Egypt. J. Chem. Vol. 67, SI: M. R. Mahran, pp. 825-835 (2024)

Egyptian Journal of Chemistry

http://ejchem.journals.ekb.eg/

Impact of Sleep Deprivation on Health Practitioners' Performance

Hamad Fraih Alanazi[1], Salman Abdullah Alamri[2], Ahmad Ebrahem Mofarreh[1], Mazen Hassan Abu Illah[2], Ali Tareq Alhabib[3], Hanan Obaid Al Mutairi[4], Naif Naja Alotaibi [5*], Abdulrahman Nuwaish Saud Alotaibi [5], Nayif Jazaae Alshamrii [6], Yousef Mubarak Badia Alharbi[6], Ibtisam Hamdan Refaei Almutairi [7], Fatimah Jameel Al -Qobaii [7]

[1]Emergency Medical Technician (EMT), Minstery of Health, Saudia Arabia
[2]Emergency Medical Services (EMS), Minstery of Health, Saudia Arabia
[3]Family Medicine Physician (FMF), Minstery of Health, Saudia Arabia
[4] Nursing, Minstery of Health, Saudia Arabia
[5]Prince Sultan Militarian Medical City, Saudi Arabia
[6] Northern Area Armed Forces Hospital (NAAFH), Saudi Arabia
[7]Minstery of Health, Saudia Arabia

In Loving Memory of Late Professor Doctor ""Mohamed Refaat Hussein Mahran""

Abstract

Background: Sleep deprivation is a common issue among health practitioners, particularly surgeons, and can significantly impact their performance and patient safety. Insufficient sleep affects cognitive functions, decision-making, and overall well-being, leading to increased risks in clinical settings.

Aim: This study aims to explore the effects of sleep deprivation on the performance of health practitioners, emphasizing the need for effective management strategies to mitigate its negative consequences.

Methods: A comprehensive review of existing literature was conducted, focusing on studies that analyze the correlation between sleep quality and job performance among healthcare professionals. Key factors such as cognitive function, emotional regulation, and patient care outcomes were assessed.

Results: Findings indicate that sleep-deprived practitioners exhibit reduced cognitive abilities, impaired decision-making, and increased likelihood of errors. Moreover, chronic sleep deprivation is linked to burnout and mental health disorders, further compromising patient care.

Conclusion: Ensuring adequate sleep and promoting well-being among health practitioners is crucial for maintaining high standards of patient care. Institutions must prioritize sleep health in scheduling and support systems to enhance both practitioner performance and patient safety.

Keywords: Sleep Deprivation, Health Practitioners, Performance, Patient Safety, Burnout.

Introduction:

Clinicians' health could affect the quality of care they provide. Indeed, as surgeons, we often neglect to take into account our own welfare, which may have negative consequences not just for our own health but also for the quality of care we provide. As seen earlier, proper nutrition and hydration are necessary for us to perform at a high level professionally. However, in order to preserve our physical and mental well-being, we also need enough sleep and relaxation [1-3].

The health of an individual is significantly influenced by the quality of their sleep, and inadequate sleep is linked to a rise in incidence of sick leave and the development of chronic health issues [4,5]. The quality of sleep is assessed based on its length, the frequency of awakenings, and the capacity to return to sleep. According to Buysse, optimal sleep health is defined by subjective happiness, suitable timing, sufficient length, high efficiency, and prolonged attentiveness during periods of wakefulness [4].

*Corresponding author e-mail: nng.vip@hotmail.com (Naif Naja Alotaibi).
Receive Date: 11 September 2024, Revise Date: 21 September 2024, Accept Date: 23 September 2024
DOI: 10.21608/ejchem.2024.320087.10400

Adequate sleep is essential for maintaining optimal health and performance, since it supports the processes that enable physiological and cognitive function. For instance, it aids in the integration of new memories and the regulation of emotions. Two crucial domains for practicing doctors. The rapid eye movement (REM) phase, which the brain experiences after a prolonged period of sleep, is related with various advantageous activities. Insufficient REM is linked to diseases such as depression [6,7].

The precise time that meets the criteria for regular sleep is a subject of debate, and research examining lack of sleep has employed varying numbers to define insufficient amounts. Most experts agree that any length of sleep less than five to seven hours a night is considered insufficient, while others argue that seven to eight hours is a "healthy" duration for adults [8-10].

Insufficient sleep, a common condition among individuals, is especially widespread among healthcare professionals, and all practicing physicians will eventually experience sleep deprivation [10-12]. Many, indeed, are oblivious to the hazards and indicators of a deficiency in it inside themselves and this might have potentially hazardous repercussions for them individually and for the people they attend to [5,6].

Physiological or psychological health disorders may impact the quality of sleep. Given that surgeons, who are less inclined to seek assistance for these illnesses, are especially affected, it is crucial that we all recognize that poor-quality or insufficient sleep might be a contributing or worsening factor [13,14].

Studies investigating the impact of sleep quantity and quality on job performance often lack reliable or comprehensive data. This may be attributed to the lack of consistency in the activities being evaluated, and the diverse criteria used to indicate what is considered sufficient or of high quality. Evaluation of job performance is influenced by many elements, making it difficult to assess sleep in isolation [6].

Extensive study has been conducted in this field, yet more definitive data is required to determine the minimal quantity and the level of quality necessary for physicians to perform well and prevent any related hazards to their own well-being. Obviously, the quantity would vary across individuals, but establishing a mutually agreed upon minimum threshold would serve as a good beginning, and would be beneficial for formulating schedules, shifts, and on-call responsibilities.

