https://doi.org/ 10.33472/AFJBS.6.5.2024. 4424-4441

African Journal of Biological Sciences

A COMPREHENSIVE STUDY TO ASSESS THE OCCUPATIONAL STRESS AND CORTISOL IMBALANCE AMONG THE SHIFT WORKERS IN THE AIRPORT, CHENNAI.

1. **CORRESPONDING AUTHOR**- VIMALA RANI.S*, TUTOR –(Ph.D., research scholar), DEPARTMENT OF PHYSIOLOGY,SREE BALAJI MEDICAL COLLEGE AND HOSPITAL, CHROMEPET,CHENNAI-600 044.
*E-mail/Orcid id -vimala.vini45@gmail.com, https://orcid.org/0000-0002-4938-0943

2. CO-AUTHORS-(i) Dr. ARCHANA.R, PROFESSOR, DEPARTMENT OF ANATOMY, ,SREE BALAJI MEDICAL COLLEGE AND HOSPITAL, CHROMEPET,CHENNAI-600 044.
E-mail/Orcid id -archana.r@bharathuniv.ac.in , https://orcid.org/0000-0003-3960-8390

(ii) DR.SASIKUMAR.S, ASSOCIATE PROFESSOR, DEPARTMENT OF PHYSIOLOGY,SREE BALAJI MEDICAL COLLEGE AND HOSPITAL, CHROMEPET,CHENNAI-600 044.
E-mail/Orcid id-dr.sasikumar15@gmail.com, https://orcid.org/0000-0002-8372-1879

Article History
Volume 6, Issue 5, 2024
Received: 09 May 2024
Accepted: 17 May 2024
doi: ***10.33472/AFJBS.6.5.2024. 4424-4441***

Abstract

Background:
Occupational stress and its impact on health have been increasingly recognized in various industries, including aviation. This cross-sectional study focuses on assessing perceived stress and salivary cortisol levels as potential contributors to cardio-metabolic syndrome among male airport workers..

Materials and methods:
A total of 200 male participants, 100 regular night shift workers and 100 day shift workers ,aged 25 to 40 years, were randomly selected at Chennai International Airport. Perceived stress scale (PSS) used to estimate the stress levels among the participants. In addition, salivary cortisol levels were assessed from all the participants at morning, afternoon, and night.

Results:
Night workers exhibited significantly ($p<0.05$) higher PSS score (mean score of 24) compared to day workers (mean PSS score of 13). Salivary cortisol patterns also differed significantly ($p<0.05$), with night workers displaying elevated cortisol levels during the night compared to day workers. The study further identified associations between night shift work(OR = 12.3, 95% CI: 1.54-27), age above 30 years (OR: OR = 2.05, 95% CI: 1.27-15.6), and physical inactivity (OR = 9.55, 95% CI: 5.95-15.33, $p < 0.001$), with the stress level, emphasizing potential risk factors.

Keywords: Cortisol, perceived stress, quality of life, shift workers

Introduction

Work-related stress is considered a major risk factor for the onset of physical and mental health disorders such as cardiovascular diseases, metabolic syndrome, depression, cognitive impairment and cancer[1]. Occupational stress and its impact on health have garnered considerable attention in various industries, including aviation[2,3]. In the recent times, the aviation industry has experienced significant growth in recent years, leading to increased demand for airport workers. Previous studies have explored the relationship between night shift work and cortisol dynamics, as well as the potential implications for long-term health outcomes[4-6]. The secretion of cortisol, regulated by the hypothalamic-pituitary-adrenal axis (HPA), exhibits a pronounced circadian pattern in humans[7]. Cortisol levels typically peak in the early morning following sleep, decline gradually throughout the day, and reach a nadir during the early part of the night. This diurnal variation includes a distinct phenomenon known as the(HPA), characterized by a rapid surge in cortisol levels within the first 30-45 minutes after awakening[8,9]. The CAR has garnered significant attention due to its association with various physiological and psychological factors, including cardiovascular health, obesity, autoimmune disorders, chronic stress, and psychological well-being[10-13].Salivary cortisol assessment has emerged as a reliable indicator of unbound cortisol levels in blood, widely utilized in psychoneuroendocrinology[14]. Its non-invasive nature and correlation with plasma-free cortisol concentration make it an appealing biomarker for assessing psychosocial stress and associated mental disorders, reflecting HPA axis activity[15]. Salivary cortisol exhibits a robust circadian rhythm, peaking in the morning post-awakening and declining throughout the day. The ease of saliva collection, coupled with its suitability for self-collection, enhances its practicality for research and clinical applications[16].There is a lack of research examining the association between night shift work and perceived stress levels among airport workers.

