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Rest or Burnout? Unveiling the Link Between Sleep Quality and Life Satisfaction in Resident Doctors: A Cross-Sectional Study

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Abstract

Background: Long and irregular duty hours impair sleep quality in resident doctors, affecting their quality of life (QoL) and increasing health risks. This study explores the relationship between sleep quality and QoL to promote their well-being. ***Methods:*** A cross-sectional study was conducted among 50 medical residents (23–45 years) after ethical approval and consent. Sleep quality was assessed using the Pittsburgh Sleep Quality Index and Quality of Life using the WHO Quality of Life-BREF questionnaire. Data were analyzed using means, standard deviations, and proportions, with $p<0.05$ as significant. ***Results:*** Overall Quality of Life was high in 80% of participants (mean score: 4.28 ± 0.829). Sleep impairment was moderate (PSQI: 8.6 ± 2.626). Environmental (63.4 ± 18.5), physical (61.0 ± 18.4), and social health (56.7 ± 25.7) domains showed moderate well-being, whereas psychological (38.9 ± 24.1) and general health (39.7 ± 12.3) were lower, indicating mental health concerns. A moderate negative correlation ($R^2 = 0.117$) was found between sleep quality and QoL. ***Conclusion:*** Poor sleep quality and psychological distress are prevalent among resident doctors, highlighting the need for interventions to improve sleep and mental well-being.

Keywords: ***Burnout, Quality of life, Professionals, Psychological distress, Residency, Sleep quality, Workplace.***

Introduction

The quality of sleep among resident doctors has become a critical area of research, particularly due to its profound impact on their overall quality of life (QOL). Long and irregular work hours significantly contribute to sleep deprivation, adversely affecting not only the well-being of residents but also patient care. A study involving 4,510 obstetric-gynecologic residents of the USA found that 71.3% reported sleeping less than three hours during night shifts [1]. A landmark study published in May 2021 by the World Health Organization (WHO) and the International Labour Organization (ILO) estimated that in 2016, over 745,000 deaths globally were attributed to heart disease or stroke linked to prolonged working hours [2]. A study conducted in northeastern India found that 45% of the junior residents were having a poor quality of sleep [3]. Research from Europe and the United States further underscores the health risks associated with nonstandard work hours, linking them to increased incidences of gastrointestinal disorders, cardiovascular diseases, breast cancer, miscarriage, preterm birth, and low birth weight in newborns [4-6]. Slow-wave sleep plays a crucial role in clearing toxins that accumulate throughout the day. Disrupting this sleep stage can lead to increased levels of amyloid-betaa protein aggregate linked to Alzheimer's diseasein cerebrospinal fluid by the following morning [7]. Additionally, chronic sleep deprivation, along with the resulting fatigue and stress, can negatively impact job productivity and raise the risk of workplace accidents [8].

Numerous studies have highlighted that sleep deprivation and poor sleep quality are widespread among medical residents, severely impacting their physical health, mental well-being, and professional performance [9,10]. Likewise, Prasad and Arora (2024) stressed the urgent need for systemic reforms in residency programs to improve sleep patterns and overall well-being [11]. In India, medical residents work hours remain largely unregulated. Despite calls for reform, the Ministry of Health and Family Welfare has yet to implement any formal regulations.

Therefore, the present research aims to further explore the relationship between sleep quality and QOL among resident doctors at this institution. Using the Pittsburgh Sleep Quality Index (PSQI) and the WHO Quality of Life-BREF (WHOQOL-BREF) questionnaire, the present study identifies any correlations between them and also advocates for essential reforms in residency training programs to enhance the well-being of future medical professionals.

Material and Method

This cross-sectional analytic observational study was conducted in the department after obtaining approval from the Institutional Research Review Board (RRB) and Ethical Committee along with informed consent from participants. The sample size of 50 subjects was determined based on a seed article, using a correlation coefficient (r) of 0.397, with 80% power and a 0.05 alpha error [12].