1. The Prevalence of Circadian Issues and Sleep Deprivation among Physicians

The physiological consequences linked to sleep deprivation are analogous to the observations of burnout. The health effects encompass mood fluctuations, heightened drowsiness, exhaustion, irritability, impaired concentration, and disorientation. While only a small number of adults attain the recommended 8 hours of sleep per night, physicians typically only log an average of 6.5 hours per night [15]. A nationwide poll conducted by the American College of Chest Physicians Sleep Establish revealed that physician participants stated that they did not get the necessary amount of sleep to perform at their highest level. A significant proportion (43%) of the questioned practicing doctors attributed their insufficient sleep to their work schedules [16]. Additionally, these physicians compensated for the sleep they lost during the week by sleeping on days or weekends off, averaging 7.5 hours. 20% of physician respondents additionally said that they were unable to participate in family or leisure activities because of sleep-related issues. For doctors with an inherently advanced sleep stage (known as the "early bird") or a delayed sleep stage (known as the "night owl") circadian rhythm, this situation might be particularly difficult. Predictably, doctors also indicated a higher use of caffeine in comparison to the general population [16].

One contributing factor to the elevated prevalence of sleep loss and circadian disorders among doctors is the prevailing culture of medical school. doctors-in-training are taught that sleep is unnecessary, hence persisting in working long and prolonged shifts despite limited duty hours. Consequently, trainees may have a reduced sensitivity to their physiological requirement for sufficient sleep. Circadian disorders, including postponed sleep-wake stage disorder, delayed sleep-wake illness, irregular sleep-wake phase disorder, as well as jet lag illness, may exacerbate physician sleep disruptions in the 24-hour medical care setting, but their impact has not been well investigated. Given the widespread occurrence of lack of sleep and circadian impairments, as well as the pandemic levels of burnout among doctors, it is crucial to have a deeper understanding of their conceptual connection [17].

2. Analysis of the Relationship Between Sleep Deprivation and Burnout

In order to have a deeper understanding of the connection between sleep deprivation/circadian disturbances and physician burnout, it is crucial to first comprehend the fundamental biological processes that would establish this relationship [18]. The crucial biological role of sleep in recovery, energy preservation, and survival is well recognized. Studies conducted on rodents by Everson and Crowley [19] have established that sleep deprivation leads to decreased levels of circulating hormones and disrupted negative feedback loops, suggesting involvement of hypothalamic processes. Insufficient sleep or a circadian imbalance can result in a

decrease in mental function, memory, and performance, as well as a weakening of the cardiovascular autonomic reaction structure. Sleep not only serves an essential part in learning, memory reorganization, and motor development but also in managing emotions and cardiovascular metabolism. Restorative consequences of sufficient sleep involve moving neurotoxic wastes from the CNS that gather throughout waking hours [20, 21].

An explanation for burnout and the persistent depletion of energy storage has been proposed: disturbed sleep [22]. Within this conceptual framework, burnout is defined as a condition that includes sensations of mental, emotional, and physical exhaustion. It is seen as a result of stresses in the work environment, without sufficient recuperation [23,24]. An alternative hypothesis is that a state of heightened activity or stress may be a fundamental component of burnout. This condition may include an intensified stimulation of the hypothalamic-pituitary-adrenal leading to a persistent and substantial rise in allostatic load [25]. Melamed et al [26] proposed that the heightened activation of the hypothalamic-pituitary-adrenal axis and persistent stress serve as drivers for both stress and inadequate sleep.

The sleep effects of burnout encompass a state of heightened arousal and an incapacity to relax caused by worries, concerns, self-deprecation, and anxiety. These elements collectively contribute to an escalation in both sleep onset sleeplessness and sleep maintenance drowsiness as well as alterations in the framework and foundation of sleep. This situation results in inadequate sleep quality and further exacerbates the recurring problem of sleep disruption and its contribution to burnout. Nevertheless, it is crucial to bear in mind that inadequate sleep itself may be a major factor contributing to burnout and may encourage the development of burnout as a condition in susceptible persons [15,25].

Geurts and Sonnentag have proposed a model where the incomplete recovery from burnout and stress acts as a mediator among stressful job circumstances and chronic health problems [27]. These authors propose that during extended exposure to work-related stressors, individuals engage in rumination and anticipation about potential future stressors, resulting in sustained mental and physiological responses. Perseverative cognition, including preoccupation with previous stressors and anticipation of future stress, has been linked to an elevated psychosomatic burden, prolonged and sustained physiological stress, and insomnia. Chronic stress is the main factor responsible for persistent psychophysiological insomnia. Even small levels of daily stress can impact the structure of sleep [28]. The interconnection between sleep deprivation, circumstances contributing to exhaustion, and the corresponding health disorders is very complex (Figure 1).

