture is also a key factor. As soon as rest and fatigue management measures are destigmatized and normalized among society, staff becomes more likely to adopt such policies.

Resources on staffing are also worth investing. Even the best logistical strategies can fail the task if understaffed hospitals try to make clinicians to work excessive shifts.

The policymakers and administrators should therefore be aware that safeguarding the employees against the negative impact of night shifts eventually improves patient safety and the quality of care.

7. RESULTS

The reviewed literature consistently demonstrates that night shift work has a significant impact on cognitive, as well as health status of healthcare professionals. Across study designs, laboratory experiments, as well as large-scale observational studies, evidence converges on several key findings.

7.1 Cognitive Performance

The direct and foreseeable consequences of night duty are cognitive impairments. Medical workers who work at night are characterized by reduced reaction times, increased cases of attentional lapse, and low vigilance in contrast to workers who work during the day. Neuroimaging experiments prove that after the night shifts, the activity of the prefrontal cortex is reduced and associated with impairment of reasoning, working memory, and decision-making. Long-term shifts enhance these impairments, resulting in a very high rate of diagnostic errors, postponed clinical decisions, and procedural complications.

7.2 Sleep and Circadian Disruption

Night shifts essentially interfere with circadian alignment. Night light exposure inhibits melatonin and changes circadian rhythms, and any efforts to sleep during the day will lead to shorter, interrupted, and less restful sleep. Actigraphy and polysomnography indicate that night workers

have uniform decreases in total sleep, slow-wave, and REM sleep. The changes result in cumulative sleep debt, chronic fatigue, and impaired capacity to recover between duties.

7.3 Health Outcomes

Beyond acute fatigue, night work poses significant long-term health risks. Circadian imbalance is a facilitator of endocrine and metabolic regulatory changes, leading to insulin resistance, obesity and type 2 diabetes predisposition. Cardiovascular condition is also affected, where hypertension, myocardial infarction, and risks of stroke are increased among long-term nighttime workers. Some of mental health consequences are a higher prevalence of depression, anxiety and burnout, specially when it comes to young clinicians and nurses. Moreover, International Agency of Research on Cancer acknowledges night shift work as a likely carcinogen where epidemiological evidence reveals a long-term association between exposure to the night shift and breast and colorectal cancer.

7.4 Patient Safety

Physiological and cognitive impairments faced by nighttime workers directly translate into patient safety concerns. Extended length and successive night shifts are related to increased medical error, adverse events and even patient death rate. High-acuity settings, especially emergency medicine, intensive care, and surgery are particularly vulnerable, since failure to attend to or make judgments in these settings may result in severe consequences. Beyond clinical care, there are also risks of occupational safety and commuting accidents reflecting the pervasive impact of fatigue

7.5 Mitigation Strategies

Several interventions have demonstrated many measurable benefits. By limiting shift length to ≤ 16 hours, medical errors and attentional lapses are markedly reduced.

Strategic napping during night shifts were determined to recover cognitive function and improve performance. Light therapy was also found to help restablishing circadian adaptation and improving subjective sleepiness. Interventions like sleep hygiene and other educational programs such as sleep banking, boost the individual resilience, making this systemic support essential.

Institutional policies restricting shifts lengths, mandatory rest intervals and the promotion of a rest base culture, are crucial towards risk reduction.

7.6 Synthesis

In general, research indicates a dual burden: night shifts impair short-term cognitive functioning while simultaneously heightening the likelihood of long-term health complications. These outcomes are interrelated since continuous sleep disturbance intensifies both individual health threats as well as workplace performance impairments. Notably, evidence also indicates that most outcomes are preventable with the assistance of applied interventions as long as both individual and organisational implementations are used.

DISCUSSION

Findings of this literature review showed a uniform pattern: the night shift work damages cognitive capabilities, circadian patterns and risks long health of health care providers. These are not only physical outcomes of an individual but of the patient and sustainability of health care. While evidence base is robust, it has methodological variation and gaps that warrant a critical examination.

8.1 Interpretation of Cognitive Impairments

Evidence for cognitive impairment during night work is one of the more stronger and consistent. From the psychomotor vigilance tasks to neuroimaging experiments, results indicate a uniform conclusion, that attention, vigilant attention, working memory, and decision-making are compromised during night shifts. Importantly, these deficits have been found to happen even after a single night of disrupted sleep, demonstrating the immediate susceptibility of clinicians. Extended-duration shifts have a greater degree of impairment, which demonstrates that fatigue is cumulative.