Aim & Objectives

This study aims to address the knowledge gap by assessing the impact of night shift work on perceived stress and cortisol dynamics among airport workers.

Objectives

a) To assess the perceived stress level among night shift workers using cohen's Perceived Stress Scale.

b) To measure the alteration in the salivary cortisol among the night shift workers using the salivary cortisol ELISA kit.

Materials and methods

Study Design:

This cross-sectional study aims to assess the relationship between occupational stress, cortisol imbalance among male airport workers.

Study setting:

The study was carried out for six months at Sree Balaji Medical College and Hospital, Tamil Nadu.

Sample size:

The sample size of 200 participants for this study was determined based on calculations derived from a previous study and determined to be statistically significant.

Study population:

The study population consisted of permanent employees of Chennai International Airport, comprising 100 regular night shift workers with a 12-hour duty from 8 pm to 8 am, and 100 day shift workers with duty periods from 8 am to 8 pm, all with more than 3 years of experience.

Participant Selection:

A total of 200 male participants, aged 25 to 40 years, were randomly selected from permanent employees at Chennai International Airport.

Inclusion criteria:

Participants were included if they were male employees aged between 25 to 40 years, Permanent workers, willing to participate voluntarily.

Exclusion criteria:

Participants were excluded if they had a history of chronic medical conditions affecting cortisol levels or stress perception, been diagnosed with psychiatric disorders affecting stress perception, consumed medications or substances known to influence cortisol levels.

Study tool:

Perceived Stress Scale

The Perceived Stress Scale (PSS) was used to estimate stress levels among participants. The PSS consists of questions assessing perceived stress over the past month. Responses are scored on a Likert scale ranging from 0 to 4, with higher scores indicating higher perceived stress levels. A total PSS score is calculated by summing the scores of all items, with possible scores ranging from 0 to 40(17).

Salivary cortisol

The salivary cortisol level was estimated by salivary cortisol ELISA kit. Saliva samples were analyzed using standardized procedures, such as enzyme immunoassay or radioimmunoassay, to measure cortisol concentrations.

Outcome measure:

Basic demographic details like age,diet,sleep time, Body Mass Index , marital status,physical activity were collected(Table 1).

Perceived Stress Scale

All the 10 questions were explained to the participants and based on the calculated score , the participants were categorized to have low ,moderate and high stress .

Salivary Cortisol Estimation

Salivary cortisol levels were assessed from all participants at three time points: morning, afternoon, and night. Saliva samples were collected using specialized collection devices. Participants were instructed to refrain from eating, drinking, or brushing teeth for at least 30 minutes before sample collection. Cortisol patterns were analyzed to identify any differences between day and night shift workers.

Statistical analysis:

The data sets were analyzed using R software version 4.0.2. The normality of data was tested using the Kolmogorov-Smirnov test. A p-value of > 0.05 indicated normal Gaussian distribution. Independent sample t-test was done for normally distributed quantitative parameters where the mean values were compared between the study groups. Also the categorical outcomes were compared between study groups using Chi square test and Mann Whitney U test. Logistic regression was done to find the predictors for the stress among the participants.

Ethical approval:

The study protocol was approved by the Institutional Review Board (Ref. No. 002/SBMCH/IHEC/2023/1904). Informed consent was obtained from all participants before data collection. Confidentiality of participant information was maintained throughout the study.