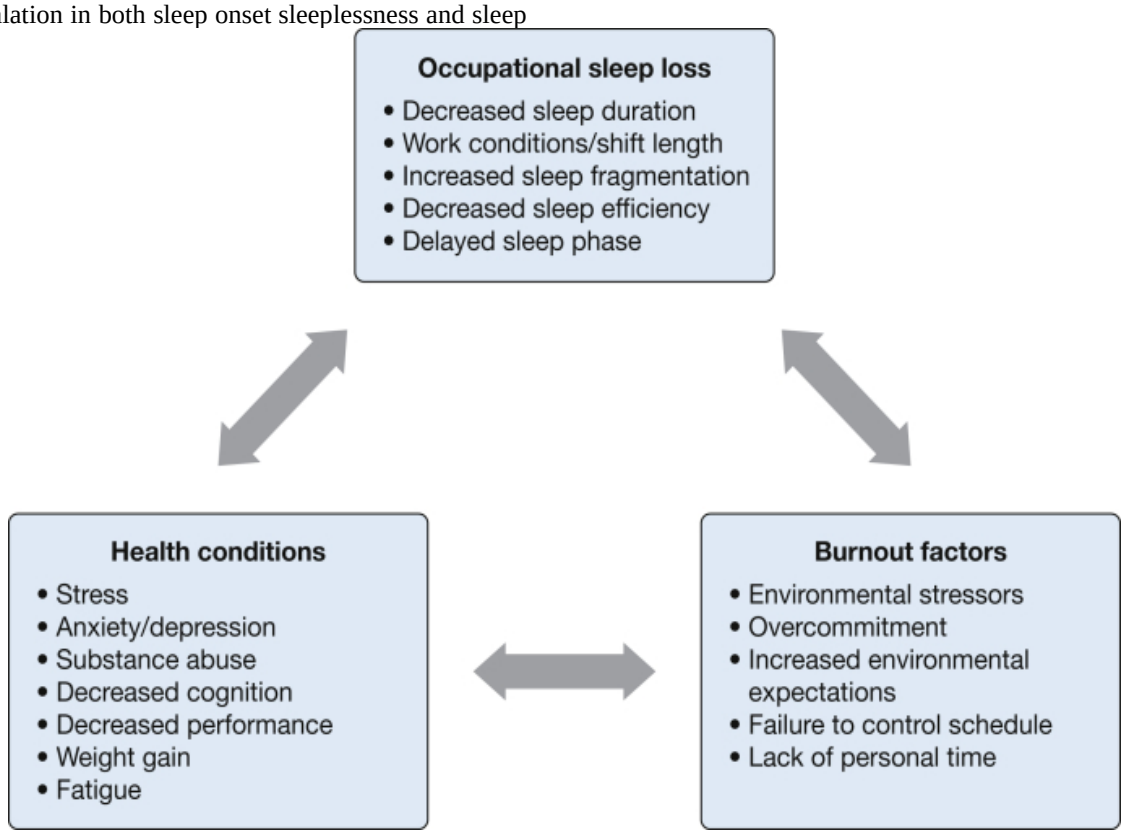

Figure 1. The cross-dimensional correlation between work-related sleep deprivation, health disorders, and variables contributing to burnout.

Considering this conceptual framework, it is unsurprising that several research have shown that sleep issues contribute to the occurrence of burnout in all individuals [29,30]. Respondents in a survey conducted among nonmedical employees identified less than 6 hours of sleep each night as the primary risk factor for experiencing burnout [31]. Furthermore, some research studies have shown that the sleep physiology improves throughout the process of recovering from burnout [30]. According to Åkerstedt [29] and Söderström et al [31], white collar workers on "sick leave" showed reductions in burnout signs, shorter sleep latency, raised sleep quality, decreased number of arousals, decreased sleep dispersion rate, and shorter time awake after sleep onset compared to the population control group. In contrast, slow wave sleep, which is essential for the consolidation and processing of memories, did not completely reinstate its usual levels after the resolution of burnout. These data suggest that some sleep characteristics need more time to revert to their usual levels after burnout [32].

Moreover, there is a considerable body of expert opinions and empirical studies that provide evidence of a connection between exhaustion and increased levels of stress [33]. Given that sleep is a revitalizing physiological process, restricting sleep increases the body's responsiveness to emotional as well as stressful events. Likewise, research has shown that everyday emotional stress impacts the physiological aspects of sleep, the patterns of dreams, and the content of one’s dreams. Profound effects of stress involve an intensified startle response, elevated levels of thresholds for awakening from REM (rapid eye movement) sleep, both heightened and reduced latency to REM sleep, extended length of REM sleep, and increased occurrences of arousal [34]. Considering the documented beneficial effect of restful sleep in reducing the negative consequences of anxiety, it is hypothesised that a reduction in the length of sleep leads to symptoms similar to burnout, such as impaired cognitive functions, fatigue, and sleepiness. In support of this idea, Bonnet and Arand, along with Blasche and Marktl [35], found that disrupted sleep had similar effects on symptoms similar to burnout.

Statistical analysis of cross-sectional research carried out in the overall population has shown a clear association between work pressure, stress, and overcommitment and disturbed sleep patterns [35-37]. Williamson and Friswell [38] carried out research among the personnel of a transportation corporation. The research revealed that modest degrees of sleep deprivation led to cognitive as well as motor function deficiencies similar to those caused by alcohol intoxication, with reaction times falling below 50% of the anticipated values. Although there is little body of research on the relationship among sleep as well as burnout, a statistical analysis undertaken by Yang et al. [39] shown that a "deficient psychosocial work environment" significantly raised the probability of encountering sleep-related issues by almost double during a span of one year. An analysis of burnout and insomnia predicted the interrelated development of both issues over time, suggesting one of them is a contributing cause for the other.

3. Relationship Among Sleep Problems and Healthcare Practitioners

Given the theoretical framework that illustrates a link between burnout as well as sleep deprivation, as well as the empirical evidence from the general population, it is of utmost importance to evaluate the association between inadequate sleep and burnout specifically among healthcare professionals.

Notwithstanding the prevailing focus of trainee research on residency students, medical learners often experience sleep deprivation and fatigue. Two cohorts of preliminary medical learners at a prestigious academic US school were the subjects of research that revealed that more than one-third of students received less than the necessary 7 hours of sleep every night, and more than 10% reported feeling tired while driving. A further investigation conducted on preclinical medical students revealed a significant association between pathological drowsiness and an increased prevalence of burnout [40].

Comprehensive countrywide duty hour research undertaken amongst internal medicine internships and fellows indicates that trainee physicians often experience substantial sleep loss and fatigue. Frequently, these doctors are required to perform extended on-call hours or midnight shifts as a routine aspect of their duties. Improvement of sleep quality and reduction of fatigue, along with the mitigation of the elevated levels of burnout amongst physicians-in-training, particularly residents, has gained increased importance [41].

Within a single-institution study conducted before duty hour reform, the occurrence of chronic sleep deprivation (9% to 43%; P =.0001), moderate depression (4.3%-29.8%; P =.0002), and clinical burnout (4.3%-55.3%; P <.0001) were found to be significantly higher when comparing the baseline data with the year-end observations [42]. Prior to duty hour reform, a prospective study of critical care fellows found elevated levels of stress, severe dehydration, arrhythmias, and reduced consecutive sleep duration [43]. Separate research conducted before the implementation of pre-duty hour reform assessed the effects of removing prolonged duty times for interns. The study saw significant improvements in sleep quality and a reduction in attention problems.57 The increasing worries about duty hours have prompted the implementation of laws aimed at enhancing trainee education and well-being [44].