Nevertheless, heterogeneity exists in the degree of observed impairment. Laboratory-based studies often report larger deficits than field studies, likely due to controlled conditions and sensitive testing methods. Compensatory behaviours such as caffeine use, cooperative behaviour, and adrenaline use in emergencies that occur in real-life hospital environments can contribute to the partial masking of deficits. This discrepancy implies that though the degree of the impairment can change depending on the context, the vulnerability remains.

8.2 Health Risks: Strengths and Limitations of Evidence

Mechanistic laboratory and large epidemiological studies support the association between shift work and cardiometabolic risk. Evidence that circadian misalignment alters glucose metabolism, increases inflammatory markers, and reduces heart rate variability provides a clear biological basis for the observed rise in diabetes and cardiovascular disease among long-term night workers. Similarly, the link between night shifts and mental health disorders such as depression and burnout is consistently reported.

Findings regarding cancer risk are more subtle. Although IARC considers night shift work to be most likely to be carcinogenic, epidemiological studies results have been inconsistent, with some studies showing a strong association and others reporting null results. Interpretation is complicated by confounding factors like lifestyle differences, exposure duration and genetic predispositions. Further longitudinal studies that include the accurate measures of exposure are required to determine causality with more confidence.

8.3 Patient Safety: Translating Evidence into Practice

Connection between patient safety outcomes and clinician fatigue is a critical theme. It has been proven that longer shifts contribute to the likelihood of medical errors, adverse events, and even the death of the patient. Remarkably, has been found a relation between reforms that restrict

duty hours with an improved patient outcome, despite the fact that the magnitude of benefit varies. One challenge is the balance between the decreased hours and continuity of care: shorter shifts might result in a higher number of handovers, creating the risk of communication failures. Therefore, although reduction of the hours is a good idea, it should be accompanied with organized hand over practices to preserve the quality of care.

8.4 Methodological Considerations

Literature includes a wide range of study designs, each with strengths and limitations. Cross sectional surveys are useful in giving prevalence information, but they are affected by recall and reporting bias. Actigraphy and polysomnography provide objective data of sleep but have limitations as they usually work with small samples. Mechanistic information on neuroimaging studies can be provided but not ecologically validated. Major epidemiological studies are very powerful in statistics, but they are limited by exposure misclassification and confounding.

Randomized controlled trials (RCTs) of scheduling interventions are relatively rare but offer some of the most practical evidence. For example, comparison of the long and short-duration shifts has revealed some differences in cognitive performance and medical errors.

However, conducting RCTs in clinical environments is challenging due to ethical considerations and logistical constraints. That is why a significant part of the evidence remains observational.

8.5 Gaps in the Literature

There are also several critical gaps remaining. First, most research concentrates on short-term cognitive and physiological outcomes, and less of the research addresses long-term outcomes, including neurodegenerative disease or lifetime cancer risk.

Second, the studies tend to focus on residents and nurses, while less attention is given to attending physicians, allied health professionals and other hospital staff that also work the night. Third, cultural and organizational factors, such as institutional support and stigma around rest, remain underexplored.

Yet another gap refers to limited work regarding protective factors and resilience. While some individuals can adapt more to night shifts compared with others, factors determining the difference remain unclear. Everything could relate to genetic polymorphisms of the circadian clock genes, variations of chronotypes and lifestyle. These could be determined as a means of making evidence-based interventions.

8.6 Implications for Policy and Practice

Evidence strongly suggests that shift length reduction, rest opportunities and circadian restorative measures implementation can increase both staff wellbeing and patient safety.

These practices cannot, however, become a reality without a system transformation. Staffing shortages, cost pressures, and prevailing cultural norms frequently restrict the use of evidence-based schedule practices. Fatigue management should therefore be recognized as a health issue of the workforce as much as patient safety issue by the policymakers and the administrators.

Meanwhile, individualised measures of sleep hygiene, education, strategic napping, and exposure to sunlight should also be encouraged. But they are effective only with a supporting organisational environment. Stress of night work handling is unevenly apportioned among individuals with no institutional support, and this is inefficient and unsustainable.

