

INFLUENCE OF CHRONIC SLEEP DEPRIVATION ON THE CLINICAL THINKING OF FUTURE PHYSICIANS

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Abstract

Chronic sleep deprivation is a prevalent issue among medical students and has significant implications for the development of clinical reasoning and decision-making skills. Insufficient sleep impairs cognitive functions such as attention, memory consolidation, problem-solving, and critical thinking, which are essential for accurate clinical judgments. Neurobiologically, sleep deprivation disrupts prefrontal cortex activity, synaptic plasticity, and neurotransmitter balance, leading to slower information processing and reduced accuracy in diagnostic reasoning. Studies have shown that prolonged sleep restriction negatively affects academic performance, clinical skill acquisition, and patient care readiness in future physicians. Understanding the impact of chronic sleep deprivation on clinical thinking is crucial for designing effective educational and wellness interventions that optimize both cognitive performance and healthcare quality [1,2].

Keywords

chronic sleep deprivation, clinical thinking, medical students, cognitive function, decision-making, prefrontal cortex.

Annotatsiya

Surunkali uyqusizlik tibbiyot talabalari orasida keng tarqalgan muammo bo‘lib, u klinik tafakkur va qaror qabul qilish ko‘nikmalarining rivojlanishiga sezilarli ta’sir ko‘rsatadi. Yetarli uyqu bo‘limganda diqqatni jamlash, xotirani mustahkamlash, muammoni hal qilish va tanqidiy fikrlash kabi kognitiv funktsiyalar buziladi, bu esa aniq klinik qarorlar qabul qilishni qiyinlashtiradi. Neyrobiologik jihatdan, uyqusizlik prefrontal korteks faoliyatini, sinaptik plastiklikni va neyrotransmitter muvozanatini buzadi, natijada axborotni qayta ishlash sekinlashadi va diagnostik tafakkur aniqligi pasayadi. Tadqiqotlar shuni ko‘rsatadiki, uzoq muddatli uyqusizlik akademik natijalarga, klinik ko‘nikmalarini egallahsga va kelajakdagi shifokorlarning bemor parvarishiga tayyorgarligiga salbiy ta’sir qiladi. Surunkali uyqusizlikning klinik tafakkurga ta’sirini tushunish kognitiv ishlash va sog‘liqni saqlash sifatini optimallashtiradigan samarali ta’lim va sog‘liqni saqlash dasturlarini ishlab chiqishda muhimdir [1,2].

Kalit so‘zlar

surunkali uyqusizlik, klinik tafakkur, tibbiyot talabalari, kognitiv funktsiya, qaror qabul qilish, prefrontal korteks.

Аннотация

Хроническое недосыпание является распространённой проблемой среди студентов-медиков и оказывает значительное влияние на развитие клинического мышления и навыков принятия решений. Недостаток сна нарушает когнитивные функции, включая внимание, консолидацию памяти, решение проблем и критическое мышление, что необходимо для точной диагностики. С нейробиологической точки зрения, недосыпание нарушает работу префронтальной коры, синаптическую пластичность и баланс нейротрансмиттеров, что приводит к замедлению обработки информации и снижению точности диагностического мышления. Исследования показывают, что длительное

ограничение сна отрицательно влияет на успеваемость, приобретение клинических навыков и готовность к уходу за пациентами у будущих врачей. Понимание влияния хронического недосыпания на клиническое мышление важно для разработки эффективных образовательных и оздоровительных программ, оптимизирующих когнитивные функции и качество медицинской помощи [1,2].

Ключевые слова

хроническое недосыпание, клиническое мышление, студенты-медики, когнитивные функции, принятие решений, префронтальная кора.

Introduction

Chronic sleep deprivation has become a pervasive issue among medical students and healthcare trainees worldwide, primarily due to demanding academic schedules, long clinical rotations, and high cognitive workloads. Adequate sleep is essential for optimal brain function, memory consolidation, learning, and emotional regulation, all of which are critical for the development of clinical reasoning and decision-making skills. When sleep is consistently restricted, cognitive domains such as attention, working memory, problem-solving, and critical thinking are impaired, potentially compromising the accuracy of diagnostic reasoning and patient care readiness [1,2].

From a neurobiological perspective, chronic sleep deprivation disrupts prefrontal cortex activity, reduces synaptic plasticity, and alters neurotransmitter balance, including dopamine, serotonin, and glutamate signaling. These changes slow information processing, impair judgment, and reduce the ability to integrate complex clinical information effectively. Moreover, sleep loss affects emotional regulation, leading to increased stress, irritability, and fatigue, which can further degrade cognitive performance and clinical decision-making [2,3].

Empirical studies have demonstrated that medical students and residents experiencing chronic sleep restriction perform worse on clinical problem-solving tasks, make more diagnostic errors, and exhibit slower reaction times compared to well-rested peers. These findings underscore the critical relationship between sleep quality and the development of clinical competence, highlighting the need for strategies that promote restorative sleep to safeguard cognitive function and patient safety [3,4].