Although duty hour regulations were introduced in 2003, studies regarding trainee tiredness and burnout lacked precision and was impeded by insufficient study design and implementation [45]. Fletcher et al. [41] executed a comprehensive analysis that examined many dimensions of quality of life during the post-duty hour interval, particularly the quantity of sleep acquired by trainees. The treatments had diverse results, suggesting that there could not be uniform benefits for residents resulting from these alterations. The incorporation of unvalidated questions added more complexity to obtaining conclusive results. While trainees often associate burnout with sleep deprivation, no statistically significant relationship was shown between the number of hours slept, the number of hours labored, or sleep deprivation. Nevertheless, the removal of prolonged work-hour hours for interns did lead to a rise in sleep duration and a decrease in instances of diminished concentration during night shifts in the Intensive Care Unit setting [46].

A research study has been conducted to investigate the effects of the work hour restrictions imposed in 2011 on the welfare of inhabitants. The Flexibility in Duty Hour Requirements for Surgical Trainees (FIRST) trial conducted in 2016 compared standard duty hours with flexible duty hours, both employing a maximum 80-hour work week. The study found no significant differences in patient safety or resident well-being, but objective measures were not used to assess sleep [47]. The Customized Comparative Effectiveness of Models Optimizing Patient Safety and Resident Education (iCOMPARE) study conducted a rigorous evaluation of flexible duty-hour programs in comparison to standardized Accreditation Council for Graduate Medical Education duty-hour policies. This evaluation was based on several indices [48]. The odds ratio (OR) for interns in variable duty hour courses (longer hours) was 2.47, with a 95% confidence interval (CI) ranging from 1.67 to 3.65. With an odds ratio of 1.43 and a 95% confidence range of 0.96-2.13, the rates of stress were notably higher in both categories: 79% in variable duty hour courses in contrast to 72% in traditional duty hour programs. Although there are no explicit studies investigating the causal link between sleep enhancements and the recovery from burnout in physicians, the existing documentation suggests that this topic might be a potentially fruitful area for future study. This is of utmost importance since investigations suggest that despite recent efforts to limit working hours, trainees, especially those who are assigned to evening shifts, are still facing inadequate sleep [49].

Practising physicians undergo prolonged working hours, which include shifts throughout the night. Medical practitioners encounter complex clinical situations, demanding clinical workloads, emotionally charged patient contacts, and often critical decision-making, each of which may lead to heightened levels of stress. Prolonged night shifts over six hours disrupt the circadian rhythm associated with sleep. Insomnia and sleep problems are more prevalent in some medical professions, including emergency treatment or urgent care, that involve on-call or shift work. The aforementioned specialties occasionally require on-call shifts and periods that occur beyond the standard circadian cycle [50].

Studies undertaken among physicians confirm a similar association between sleep insufficiencies and burnout. Within the population of primary care doctors in Madrid, Spain, individuals who experienced high levels of burnout had significantly higher rates of insomnia and worse sleep quality (39.7% vs 7%, respectively), even after accounting for sociodemographic variables. In addition to significant variations in sleep length, sleeping latency, and Pittsburgh Sleep Quality Index scores, the group with more burnout was also shown to have worse sleep quality [51]. These findings align with the results already published by Oosterholt et al. [52].

According to a 2011 study conducted among Japanese doctors specializing in stroke therapy, more than 40% of the participants indicated experiencing clinical burnout [53]. With a mean age of 45 years, working an average of 72 hours per week, and sleeping on average, ninety percent of individuals suffering severe burnout were male. Furthermore, second research carried out in Japan revealed a clear correlation between inadequate sleep duration and both burnout and work dissatisfaction. Nevertheless, they were further indirectly associated with insufficient workplace supervision and extensive on-call obligations [54]. Physicians who have autonomy over their work schedule might alleviate the negative consequences of midnight shifts on the amount and quality of sleep. Junior attendings in educational institutions may be more vulnerable to these difficulties, since they are required to manage a higher clinical burden and also to guarantee efficiency in producing grants or scientific articles [55].

4. Sleep-deprived physicians raise the danger for patients

Many physicians currently work shifts that may significantly and inconsistently alter the circadian rhythm. As an example, after a few days of working during the day, young physicians may be required to work a week of nights from 8 pm to 8 pm with very little time to adjust. Under many work schedules, there is little opportunity for sleep as well as the necessary amenities to do so. Nighttime doctors sometimes operate with a reduced number of coworkers or even alone, which may result in other team members being unable to make up for any shortcomings in their performance. Laboring in isolation while experiencing sleep deprivation might provide a potentially dangerous setting for patients

[5]. Lenzer and colleagues documented a threefold rise in fatalities among patients due to avoidable incidents when sleep-deprived, American first-year resident physicians were available for emergency care [56].

Less than five hours of sleep every night diminishes the capacity to do previously acquired activities and retain information; it also hampers decision-making abilities and decreases attention.Studies conducted on doctors who are sleep-deprived have also shown reduced response times [6,57]. Therefore, it is reasonable to anticipate that such cognitive impairments may adversely affect the learning capacity of young physicians during their clinical duties [12].

An analysis of the military services, aerospace sector, and health service, all of which need the most advanced cognitive abilities (often for prolonged durations), is valuable as it enables the dissemination of research results and their practical implementation [58]. Fatigue undermines the safety and effectiveness of armed forces since it reduces their level of alertness. Indeed, this principle may be as relevant to physicians who encounter profound psychological difficulties. The aviation sector has acknowledged the need of adjusting to shifts in sleep patterns, resulting in airline pilots now having designated days of rest before of and after night flights. Nevertheless, this approach has not been generally embraced in the healthcare sector, and young physicians often go from a day schedule to a week of night shifts with only one day dedicated to adaptation.

Rapid and informed decision-making is crucial in emergency, trauma, and ITU environments. Medical practitioners who are unable to perform at their optimal level may commit mistakes connected to attention, which not only jeopardize the quality of treatment for a patient but also expose themselves to potential harm. For instance, research has demonstrated a higher occurrence of self-inflicted needle-stick injuries among experienced practitioners [6,11].