8.7 Future Research Directions

Future research should also focus on longitudinal designs with the aim of making clear night work's health risks in the long term and especially, regarding cancer and cognitive impairment.

Additional RCTs on timing interventions and countermeasures are required to have best practices. Additionally, greater attention should be paid to diverse healthcare roles and global contexts, as most existing studies originate from high-income countries.

Finally, incorporation of wearable technology and biomarkers in research would help enhance the accuracy assessing circadian disruption and fatigue measurement.

8.8 Summary of Discussion

In summary, this research provides compelling evidence that night shifts impair cognitive functions, compromise health, and jeopardize patient safety. While effective mitigation strategies exist, their implementation is uneven, and systemic barriers persist. It is important to recognize night work as an essential component of healthcare, but as an occupational hazard as well. Addressing it requires a balanced approach that combines policy reforms, organizational support, and individual strategies, with ongoing research to fill remaining knowledge gaps.

CONCLUSIONS

This literature review reflects the significant and multifaceted impact of night shift work on healthcare professionals. The data frequently indicates that any work in the biological night interferes with circadian rhythms, decreases the duration and quality of sleep, and provokes the cognitive dysfunctions that directly affect the professional performance. Decreased attention, vigilance, working memory and decision-making are equally well documented and they exert serious and severe effects on patient safety.

This is of particular concern in acute, high acuity settings, such as surgical theatres, intensive care and emergency medicine, where fast and sharp responses are constantly required. These are settings where failure may immediately have disastrous effects.

Night shifts induce long-term health issues as well as acute cognitive effects. Circadian misalignment has also been implicated in metabolic and cardiovascular disorders like obesity, diabetes mellitus, hypertension and coronary artery disease. Even mental health is unaffected, as prevalence of depression, anxiety and burn-out are greater among night shift workers. These occupational exposures also are demonstrated to constitute of severe issues as night shift work has been classified as a probable carcinogen by the International Agency for Research on Cancer. These are not only health outcomes of the employee but also imperil the sustainability of the workforce as a measure of absenteeism as well as early retirement and low retention.

The conclusion extends to patient safety and healthcare systems generally. It has been established that providing long-duration shifts increases the volume of medical mistakes and adverse results, while reform of the number of duty hours has been correlated with a reducing number of deaths and complications. Organisational effects of the mistakes produced through fatigue are longer hospital admissions, litigation, and erosion of confidence of the system. Night work is therefore an ethical and a practical problem and one that needs resolution.

The mitigation measures give a way out. The interventions that are supported by evidence include restricting the amount of time spent in a shift to ≤ 16 hours, implementing forward-rotating schedules, introducing scheduled naps, and exposure to bright light during night shift. Individual resilience can be promoted by sleep hygiene education, as well as proactive approaches, such as sleep banking. Nevertheless, such interventions can be best enhanced by organizational policies that put an emphasis on rest, offer resources to recover, and a culture that understands fatigue management as a part of patient safety.

In all, night shift work is an indisputable characteristic of modern healthcare that is, at the same time, a known occupational risk. It has both long-term and immediate, individual and systemic effects. In order to protect the health and safety of healthcare professionals and patients, the institutions should use evidence-based scheduling models, encourage restful sleep, and regularly evaluate the health and performance of the night employees. Further studies would focus on further developing interventions, identifying risks in the long term, and protective factors. Ultimately, when confronting the issue of night work, it must be a balance between the needs of the 24-hour care of the patients and the well-being of the employees that ensure the said well-being.

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APPENDICES

Declaration

I, Núria Filipa Dos Santos Esperança, hereby certify that this research paper on the topic

“Nakts maiņu ietekme uz veselības aprūpes speciālistu kognitīvo veiktspeju un veselību”

(title of the research paper in Latvian)

“The impact of night shifts on cognitive performance and health among healthcare professionals”

(title of the research paper in English)

is my own independent research. All other sources of data, definitions and quotations in my research paper are referenced accordingly. The text of this research paper has never been submitted in any way to any other National Examination Board for evaluation in its entirety or parts, and has never been published in its entirety.

Núria Santos Esperança /Núria Esperança/
(student's signature) (name, surname)

29th of October 2025.