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A random sampling technique was employed to select study participants.

A total of 50 medical residents, aged 23-45 years, of both genders, who were engaged in night duties and provided written informed consent, were included in the study by simple random technique. Participants with a history of acute or chronic illness, neurological or psychotic disorders, or those who were non-cooperative were excluded.

General demographic information, including age, sex, residence, personal, and medical history, was collected from all participants. Sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI), while quality of life was measured using the WHO Quality of Life-BREF (WHOQOL-BREF) questionnaire. Pittsburgh Sleep Quality Index (PSQI): The PSQI is a self-reported scale widely used in clinical research to assess sleep quality over the past month. Developed by Daniel J. Buysse and colleagues [13], it comprises 19 items covering the following seven components: C1. Subjective sleep quality; C2. Sleep latency; C3. Sleep duration; C4. Habitual sleep efficiency; C5. Sleep disturbances; C6. Use of sleeping addiction; C7. Daytime dysfunction. Each component is scored from 0 to 3, where "0" indicates no difficulty and "3" represents severe difficulty. The total PSQI score is derived by summing all component scores, ranging from 0 to 21. Higher scores indicate poorer sleep quality, with a PSQI total score >5 suggesting poor sleep quality.

World Health Organization Quality of Life-BREF (WHOQOL-BREF) [14]: The WHOQOL-BREF is a validated self-assessment questionnaire, a shorter version of the WHOQOL-100, designed for use in clinical trials. It consists of 26 items that evaluate the quality of life across four domains: Domain1: Physical health (7 items); Domain 2: Psychological health (6 items); Domain 3: Social relationships (3 items); Domain 4: Environment (8 items). Additionally, two items assess the overall quality of life and general health of an individual. Responses are recorded on a five-point Likert scale, the scoring is in a positive direction (i.e. higher scores denote higher quality of life). The raw scores for each domain are transformed into a 0-100 scale, comparable to the WHOQOL-100, with higher scores indicating better quality of life.

Statistical Analysis

The qualitative data were presented as percentages and proportions, while the quantitative data were reported as Mean ± Standard Deviation (SD). The significance of differences between two means was evaluated using an unpaired t-test, whereas differences among more than two means were analyzed using one-way ANOVA. Significant findings from the ANOVA were further examined with Tukey's post-hoc test. All statistical analyses were performed using SPSS version 2023, and a P <0.05 was considered statistically significant.

Results

This study was conducted on 50 medical residents of both genders, performing night shifts in the institution, to explore the association between sleep quality and quality of life. Table 1 shows that individuals under 30 years outnumber those 30 years and males are more prevalent than females, with a 4:1 ratio. Unmarried individuals are significantly more common than married ones. The urban population exceeds the rural, showing a 3.2:1 ratio. In terms of BMI, healthy-weight individuals are more common than overweight and obese individuals and snoring is less common, with a 1:9 ratio of those who snore to those who do not.

Table 2 presents data on various sleep components, revealing moderate impairment in sleep quality, latency, duration, and disturbances. However, habitual sleep efficiency (0.18 ± 0.388) and the use of sleeping medications (0.26 ± 0.443) were relatively low. Daytime dysfunction (0.86 ± 0.756) suggests some impact on daily activities. The global PSQI score (8.6 ± 2.626) indicates poor sleep quality, as it exceeds the threshold of five.

The mean score for Overall Quality of Life was 4.28 (SD = 0.829). Among the resident doctors, 80% reported a satisfactory quality of life, 16% were neutral, and 4% found it unsatisfactory. The mean score for General Health was 4.16 (SD = 1.03), with 78% of resident doctors reporting satisfactory health, 16% remaining neutral, and 6% indicating poor health (Table 3).