Sleep deprivation-induced fatigue may adversely influence cognitive flexibility, which is a measure of the capacity to adjust to shifts in a process. This can particularly effect surgeons working in acute settings characterized by rapid development of alterations and problems. The impacts of this phenomenon may be mitigated by surgeons taking brief breaks of about 20 seconds every 20 - 30 minutes. This practice reduces the physical strain on the process and has little impact on the duration of the operation [1]. We regularly use this method and, when it is deemed safe, instead, divert our attention from the surgical table as we move around, or gaze out of a window. It is certainly worth trying.

In addition, we recommend including brief intervals of rest (5-10 minutes is often sufficient) every two to three hours for the purpose of consuming beverages and meals. This perceived time loss may be easily compensated for, since the break can rejuvenate and enhance performance [2]. Additional recommendations for alleviating the consequences of insufficient sleep include extending the length of time spent sleeping previous to commencing a shift or including brief periods of rest wherever feasible.

5. Prolonged sleep deprivation

Scientific evidence has shown that a mere eight hours of sleep each day for three consecutive days is insufficient to restore cognitive function to its normal levels after prolonged sleep deprivation due to the presence of "sleep debt" [11,58]. Clinical practitioners must make a conscious effort to minimize prolonged periods of sleep deprivation, since it is difficult to recuperate from and will significantly affect their clinical performance and well-being. Following a series of nocturnal shifts, it is crucial to allocate a few days for relaxation and recovery previous to the commencement of the subsequent shift [59].

6. Chronic sleep deprivation is linked to significant alterations in behavior

Burnout is a significant challenge for physicians and is linked to arduous work environments and psychological strain [60,61]. The pressures associated with working in such settings heighten the likelihood of suicide, and doctors had a 2.45-fold higher probability of self-inflicted death compared to those in other occupational domains [62]. Many surgeons believe that there is little help to mitigate burnout, while people themselves are frequently aware when their occupational performance is being impacted [60]. The effects of burnout include diminished performance, reduced motivation, and depersonalization. The excessive detachment of surgeons from their patients as well as teams has the potential to compromise the quality of patient care [61]. Conflicts of interest and ambiguity, whether genuine or imagined, resulting from burnout may adversely influence doctors in this scenario and have detrimental effects on their mental and physical health [61].

Optimized collaboration among healthcare teams enhances the quality of patient treatment. Deficits in cooperation and communication have been identified as a significant cause of avoidable mistakes. In order to provide safe treatment of patients, it is essential that the team operates with efficiency. There have been seen alterations in personality, mental health issues, anxiety, sadness, and suicide among physicians who experienced sleep deprivation. The impact on mood has been more prominent than on cognition or performance [6,56]. Research conducted on US army commanders

revealed that persistent lack of sleep was strongly linked to a decline in leadership effectiveness, characterized by decreased levels of motivation, confidence, and emotional intelligence [1].

The presence of these attributes is crucial for the effectiveness of a multidisciplinary team, and their effectiveness will be diminished if the leader, such as a consultant surgeon in the operating theatre, is denied sufficient sleep. The negative impact of inadequate sleep on job performance and increased risk-taking may be attributed to fluctuations in self-confidence [1]. This, in conjunction with changes in awareness and compassion (which are additionally related to sleep deprivation), might further jeopardize the safety of patients.

Chronic exhaustion and sleep deprivation may lead to enduring consequences, such as mental health disorders [62-64]. A pair of studies have shown exhaustion resulting from being on call as a causative element in the emergence of indifference and medical blunders, ultimately culminating in burnout [58,65]. Another study indicated that a duration of five hours of sleep every night for a week resulted in the emergence of emotional instability [7]. Research conducted by Hutter et al. examined the impact of restricting the working hours of resident physicians. The findings revealed a decrease in burnout ratings and a reduction in emotional exhaustion among doctors [66]. Subsequent research has shown that engaging in leisure activities may be advantageous, and that involvement in such activities enhances the quality of life and motivation of physicians [66].

Working conditions that fail to provide sufficient time for relaxation and preparation for a shift change are seen to be dangerous [65]. Scheduling that fails to acknowledge or account for the impact of weariness may jeopardize the well-being of medical professionals and diminish the quality of treatment they provide to their patients. A study conducted by Goldstein and Walker found that a single night of sleep deprivation led to heightened levels of anger and impulsivity, even in circumstances with little stress [7]. Robust associations exist among impulsive and suicidal ideation, both of which are associated with sleep loss [67]. The aviation sector observed a positive correlation between attitudes and behavioural traits such as impulsivity, defiance of authority, and invulnerability, and a higher occurrence of accidents. As a consequence of the reaction, which was to recognize and discourage them, most airlines have adopted a zero-tolerance policy [67]. The maintenance of sufficient sleep and rest may effectively reduce the manifestation of negative behaviors and attitudes that tend to intensify when individuals experience fatigue.

Previous research has proposed that individuals with advanced academic qualifications may exhibit certain personality characteristics such as hostility, independence, and self-sufficiency. These characteristics, believed to be associated with a higher occurrence of preventable mistakes, may be worsened by lack of necessary sleep [67].

7. Chronic sleep deprivation negatively affects daily functioning outside of the hospital

Insufficient sleep, as both in terms of quality and quantity, adversely affects the performance of physicians both in their professional and personal lives. This is especially true for surgeons of whom burnout rates are elevated [14]. Physicians experiencing sleep deprivation are at a higher risk of participating in road traffic incidents due to their potential to drive when fatigued [56,64]. Prolonged sleep deprivation has harmful consequences including heightened nocturnal awakenings, insomnia, and daytime drowsiness. It has been shown that a progressive decrease in sleep duration is associated with heightened irritation [7].

While these issues may be controllable in the short term, persistent instances might result in recurring problematic behaviors such as drug and alcohol addiction [6,61,68]. Doctors fatigued after a hectic night shift should aim to obtain some rest before reaching their homes, unfortunately, most Trusts do not provide such amenities.