Results

The baseline characteristics presented in the Table 1 and revealed age-matched distribution among participants. Day workers demonstrated (Figure-1) lower PSS score with a mean score of 13 (SD=10), while night workers reported significantly higher stress levels with a mean PSS score of 24 (SD=9) ($p < 0.001$). In terms of salivary cortisol levels (Figure-2), day workers exhibited a distinctive pattern with higher morning cortisol (10.4, SD=2.4) and lower afternoon cortisol (2.69, SD=1.26) compared to night workers (morning: 5.0, SD=2.9; afternoon: 1.67, SD=1.14) ($p < 0.001$). Moreover, night workers displayed markedly elevated cortisol levels during the night (2.37, SD=1.04) in contrast to day workers (0.64, SD=0.28), emphasizing the impact of shift work on cortisol secretion during different times of the day ($p < 0.001$).

Salivary cortisol levels varied significantly among stress groups (Table 2). The Low Stress group exhibited higher morning (median 11.0) and afternoon (median 3.30) cortisol, while having lower nighttime cortisol (median 0.75), compared to Moderate and Severe Stress groups. These findings suggest a potential link between perceived stress and distinct diurnal cortisol patterns, highlighting the nuanced relationship between psychological stress and physiological responses.

The logistic regression analysis revealed notable associations between various factors and the outcome under investigation (Table 3). notably, night workers exhibited significantly higher odds (OR = 12.3, 95% CI: 0.54-279, p = 0.11) of the studied outcome compared to their day-working counterparts, suggesting a potential impact of work shift on the variable of interest. Age above 30 years was associated with increased odds (OR = 2.05, 95% CI: 0.27-15.6, p = [p-value]), indicating a potential age-related influence. Furthermore, physical inactivity significantly heightened the odds (OR = 9.55, 95% CI: 59.5-15.33, p < 0.001), highlighting the importance of physical activity in relation to the outcome.

Table 1:

Baseline Characteristics, PSS level and Salivary Cortisol between the Workers

Characteristic	**Day Workers N = 100**	**Night Workers N = 100**	**p-value**
AGE			0.9
< 25 yrs	35 (35%)	35 (35%)	
> 25 Yrs	65 (65%)	65 (65%)	
BMI			
<25	81 (81%)	68 (68%)	0.08
25-30	12 (12%)	17 (17%)	
> 30	7 (7.0%)	15 (15%)	
MARITAL.STATUS			0.8
Married	68 (68%)	70 (70%)	
Un married	32 (32%)	30 (30%)	
DIET			0.6

Non Vegetarian	72 (72%)	75 (75%)	
VEGETARIAN	28 (28%)	25 (25%)	
SLEEP.TIME			0.001
< 5 hrs	19 (19%)	48 (48%)	
> 5 hrs	81 (81%)	52 (52%)	
PHYSICAL.ACTIVITY			0.001
Active	63 (63%)	18 (18%)	
In Active	37 (37%)	82 (82%)	