In the Health Domains of the quality of life, the Environmental (63.4 ± 18.5), Physical (61.0 ± 18.4), and Social Health (56.7 ± 25.7) were relatively better. Psychological Health (38.9 ± 24.1) and Average Health (39.7 ± 12.3) were lower, highlighting concerns about mental well-being (**Figure 1**).

The table 4, reveals significant associations between various sleep components and health domains among resident doctors. Specifically, C1 (. Subjective sleep quality) shows significant negative correlations with physical and psychological health, as well as with the average score (p-values < 0.05). C2 (Sleep latency) is notably associated with physical health (p = 0.020), and C7 (Daytime dysfunction) has a strong negative correlation with social health (p = 0.001). The global PQSI score does not show any significant correlations with the health domains (p-values > 0.05). Most other sleep components exhibit weak or no significant associations with health domains.

The relationship between the Total PSQI Score and the Average health is weak and shows a slightly negative trend (R2=0.015). whereas a moderate negative correlation is observed (R2=0.117) between Total PSQI Score and Overall Quality of Life. This suggests that poorer sleep quality (higher PSQI scores) is associated with a lower overall quality of life among resident doctors. The relationship between Total PSQI Score and General Health shows no meaningful trend (R2≈0). This indicates no significant correlation between sleep quality and general health in this dataset. In summary, while overall quality of life demonstrates a moderate negative association with sleep quality, average health scores and general health show minimal to no correlation with the PSQI scores (**Figure 2**).

Table 1: Distribution of Resident Doctors According to Sociodemographic and General Characteristics (Ratios)

Variables	Categories	Ratio
Age	< 30 years: ≥ 30 years	3:2
Gender	Male: Female	4:1
Marital Status	Married: Unmarried	1:3.2
Locality	Urban: Rural	3.2:1
BMI	Healthy weight: Overweight: Obese	4.6:4.4:1
Snoring	Yes: No	1:9

Table 2: Distribution of mean and SD values of various sleep components among Resident Doctors

Components of sleep	Mean	SD
C1: Subjective Sleep Quality	1.14	0.78
C2: Sleep Latency	1.48	0.79
C3: Sleep Duration	1.52	0.68
C4: Habitual Sleep Efficiency	0.18	0.39
C5: Sleep Disturbances	1.14	0.35
C6: Use of Sleeping Medications	0.26	0.44
C7: Daytime Dysfunctions	0.86	0.76
Global PSQI Scores	8.6	2.63

Table 3: Distribution of Resident Doctors According to Overall Quality of Life and General Health

Variables of QOL	Grading	n (%)
Overall Quality of Life	**Mean = 4.28, SD = 0.829**	
	Unsatisfactory	2 (4.0)
	Neither satisfactory nor unsatisfactory	8 (16.0)
	Satisfactory	40 (80.0)
General Health	**Mean = 4.16, SD = 1.03**	
	Unsatisfactory	3 (6.0)
	Neither satisfactory nor unsatisfactory	8 (16.0)
	Satisfactory	39 (78.0)