The impact of shift work on both wellness and efficiency is well-documented, and prolonged periods of inadequate sleep present a significant health condition. While many physicians may use coping strategies, we propose that these treatments are insufficient, since persistent insufficient sleep is a significant risk factor for the development of diabetes, hypertension, obesity, and heart disease.

St-Onge et al. [9] discovered that those who slept for shorter durations consumed a higher number of calories, mostly derived from snacks and high-fat meals [9] Prolonged periods of insufficient sleep can contribute to higher death rates [69,70]. We have lately advocated for the significance of sufficient nutrition for the well-being and professional performance of clinicians. Consuming low-quality food, which is facilitated by insufficient sleep, and excessive eating, are detrimental to a surgeon's well-being and their capacity to provide proper care for their patients [71,72].

8. Conclusion

Ultimately, sleep deprivation results in a rapid and noticeable decline in performance and an elevated likelihood of making mistakes. Nevertheless, clinicians often disregard their own well-being in order to prioritize their therapeutic responsibilities.2 In order to maintain optimal performance as surgeons, it is crucial that we get sufficient sleep and relaxation during as well as following demanding work schedules, especially night shifts. Trusts and management should acknowledge and honor this need. Given the variation in sleep needs, it is crucial that we identify the indicators of exhaustion in ourselves as well as

other team members and feel empowered to request assistance and support when needed. In the high stakes work environment, the importance of sleep and rest, as well as the potential for negative outcomes, should be regarded with the same seriousness as other human variables that impact performance.

References

1. Olsen OK, Pallesen S, Torsheim T, Espevik R. The effect of sleep deprivation on leadership behaviour in military officers: An experimental study. Journal of Sleep Research. 2016 Dec;25(6):683-9.
2. Parry D, Oeppen RS, Gass H, Brennan PA. Impact of hydration and nutrition on personal performance in the clinical workplace. British Journal of Oral and Maxillofacial Surgery. 2017 Dec 1;55(10):995-8.
3. Parry DA, Oeppen RS, Amin M, Brennan PA. Can dietary supplements improve a clinician's well-being and health?. British Journal of Oral and Maxillofacial Surgery. 2018 Feb 1;56(2):85-9.
4. Buysse DJ. Sleep health: can we define it? Does it matter?. Sleep. 2014 Jan 1;37(1):9-17.
5. Ghalichi L, Pournik O, Ghaffari M, Vingard E. Sleep quality among health care workers. Archives of Iranian medicine. 2013 Feb 1;16(2):0-.
6. Sanches I, Teixeira FC, dos Santos JM, Ferreira AJ. Effects of acute sleep deprivation resulting from night shift work on young doctors. Acta medica portuguesa. 2015;28(4):457-62.
7. Goldstein AN, Walker MP. The role of sleep in emotional brain function. Annual review of clinical psychology. 2014 Mar 28;10(1):679-708.
8. Gangwisch JE. A review of evidence for the link between sleep duration and hypertension. American journal of hypertension. 2014 Oct 1;27(10):1235-42.
9. St-Onge MP, Mikic A, Pietrolungo CE. Effects of diet on sleep quality. Advances in nutrition. 2016 Sep 1;7(5):938-49.
10. Yasin R, Muntham D, Chirakalwasan N. Uncovering the sleep disorders among young doctors. Sleep and Breathing. 2016 Dec;20:1137-44.
11. Parker RS, Parker P. The impact of sleep deprivation in military surgical teams: a systematic review. BMJ Military Health. 2017 Jun 1;163(3):158-63.
12. Mustahsan SM, Ali SM, Khalid F, Ali AA, Ahmed H, Hashmi SA, Syedain M, Feroz F. Sleep deprivation and its consequences on house officers and postgraduate trainees. JPMA. The Journal of the Pakistan Medical Association. 2013 Apr 1;63(4):540-3.
13. Gerada C. Clinical depression: surgeons and mental illness. The Bulletin of the Royal College of Surgeons of England. 2017 Sep;99(8):260-3.
14. Wall M, Schenck-Gustafsson K, Minucci D, Sendén MG, Løvseth LT, Fridner A. Suicidal ideation among surgeons in Italy and Sweden–a cross-sectional study. BMC psychology. 2014 Dec;2:1-8.
15. Sheldon SH, Kryger MH, Gozal D, Ferber R, editors. Principles and Practice of Pediatric Sleep Medicine: Expert Consult-Online and Print. Elsevier Health Sciences; 2014 Mar 24.
16. American College of Chest Physicians. Most physicians sleep fewer hours than needed for peak performance, report says. ScienceDaily. March 5, 2008.
17. Buxton OM, Chang AM, Spilsbury JC, Bos T, Emsellem H, Knutson KL. Sleep in the modern family: protective family routines for child and adolescent sleep. Sleep health. 2015 Mar 1;1(1):15-27.
18. Vollert C, Zagaar M, Hovatta I, Taneja M, Vu A, Dao A, Levine A, Alkadhi K, Salim S. Exercise prevents sleep deprivation-associated anxiety-like behavior in rats: potential role of oxidative stress mechanisms. Behavioural brain research. 2011 Oct 31;224(2):233-40.
19. Everson CA, Crowley WR. Reductions in circulating anabolic hormones induced by sustained sleep deprivation in rats. American Journal of Physiology-Endocrinology and Metabolism. 2004 Jun;286(6):E1060-70.
20. Cincin A, Sari I, Oğuz M, Sert S, Bozbay M, Ataş H, Ozben B, Tigen K, Basaran Y. Effect of acute sleep deprivation on heart rate recovery in healthy young adults. Sleep and Breathing. 2015 May;19:631-6.
21. Davies SK, Ang JE, Revell VL, Holmes B, Mann A, Robertson FP, Cui N, Middleton B, Ackermann K, Kayser M, Thumser AE. Effect of sleep deprivation on the human metabolome. Proceedings of the National Academy of Sciences. 2014 Jul 22;111(29):10761-6.
22. Toker S, Shirom A, Shapira I, Berliner S, Melamed S. The association between burnout, depression, anxiety, and inflammation biomarkers: C-reactive protein and fibrinogen in men and women. Journal of occupational health psychology. 2005 Oct;10(4):344.
23. Wessells Jr DT, Kutscher A, Seeland IB, Selder FE, Cherico DJ, Clark EJ. Professional burnout in medicine and the helping professions. Routledge; 2013 Oct 31.
24. Milićević-Kalašić A. Burnout examination. InBurnout for experts: Prevention in the