Understanding the influence of chronic sleep deprivation on clinical thinking is vital not only for educational outcomes but also for the overall quality of healthcare delivery. Integrating sleep hygiene education, workload management, and wellness programs into medical training can mitigate the negative effects of sleep deprivation, enhance cognitive performance, and support the professional development of future physicians [1,4].

In addition to cognitive impairments, chronic sleep deprivation has significant physiological and psychological consequences that indirectly influence clinical thinking. Prolonged sleep loss elevates cortisol levels, disrupts circadian rhythms, and induces systemic inflammation, which can increase fatigue, reduce alertness, and impair executive functions essential for clinical judgment. Emotional regulation is also compromised, leading to heightened stress, anxiety, and irritability, all of which can interfere with effective decision-making in high-pressure clinical environments [2,3].

The modern medical education environment often exacerbates these effects. Long study hours, night shifts, and frequent on-call duties contribute to cumulative sleep debt, which is associated with reduced learning efficiency, impaired memory consolidation, and slower acquisition of practical clinical skills. Importantly, repeated exposure to sleep deprivation during training can have lasting impacts on cognitive performance, resilience, and professional competence, emphasizing the need for systematic interventions in medical curricula [3,4].

From an educational standpoint, fostering awareness of sleep hygiene and its impact on cognitive and clinical performance is critical. Strategies such as structured scheduling, time management, sleep education programs, and wellness initiatives can help mitigate the negative

effects of sleep deprivation, improve attention, enhance diagnostic accuracy, and support the development of sound clinical reasoning skills [1,4].

Overall, chronic sleep deprivation represents a multifaceted challenge in medical education, affecting cognitive function, emotional regulation, and clinical decision-making. Addressing this issue is essential for ensuring both the well-being of future physicians and the quality of patient care they provide. Understanding the mechanisms by which sleep deprivation impairs clinical thinking forms the foundation for designing effective educational interventions, promoting cognitive resilience, and fostering competent, safe healthcare practice [1,4].

Research Methodology

This study employed a cross-sectional observational design to investigate the impact of chronic sleep deprivation on the clinical thinking and cognitive performance of medical students. A total of 120 participants aged 19–25 years, enrolled in the second and third years of the Faculty of Medicine, were recruited from the Andijan Branch of Kokand University. Participants with diagnosed sleep disorders, neurological conditions, or psychiatric illnesses were excluded to minimize confounding factors.

Sleep Assessment: Chronic sleep deprivation was evaluated using a combination of self-reported sleep diaries, the Pittsburgh Sleep Quality Index (PSQI), and actigraphy over a 14-day period. Participants were categorized into three groups based on average nightly sleep duration: sufficient sleep (≥ 7 hours), moderate sleep deprivation (5–6 hours), and severe sleep deprivation (< 5 hours).

Clinical Thinking Assessment: Clinical reasoning and decision-making skills were assessed using standardized case-based scenarios, multiple-choice questions (MCQs) on clinical problem-solving, and Objective Structured Clinical Examinations (OSCEs). Cognitive performance parameters, including attention, working memory, problem-solving speed, and accuracy, were recorded.

Physiological and Psychological Measures: Salivary cortisol levels were measured as an objective marker of physiological stress. Questionnaires were administered to assess fatigue, perceived stress (Perceived Stress Scale – PSS), and emotional regulation.

Descriptive statistics were used to summarize participant demographics, sleep patterns, and cognitive performance scores. One-way ANOVA and post hoc tests were performed to compare clinical reasoning scores across different sleep groups. Pearson's correlation coefficient was used to examine associations between sleep duration, cortisol levels, and clinical thinking performance. Multiple regression analysis was applied to determine the predictive value of sleep deprivation on diagnostic accuracy and problem-solving speed. Statistical significance was set at $p < 0.05$.

Ethical Considerations

The study was conducted in accordance with the Declaration of Helsinki. Written informed consent was obtained from all participants prior to inclusion. The research protocol was approved by the Institutional Review Board of the Andijan Branch of Kokand University. Participants were ensured confidentiality and the right to withdraw from the study at any time.

This methodological framework allowed for a comprehensive evaluation of how chronic sleep deprivation affects clinical thinking, cognitive performance, and stress levels among future physicians, providing insights for educational and wellness interventions in medical training [1,2,3].

Research Results

The study included 120 medical students, with 70 females and 50 males, aged 19–25 years. Based on their average nightly sleep duration, participants were divided into three groups: sufficient sleep (≥ 7 hours, $n = 40$), moderate sleep deprivation (5–6 hours, $n = 45$), and severe sleep deprivation (< 5 hours, $n = 35$).

Students in the severe sleep deprivation group demonstrated significantly lower scores in case-based clinical reasoning tests (mean 62.5 ± 8.3) compared to the sufficient sleep group (mean 85.4 ± 7.1 , $p < 0.001$). Accuracy in diagnostic problem-solving was reduced by 18–25% in the severe sleep deprivation group. Attention and working memory tasks also revealed slower reaction times and increased errors under conditions of chronic sleep loss [2,3].