n= Number of subjects, % = Percentage of subjects

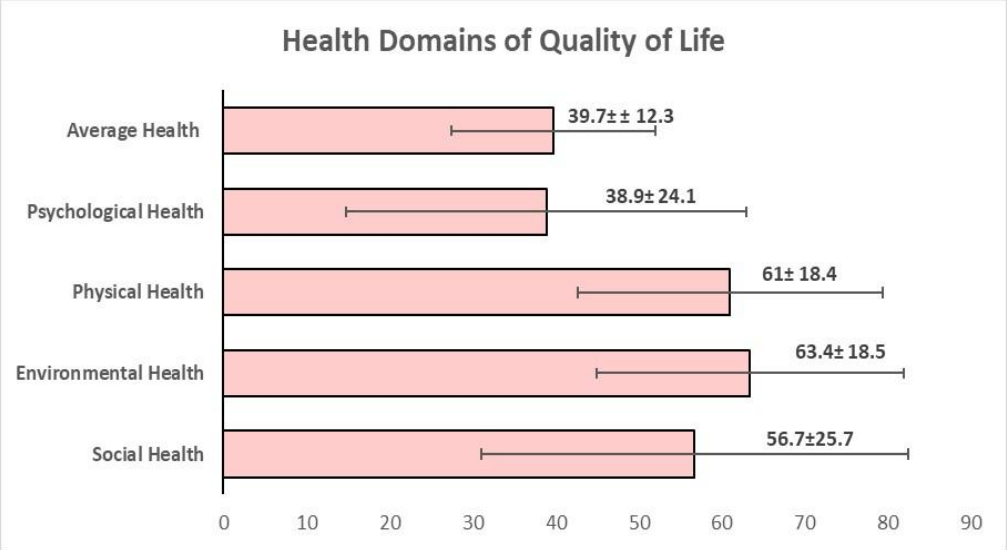

Figure 1: Distribution of mean and SD values of various health Domains of Resident Doctors

Table 4: Association of Quality of Sleep Components with Health Domains Among Resident Doctors using Pearson Correlation

Sleep Components	Social Health	Environmental Health	Physical Health	Psychological Health	Average
C1	0.03	-0.356*	-0.399**	-0.304*	-0.280*
Sig. (2-tailed)	0.984	0.011	0.004	0.032	0.048
C2	0.212	-0.032	-0.328*	-0.07	0.095
Sig. (2-tailed)	0.139	0.826	0.020	0.961	0.511
C3	0.189	-0.088	0.015	0.235	0.180
Sig. (2-tailed)	0.189	0.542	0.919	0.101	0.211
C4	-0.022	0.211	-0.026	-0.030	0.053
Sig. (2-tailed)	0.882	0.142	0.860	0.836	0.714
C5	0.048	-0.039	-0.085	0.067	0.043
Sig. (2-tailed)	0.742	0.789	0.556	0.646	0.768
C6	-0.262	-0.028	-0.057	-0.011	-0.152
Sig. (2-tailed)	0.066	0.847	0.692	0.939	0.291
C7	-0.451**	0.097	0.157	-0.061	-0.228
Sig. (2-tailed)	0.001	0.502	0.277	0.672	0.111
Global PQSI Score	-0.082	-0.126	-0.274	-0.067	-0.123
Sig. (2-tailed)	0.574	0.382	0.054	0.645	0.397

*(C1. Subjective sleep quality; C2. Sleep latency; C3. Sleep duration; C4. Habitual sleep efficiency; C5. Sleep disturbances; C6. Use of sleeping addiction; C7. Daytime dysfunction); *: p <0.05; **: p <0.001*