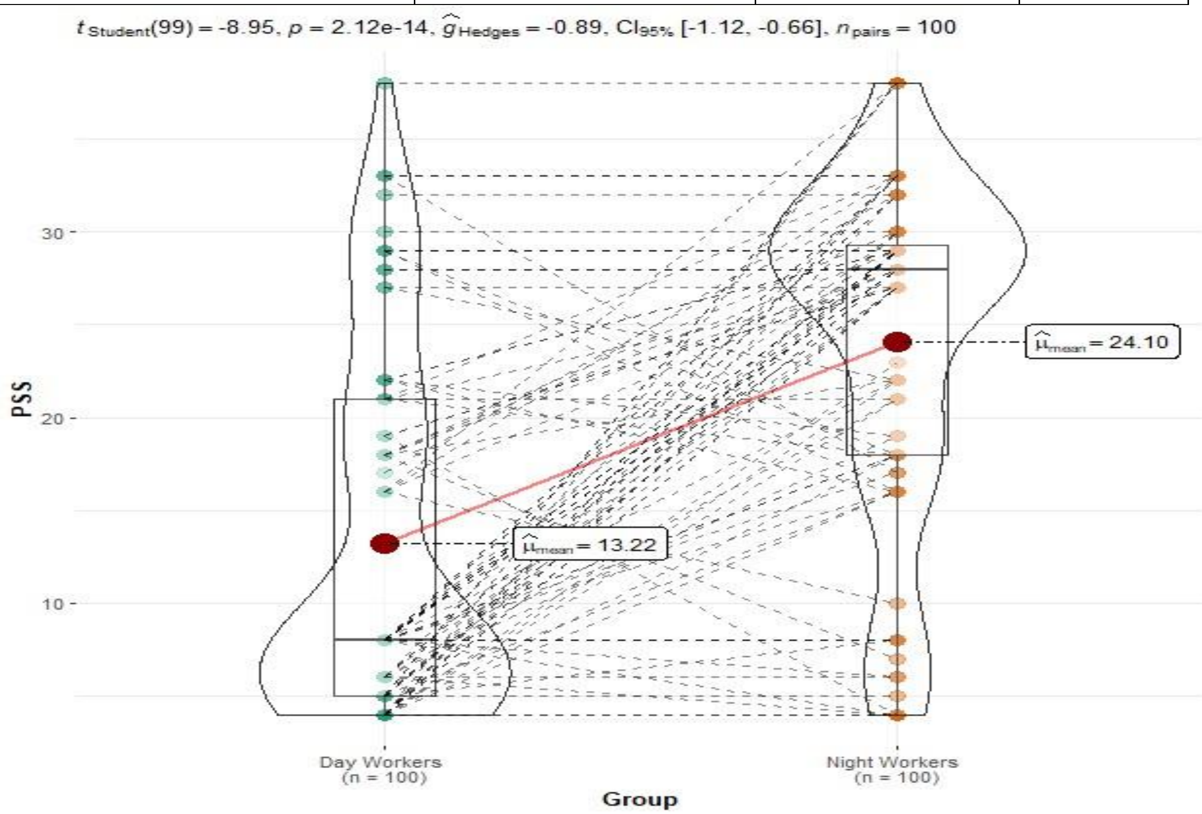

Figure- 1: PSS level between the day and night workers

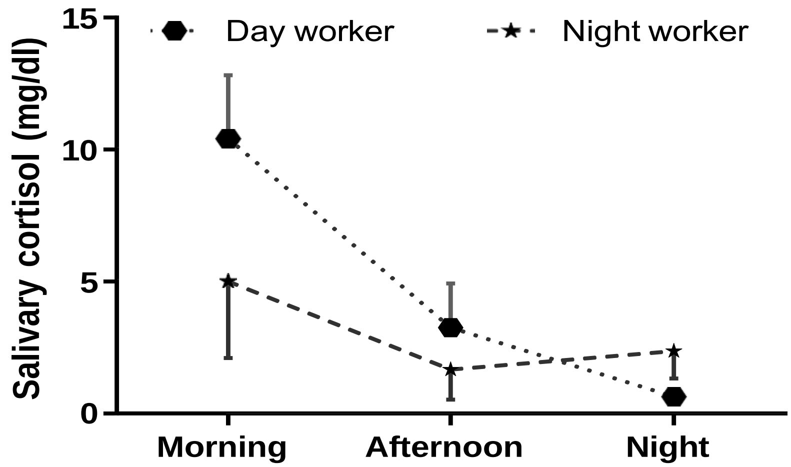

Figure-2: Salivary cortisol level between the day and night workers

Table 2: Comparisons based on the PSS Level between the groups

CHARACTERISTIC	**Overall, N = 200**	**Low Stress N = 76**	**Moderate Stress N = 43**	**Severe Stress N = 81**	**p-value**
AGE					
< 25 yrs	70 (35%)	33 (43%)	18 (42%)	19 (23%)	
> 25 Yrs	130 (65%)	43 (57%)	25 (58%)	62 (77%)	0.018
BMI					
<25	149 (74%)	76 (100%)	35 (81%)	38 (47%)	
25-30	29 (14%)	0 (0%)	8 (19%)	21 (26%)	
> 30	22 (11%)	0 (0%)	0 (0%)	22 (27%)	<0.001
MARITAL.STATUS					
Married	138 (69%)	74 (97%)	31 (72%)	33 (41%)	