Salivary cortisol levels were significantly elevated in students with severe sleep deprivation (mean 18.3 ± 3.2 nmol/L) compared to those with sufficient sleep (mean 11.2 ± 2.4 nmol/L, $p < 0.01$), indicating increased physiological stress. High-stress perception and fatigue scores correlated strongly with reduced clinical reasoning performance ($r = -0.48$, $p < 0.01$). Emotional regulation scores were also lower in the severe sleep deprivation group, suggesting difficulty managing stress and maintaining focus during complex clinical tasks [3,4].

Statistical analysis revealed strong positive correlations between sleep duration and clinical thinking scores ($r = 0.62$, $p < 0.001$), as well as negative correlations between sleep deprivation and fatigue ($r = -0.54$, $p < 0.01$). Multiple regression analysis indicated that chronic sleep deprivation was an independent predictor of reduced diagnostic accuracy and slower problem-solving speed, even after controlling for age, gender, and academic year [2,3].

These results demonstrate that chronic sleep deprivation significantly impairs clinical thinking, cognitive performance, and stress regulation in future physicians. The severity of cognitive deficits is proportional to the degree of sleep loss, emphasizing the critical role of sufficient restorative sleep in medical education. Addressing sleep deprivation through educational interventions, time management strategies, and wellness programs may improve both cognitive function and clinical competence among medical students [1,4].

Literature Review

Chronic sleep deprivation has been extensively studied for its impact on cognitive performance, learning, and professional competence among medical students and healthcare professionals. Numerous studies have established that insufficient sleep impairs attention, working memory, problem-solving, and critical thinking, which are all essential components of clinical reasoning [1,2].

Neurobiological research indicates that sleep loss disrupts prefrontal cortex functioning, reduces synaptic plasticity, and alters neurotransmitter levels, including dopamine, serotonin, and glutamate. These alterations negatively affect executive functions, decision-making, and the ability to integrate complex clinical information accurately [2,3]. Functional MRI studies further demonstrate decreased activation in brain regions responsible for judgment and diagnostic reasoning after sleep deprivation.

Empirical studies on medical students have shown that chronic sleep deprivation correlates with lower scores on case-based clinical assessments, slower problem-solving speed, and higher rates of diagnostic errors. For example, research by Pilcher & Huffcutt (1996) demonstrated that sleep-deprived individuals exhibit significant declines in cognitive performance comparable to alcohol intoxication. Similarly, studies in medical education contexts reveal that students with less than 5–6 hours of sleep per night perform significantly worse on OSCEs and multiple-choice clinical reasoning tests [3,4].

Psychological factors also mediate the effects of sleep deprivation on clinical thinking. Elevated stress, fatigue, and poor emotional regulation exacerbate cognitive deficits, creating a compounding effect on decision-making and patient care readiness. Conversely, interventions such as structured sleep schedules, mindfulness, and stress reduction programs have been shown to partially mitigate the adverse effects of sleep loss on clinical competence [2,4,5].

Overall, the literature consistently highlights that chronic sleep deprivation is a major determinant of impaired clinical thinking among future physicians. The interplay of neurobiological, cognitive, and psychosocial factors underscores the need for targeted

interventions to preserve cognitive performance, ensure patient safety, and support professional development in medical education [1,5].

Conclusion

Chronic sleep deprivation has a profound and multifaceted impact on the clinical thinking and cognitive performance of future physicians. The findings of this study, together with existing literature, demonstrate that insufficient sleep significantly impairs attention, working memory, problem-solving, and critical thinking, all of which are essential for accurate diagnostic reasoning and effective clinical decision-making [1,2].

Neurobiological disruptions, including decreased prefrontal cortex activity, altered neurotransmitter balance, and reduced synaptic plasticity, provide a mechanistic basis for these cognitive deficits. Additionally, elevated physiological stress, emotional dysregulation, and fatigue exacerbate the negative effects of sleep loss, further compromising clinical competence and patient care readiness [2,3].

Importantly, the severity of cognitive impairments is proportional to the degree and duration of sleep deprivation. Students experiencing severe chronic sleep loss performed worse on clinical reasoning assessments, exhibited slower problem-solving speed, and made more errors compared to well-rested peers. These findings emphasize the critical role of restorative sleep in medical education for maintaining cognitive performance, reducing medical errors, and supporting professional development [3,4].

Educational and wellness interventions targeting sleep hygiene, workload management, mindfulness, and stress reduction are essential strategies to mitigate the adverse effects of chronic sleep deprivation. Integrating these measures into medical curricula can enhance clinical reasoning, promote cognitive resilience, and ultimately improve the quality and safety of healthcare delivery [1,4,5].

In conclusion, addressing chronic sleep deprivation among medical students is not only vital for their personal well-being but also a key factor in fostering competent, effective, and safe future physicians.

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