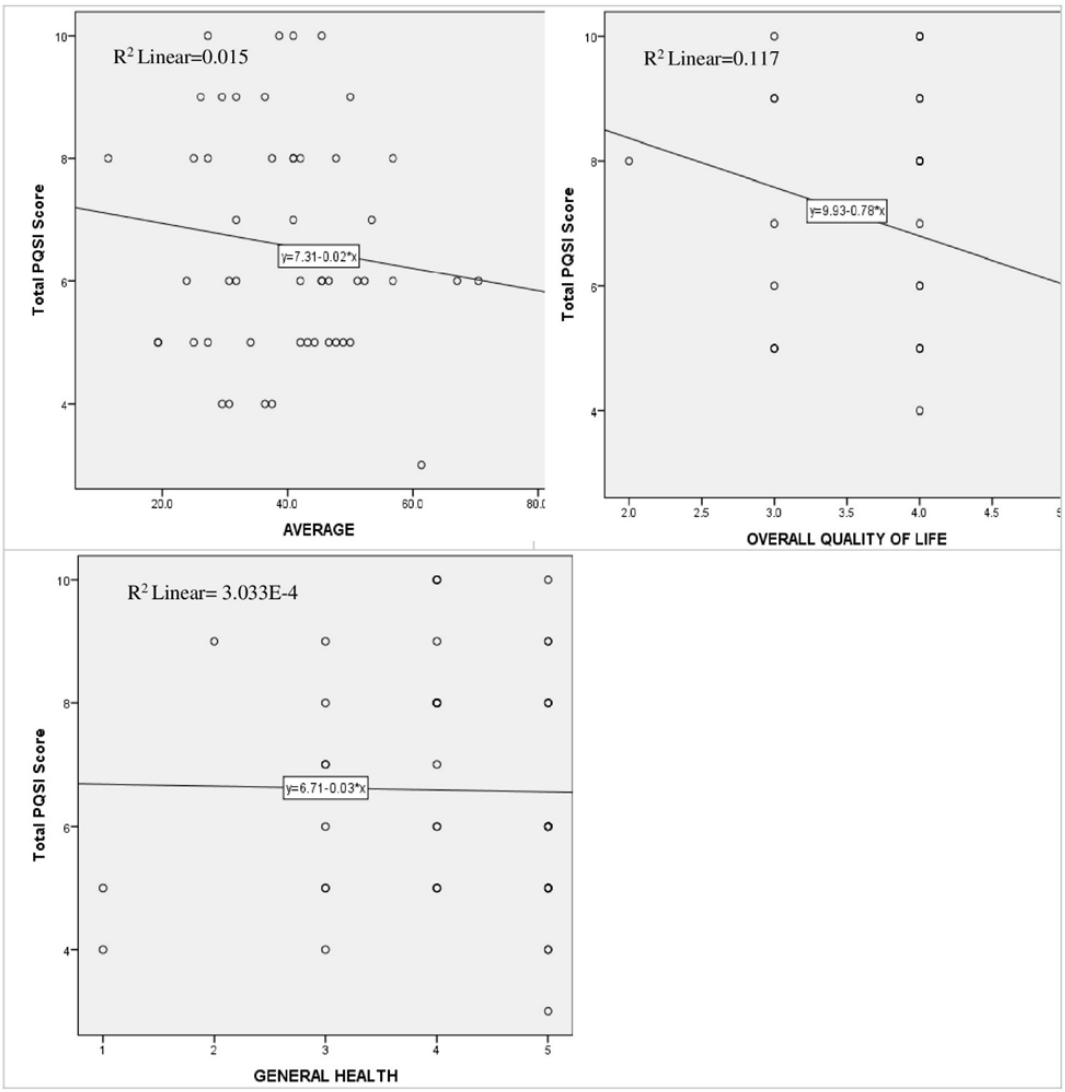

Figure: 2 Scatter Plot between Total PQSI Score and Average and General Health and with quality of life of Resident Doctors

Discussion

The study shows a high overall quality of life (QoL) among resident doctors, with a mean score of 4.28 and 80% reporting satisfaction. However, 16% were neutral and 4% were dissatisfied, indicating stress concerns. General health had a mean score of 4.16, with 78% satisfied, but 6% reported poor health, reflecting burnout. These findings align with research findings of Abhay Singh *et al.*, [15] indicating that 68–80.9% of resident doctors of South Delhi are generally satisfied with their jobs and lives. However, issues like inadequate pay, poor infrastructure (Chellaiyan, D *et al.*, 2022) [16], work-life imbalance, and stress (Fareeba *et al.*, 2024) [17] persist, suggesting the need for targeted improvements to enhance the overall quality of life and satisfaction.

In the health domains, environmental (63.4 ± 18.5), physical (61.0 ± 18.4), and social health (56.7 ± 25.7) scores were relatively better, indicating a moderate perception of well-being in these areas. However, psychological health (38.9 ± 24.1) and average health (39.7 ± 12.3) were lower, highlighting concerns about mental well-being. These findings are consistent with previous studies demonstrating high stress and mental health concerns among medical professionals (West *et al.*, 2018[18]; Dyrbye *et al.*, 2017[19]). Psychological health concerns among resident doctors may be attributed to high job demands, burnout, and inadequate coping mechanisms (Shanafelt *et al.*, 2019) [20]. Similarly, a study conducted in Saudi Arabia found varying QoL scores across different domains, with the highest in environmental (75.6%) and the lowest in mental health (49.2%) (Mohammed A. Arr *et al.*, 2022 [21].