context of living and working 2012 Sep 5 (pp. 169-183). Boston, MA: Springer US.
25. Bizik G, Picard M, Nijjar R, Tourjman V, McEwen BS, Lupien SJ, Juster RP. Allostatic load as a tool for monitoring physiological dysregulations and comorbidities in patients with severe mental illnesses. Harvard Review of Psychiatry. 2013 Nov 1;21(6):296-313.
26. Melamed S., Shirom A., Toker S., Berliner S., Shapira I. Burnout and risk of cardiovascular disease: evidence, possible causal paths, and promising research directions. *Psychol Bull.* 2006;132(3):327–353.
27. Geurts S.A.E., Sonnentag S. Recovery as an explanatory mechanism in the relation between acute stress reactions and chronic health impairment. *Scand J Work Environ Health.* 2006;32(6):482–492.
28. Brosschot J.F. Markers of chronic stress: prolonged physiological activation and (un)conscious perseverative cognition. *Neurosci Biobehav Rev.* 2010;35(1):46–50.
29. Åkerstedt T. Sleep disorders. InThe Routledge International Handbook of Psychosocial Epidemiology 2017 Dec 14 (pp. 346-360). Routledge.
30. Armon G, Melamed S, Toker S, Berliner S, Shapira I. Joint effect of chronic medical illness and burnout on depressive symptoms among employed adults. Health Psychology. 2014 Mar;33(3):264.
31. Söderström M., Jeding K., Ekstedt M., Perski A., Akerstedt T. Insufficient sleep predicts clinical burnout. *J Occup Health Psychol.* 2012;17(2):175–183.
32. Maski KP. Sleep-dependent memory consolidation in children. InSeminars in pediatric neurology 2015 Jun 1 (Vol. 22, No. 2, pp. 130-134). WB Saunders.
33. Vandekerckhove M, Wang YL. Emotion, emotion regulation and sleep: An intimate relationship. AIMS neuroscience. 2018;5(1):1.
34. Killgore WD, Weber M. Sleep deprivation and cognitive performance. Sleep deprivation and disease: Effects on the body, brain and behavior. 2013 Oct 12:209-29.
35. Blasche G, Marktl W. Recovery intention: Its association with fatigue in the working population. International Archives of Occupational and Environmental Health. 2011 Dec;84:859-65.
36. Kristiansen J, Persson R, Björk J, Albin M, Jakobsson K, Östergren PO, Ardö J. Work stress, worries, and pain interact synergistically with modelled traffic noise on cross-sectional associations with self-reported sleep problems. International archives of occupational and environmental health. 2011 Feb;84:211-24.
37. Yoshioka E, Saijo Y, Kita T, Satoh H, Kawaharada M, Kishi R. Effect of the interaction between employment level and psychosocial work environment on insomnia in male Japanese public service workers. International Journal of Behavioral Medicine. 2013 Sep;20:355-64.
38. Williamson A, Friswell R. Investigating the relative effects of sleep deprivation and time of day on fatigue and performance. Accident Analysis & Prevention. 2011 May 1;43(3):690-7.
39. Yang B, Wang Y, Cui F, Huang T, Sheng P, Shi T, Huang C, Lan Y, Huang YN. Association between insomnia and job stress: a meta-analysis. Sleep and Breathing. 2018 Dec;22:1221-31.
40. Johnson KM, Simon N, Wicks M, Barr K, O'Connor K, Schaad D. Amount of sleep, daytime sleepiness, hazardous driving, and quality of life of second year medical students. Academic Psychiatry. 2017 Oct;41:669-73.
41. Fletcher KE, Nickoloff S, Whittle J, Jackson JL, Frank M, Schapira MM. Why residents consider working beyond the duty hour limits: implications of the ACGME 2011 duty hour standards. Journal of Graduate Medical Education. 2011 Dec 1;3(4):571-3.
42. Shea JA, Bellini LM, Dinges DF, Curtis ML, Tao Y, Zhu J, Small DS, Basner M, Norton L, Novak C, Dine CJ. Impact of protected sleep period for internal medicine interns on overnight call on depression, burnout, and empathy. Journal of graduate medical education. 2014 Jun 1;6(2):256-63.
43. Osborne R, Parshuram CS. Delinking resident duty hours from patient safety. BMC Medical Education. 2014 Dec;14:1-6.
44. St Hilaire MA, Anderson C, Anwar J, Sullivan JP, Cade BE, Flynn-Evans EE, Czeisler CA, Lockley SW, Harvard Work Hours Health and Safety Group. Brief (< 4 hr) sleep episodes are insufficient for restoring performance in first-year resident physicians working overnight extended-duration work shifts. Sleep. 2019 May;42(5):zsz041.
45. Bolster L, Rourke L. The effect of restricting residents' duty hours on patient safety, resident well-being, and resident education: an updated systematic review. Journal of Graduate Medical Education. 2015 Sep 1;7(3):349-63.
46. Basner M, Dinges DF, Shea JA, Small DS, Zhu J, Norton L, Ecker AJ, Novak C, Bellini LM, Volpp KG. Sleep and alertness in medical interns and residents: an observational study on the role of extended shifts. Sleep. 2017 Apr 1;40(4):zsx027.