The moderate impairment in sleep quality, latency, duration, and disturbances, as reflected in the global Pittsburgh Sleep Quality Index (PSQI) score of 8.6 (± 2.626). While habitual sleep efficiency (0.18 ± 0.388) and the use of sleeping medications (0.26 ± 0.443) were low, daytime dysfunction (0.86 ± 0.756) indicates a notable impact on daily activities. These results align with existing literature, which suggests that medical professionals often experience disrupted sleep patterns due to workload and stress (Shanafelt *et al.*, 2019 [20]; Mao Y *et al.*, 2020 [22].

The relationship between sleep quality and health outcomes among resident doctors reveals notable trends. In the present study, a moderate negative correlation ($R^2 = 0.117$) between total PSQI score and overall quality of life indicates that poorer sleep quality is associated with lower perceived quality of life. These findings align with existing research, which suggests that insufficient sleep significantly impacts well-being and professional performance among healthcare workers (Shanafelt *et al.*, 2019 [20]; Mao Y *et al.*, 2020 [22]; Walker, 2017 [23].

Interestingly, the negligible correlation between total PSQI score and general health ($R^2 \approx 0$) indicates no significant association between sleep quality and general health in this dataset. This finding contrasts with previous studies that have reported sleep deprivation as a risk factor for poor physical health, including cardiovascular and metabolic disorders (West *et al.*, 2018 [18]; Spiegel *et al.*, 2009 [24]).

The discrepancy may stem from subjective differences in self-reported general health perceptions or the relatively young and resilient population of resident doctors in this study. Overall, the results highlight the need for targeted interventions to improve sleep quality among resident doctors, as it directly affects their overall quality of life. Addressing sleep-related issues through structured wellness programs, workload management, and mental health support could enhance both professional efficiency and well-being.

The present study is pioneering study at our Institute aimed to assess sleep quality and life satisfaction among resident doctors. The reliance on self-reported data introduces potential limitations, including recall bias and the influence of participants' righteousness. The study population was restricted to resident doctors in a tertiary care hospital setting, which may limit the external validity and generalizability of the findings. Furthermore, follow-up over time is not possible due to the cross-sectional design, which also makes it impossible to demonstrate causal linkages.

Conclusions

The study highlights a concerning trend of poor sleep quality and significant psychological distress among resident doctors, despite their moderate physical and environmental health status. Subjective sleep quality is strongly linked to both physical and psychological health, while increased sleep latency negatively affects physical well-being. Additionally, daytime dysfunction significantly impairs social health. However, the global PSQI score does not show strong associations with overall health domains, and most sleep components exhibit weak or insignificant correlations. These findings suggest that while sleep quality moderately impacts overall quality of life, its direct relationship with general health remains limited. Addressing sleep disturbances in resident doctors may be crucial for improving their well-being and professional performance.

Abbreviations

PSQI: Pittsburgh Sleep Quality Index
QoL: Quality of Life
WHOQOL-BREF: WHO Quality of Life-BREF

Declarations

Ethical Approval and Consent to participate

Yes

Consent for publication

Yes

Availability of supporting data

Available on corresponding author upon a responsible request.

Competing interests

None

Funding Statement

None

Authors' contributions

Dr. Anuradha Yadav, Senior Professor, played a key role in the conception and design of the study. She also contributed significantly to the literature review, data and statistical analysis, and interpretation of results, and was actively involved in the preparation and editing of the manuscript.

Dr. Jitendra Singh, Jr Resident, was involved in the literature search, data acquisition, data collection, analysis, and interpretation and contributed to the manuscript preparation.

Dr. Sandeep Saxena, Jr Resident assisted with data collection, literature search, and manuscript preparation. All authors are guarantors of this research work.

References

[1] Defoe DM, Power ML, Holzman GB, Carpentieri A, Schulkin J. Long hours and little sleep: work schedules of residents in obstetrics and gynecology. Obstet Gynecol. 2001 Jun;97(6):1015-8. doi: 10.1016/s0029-7844(01)01363-1. PMID: 11384712.

[2] Pega F, Náfrádi B, Momen NC, Ujita Y, Streicher KN, Prüss-Üstün AM; Technical Advisory Group; Descatha A, Driscoll T, Fischer FM, Godderis L, Kiiver HM, Li J, Magnusson Hanson LL, Rugulies R, Sørensen K, Woodruff TJ. Global, regional, and national burdens of ischemic heart disease and stroke attributable to exposure to long working hours for 194 countries, 2000-2016: A systematic analysis from the WHO/ILO Joint Estimates of the Work-related Burden of Disease and Injury. Environ Int. 2021 Sep;154:106595. doi: 10.1016/j.envint.2021.106595. Epub 2021 May 17. PMID: 34011457; PMCID: PMC8204267.

[3] Dey R, Dutta S, Bhandari SS. Sleep Quality and Daytime Sleepiness among the Clinicians Working in a Tertiary Care Center in Sikkim, India. Indian J Psychol Med. 2020 Mar 9;42(2):141-146. doi: 10.4103/IJPSYM.IJPSYM_439_18. PMID: 32346255; PMCID: PMC7173663.

[4] Kelly MM, Brace M. Cardiovascular risk emerges earlier by birth weight and preterm birth status in the United States Add Health sample. Int J Cardiol. 2025 Mar 15;423:132994. doi: 10.1016/j.ijcard.2025.132994. Epub 2025 Jan 18. PMID: 39832537.

[5] Rivera AS, Akanbi M, O'Dwyer LC, McHugh M. Shift work and long work hours and their association with chronic health conditions: A systematic review of systematic reviews with meta-analyses. Beiki O, editor. PLOS ONE. 2020 Apr 2;15(4). https://doi.org/10.1371/journal.pone.0231037.

[6] Bøggild H, Knutsson A. Shift work, risk factors and cardiovascular disease. Scand J Work Environ Health. 1999 Apr;25(2):85-99. doi: 10.5271/sjweh.410. PMID: 10360463.

[7] Ju YS, Ooms SJ, Sutphen C, Macauley SL, Zangrilli MA, Jerome G, *et al.* Slow wave sleep disruption increases cerebrospinal fluid amyloid-β levels. Brain. 2017 Jul 10;140(8):2104-11. doi: 10.1093/brain/awx148. PMID: 28899014; PMCID: PMC5790144.

[8] Cunningham TR, Guerin RJ, Ferguson J, Cavallari J. Work-related fatigue: A hazard for workers experiencing disproportionate occupational risks. Am J Ind Med. 2022 Nov;65(11):913-925. doi: 10.1002/ajim.23325. Epub 2022 Jan 27. PMID: 35088430; PMCID: PMC9325913.

[9] Redinger J, Kabil E, Forkin KT, Kleiman AM, Dunn LK. Resting and Recharging: A Narrative Review of Strategies

to Improve Sleep During Residency Training. J Grad Med Educ. 2022 Aug;14(4):420-430. doi: 10.4300/JGME-D-21-01035.1. PMID: 35991104; PMCID: PMC9380640

[10] Alotaibi AD, Alosaimi FM, Alajlan AA, Bin Abdulrahman KA. The relationship between sleep quality, stress, and academic performance among medical students. J Family Community Med. 2020 Jan-Apr;27(1):23-28. doi: 10.4103/jfcm.JFCM_132_19. Epub 2020 Jan 13. PMID: 32030075; PMCID: PMC6984036.