47. Bilimoria KY, Chung JW, Hedges LV, Dahlke AR, Love R, Cohen ME, Hoyt DB, Yang AD, Tarpley JL, Mellinger JD, Mahvi DM. National cluster-randomized trial of duty-hour flexibility in surgical training. New England Journal of Medicine. 2016 Feb 25;374(8):713-27.
48. Desai SV, Asch DA, Bellini LM, Chaiyachati KH, Liu M, Sternberg AL, Tonascia J, Yeager AM, Asch JM, Katz JT, Basner M. Education outcomes in a duty-hour flexibility trial in internal medicine. New England Journal of Medicine. 2018 Apr 19;378(16):1494-508.
49. Basner M, Dinges DF, Shea JA, Small DS, Zhu J, Norton L, Ecker AJ, Novak C, Bellini LM, Volpp KG. Sleep and alertness in medical interns and residents: an observational study on the role of extended shifts. Sleep. 2017 Apr 1;40(4):zsx027.
50. McClafferty H, Brown OW, Section on Integrative Medicine, Committee on Practice and Ambulatory Medicine, Vohra S, Bailey ML, Becker DK, Culbert TP, Sibinga EM, Zimmer M, Simon GR. Physician health and wellness. Pediatrics. 2014 Oct 1;134(4):830-5.
51. Vela-Bueno A, Moreno-Jiménez B, Rodríguez-Muñoz A, Olavarrieta-Bernardino S, Fernández-Mendoza J, De la Cruz-Troca JJ, Bixler EO, Vgontzas AN. Insomnia and sleep quality among primary care physicians with low and high burnout levels. Journal of psychosomatic research. 2008 Apr 1;64(4):435-42.
52. Oosterholt BG, Maes JH, Van der Linden D, Verbraak MJ, Kompier MA. Burnout and cortisol: evidence for a lower cortisol awakening response in both clinical and non-clinical burnout. Journal of psychosomatic research. 2015 May 1;78(5):445-51.
53. Nishimura K, Nakamura F, Takegami M, Fukuhara S, Nakagawara J, Ogasawara K, Ono J, Shiokawa Y, Miyachi S, Nagata I, Toyoda K. Cross-sectional survey of workload and burnout among Japanese physicians working in stroke care: the nationwide survey of acute stroke care capacity for proper designation of comprehensive stroke center in Japan (J-ASPECT) study. Circulation: Cardiovascular Quality and Outcomes. 2014 May;7(3):414-22.
54. Tokuda Y, Hayano K, Ozaki M, Bito S, Yanai H, Koizumi S. The interrelationships between working conditions, job satisfaction, burnout and mental health among hospital physicians in Japan: a path analysis. Industrial health. 2009;47(2):166-72.
55. Stewart NH, Arora VM. The impact of sleep and circadian disorders on physician burnout. Chest. 2019 Nov 1;156(5):1022-30.
56. Lenzer J. Doctors underwent "extreme sleep deprivation" in studies of effect on patient deaths. BMJ 2015;351, h6295.
57. Mansukhani MP, Kolla BP, Surani S, et al. Sleep deprivation in resident physicians, work hour limitations, and related outcomes: a systematic review of the literature. Postgrad Med 2012;124:241–9.
58. Arnal PJ, Sauvet F, Leger D, et al. Benefits of sleep extension on sustained attention and sleep pressure before and during total sleep deprivation and recovery. Sleep 2015;38:1935–43.
59. Khajuria A, Khajuria A. Effect of pharmacological enhancement on cog- nitive and clinical psychomotor performance of sleep-deprived doctors. Int J Surg 2013;11:1143–4.
60. Guest RS, Baser R, Li Y, et al. Cancer surgeons' distress and well-being, I: the tension between a culture of productivity and the need for self-care. Ann Surg Oncol 2011;18:1229–35.
61. Aldrees TM, Aleissa S, Zamakhshary M, et al. Physician well-being: prevalence of burnout and associated risk factors in a tertiary hospital, Riyadh, Saudi Arabia. Ann Saudi Med 2013;33:451–6.
62. Orri M, Farges O, Clavien PA, et al. Being a surgeon—the myth and the reality: a meta-synthesis of surgeons' perspectives about factors affecting their practice and well-being. Ann Surg 2014;260:721–9.
63. Havyer RD, Wingo MT, Comfere NI, et al. Teamwork assessment in internal medicine: a systematic review of validity evidence and outcomes. J Gen Intern Med 2014;29:894–910.
64. Nathanson BH, Henneman EA, Blonaisz ER, et al. How much teamwork exists between nurses and junior doctors in the intensive care unit? J Adv Nurs 2011;67:1817–23.
65. Chen X, Gelaye B, Williams MA. Sleep characteristics and health-related quality of life among a national sample of American young adults: assess- ment of possible health disparities. Qual Life Res 2014;23:613–25.
66. Paice E, Hamilton-Fairley D. Avoiding burnout in new doctors: sleep, supervision and teams. Postgrad Med J 2013;89:493–4.
67. Hutter MM, Kellogg KC, Ferguson CM, et al. The impact of the 80-hour resident workweek on surgical residents and attending surgeons. Ann Surg 2006;243:864–75.
68. Kadzielski J, McCormick F, Herndon JH, et al. Surgeons' attitudes are associated with

reoperation and readmission rates. Clin Orthop Relat Res 2015;473:1544–51.
69. Irish LA, Kline CE, Rothenberger SD, et al. A 24-hour approach to the study of health behaviors: temporal relationships between waking health behaviors and sleep. Ann Behav Med 2014;47:189–97.
70. Asfour L, Asfour V, McCormack D, et al. In surgeons performing cardio- thoracic surgery is sleep deprivation significant in its impact on morbidity or mortality? Interact Cardiovasc Thorac Surg 2014;19:479–87.
71. Banoon, S.R., Salih, T.S., Ghasemian, A. Genetic Mutations and Major Human Disorders: A Review. Egyptian Journal of Chemistry, 2022, 65(2), pp. 571–589
72. Banoon, S.R., Kadhim, Z.K., Aziz, Z.S., Jameel, Z.I. Ewadh, R.M.J. Using random amplified polymorphic dna (Rapd) fingerprinting technique to analyze genetic variation in staphylococcus aureus isolated from different sources in babylon province hospitals. Indian Journal of Public Health Research and Development, 2019, 10(9), pp. 1300–1305