[11] Prasad B, Arora VM. Sleep and Wellness in Residency Embracing the Shift. JAMA Network Open. 2024;7(10):e2438294. doi:10.1001/jamanetworkopen.2024.38294

[12] Alami YZ, Ghanim BT, Zyoud SE. Epworth sleepiness scale in medical residents: quality of sleep and its relationship to quality of life. Journal of Occupational Medicine and Toxicology. 2018 Dec;13(1):1-9. https://doi.org/10.1186/s12995-018-0203-z]

[13] Buysse DJ, Reynolds III CF, Monk TH, Hoch CC, Yeager AL, Kupfer DJ. Quantification of subjective sleep quality in healthy elderly men and women using the Pittsburgh Sleep Quality Index (PSQI). Sleep. 1991 Jul 1;14(4):331-8.

[14] World Health Organization. WHOQOL-BREF: introduction, administration, scoring and generic version of the assessment: field trial version, December 1996. World Health Organization; 1996.

[15] Singh A, Singh N, Dixit S, Kaur S, Chellaiyan VG, Alfred J. Satisfaction with life among MBBS students and resident doctors of a tertiary hospital in South Delhi. Int J Community Med Public Health [Internet]. 2021 Nov. 24 [cited 2025 Apr. 5];8(12):5843-6. Available from: https://www.ijcmph.com/index.php/ijcmph/article/view/9035

[16] Chellaiyan DVG, Gupta S, Britto JJ, Kamble B. Job Satisfaction among Resident Doctors of a Tertiary Care Hospital in South Delhi. Indian J Occup Environ Med. 2022 Jul-Sep;26(3):151-156. doi: 10.4103/ijoem.ijoem_319_21. Epub 2022 Sep 26. PMID: 36408434; PMCID: PMC9674073.

[17] Fareeba, Rasheed Z, Saleema, Idrees A, Ahmad H, Sabir S, *et al.* An Evaluation of Work-Related Quality of Life Among General Surgery Residents Working in A Tertiary Care Hospital. Biological and Clinical Sciences Research Journal. 2024 Jun 20;2024(1):910–0.

[18] West CP, Dyrbye LN, Shanafelt TD. Physician burnout: Contributors, consequences, and solutions. J Intern Med. 2018;283(6):516-529.

[19] Dyrbye LN, West CP, Satele D, *et al.* Burnout among U.S. medical students, residents, and early career physicians relative to the general U.S. population. Acad Med. 2017;89(3):443-451.

[20] Shanafelt TD, Boone S, Tan L, *et al.* Burnout and satisfaction with work-life balance among US physicians relative to the general US population. Arch Intern Med. 2019;172(18):1377-1385.

[21] A. Arr M, F. ALAhmadi A, A. Al-Harbi M, G. Al ghamdi A, A. Rahman Al-Dubai S. Quality of Life Among Physicians In Residency Programs In Al Madinah 2022. International Journal of Advanced Research. 2022 Apr 30;10(04):765–73. www.journalijar.com. https://doi.org/10.21474/ijar01/14614

[22] Mao Y, Raju G, Zabidi MA. Association Between Occupational Stress and Sleep Quality: A Systematic Review. Nat Sci Sleep. 2023 Nov 14;15:931-947. doi: 10.2147/NSS.S431442. PMID: 38021213; PMCID: PMC10656850.

[23] Walker MP. The Role of Sleep in Cognition and Emotion. Annals of the New York Academy of Sciences. 2009 Mar;1156(1):168–97. doi: 10.1111/j.1749-6632.2009.04416.x. PMID: 19338508.

[24] Spiegel K, Leproult R, Van Cauter E. Impact of sleep debt on metabolic and endocrine function. Lancet. 1999 Oct 23;354(9188):1435-9. doi: 10.1016/S0140-6736(99)01376-8. PMID: 10543671.