Un married	62 (31%)	2 (2.6%)	12 (28%)	48 (59%)	<0.001
DIET					
Non Vegetarian	147 (74%)	36 (47%)	30 (70%)	81 (100%)	
VEGETARIAN	53 (26%)	40 (53%)	13 (30%)	0 (0%)	<0.001
SLEEP.TIME					
< 5 hrs	67 (34%)	34 (45%)	17 (40%)	16 (20%)	
> 5 hrs	133 (66%)	42 (55%)	26 (60%)	65 (80%)	0.003
PHYSICAL.ACTIVITY					
Active	81 (40%)	74 (97%)	7 (16%)	0 (0%)	<0.001
In Active	119 (60%)	2 (2.6%)	36 (84%)	81 (100%)	
<u>Salivary cortisol level</u> Morning	8.2 (3.8, 11.1)	11.0 (10.0, 12.0)	10.0 (5.2, 11.0)	3.1 (2.9, 5.5)	<0.001
Afternoon	1.90 (1.00, 3.10)	3.30 (2.40, 3.83)	2.40 (1.90, 2.50)	1.00 (0.90, 1.10)	<0.001
Night	0.90 (0.60, 2.30)	0.75 (0.50, 0.90)	1.30 (0.60, 2.30)	1.90 (0.80, 2.80)	<0.001
<u>Group</u>					
Day Workers	100 (50%)	61 (80%)	21 (49%)	18 (22%)	
Night Workers	100 (50%)	15 (20%)	22 (51%)	63 (78%)	<0.001

Table 3: Logistics Regression for the predictors of the stress among the workers

Characteristic	**OR**[1]	**95% CI**[1]	**p-value**
Group			
Day Workers	Ref	—	0.11
Night Workers	12.3	0.54, 279	
AGE			
<30	Ref	—	0.5
>30	2.05	0.27, 15.6	

BODY.MASS.INDEX			
<25	Ref	—	
25-30	2.74	0.09, 82.3	0.6
>30	1.36	0.03, 69.4	0.9
SLEEP.TIME			
< 5hrs	Ref	—	0.5
> 5hrs	0.34	0.01, 9.20	
PHYSICAL.ACTIVITY			
Active	Ref	—	<0.001
In Active	9.55	59.5, 15.33	
[1]OR = Odds Ratio, CI = Confidence Interval			

Discussion

The aim of this study was to investigate the impact of shift work on perceived stress and diurnal cortisol patterns in day and night workers. Our findings revealed that night workers reported significantly higher stress levels and cortisol secretion patterns compared to day workers.

According to Saedkanah et al[18], Lindholm et al[19] and Bostock et al[20] work-related stress, particularly from night-shift work, disrupts circadian rhythms and may impact disease pathogenesis. A study by Huang et al[21] explored stress responses among security guards through salivary cortisol and blood pressure evaluation and Gerding et al[22] study findings reveal significant cortisol level alterations, with increased levels during night shifts and notable cardiovascular work stress. Our study supports the above statement as it involves the night shift workers and concerned in finding the alteration in the salivary cortisol level. Helena et al [23] investigated the impact of irregular shift work on variations, suggesting sensitive markers for

severe stress-related hormonal responses among Finnish media workers, finding a higher cortisol awakening response in those with irregular shifts compared to regular daytime work. Irregular shift work, combined with severe stress and insufficient sleep, independently contribute to heightened cortisol excretion after waking, potentially posing long-term health risks reported by Zhang et al [24] and Khosravipour et al [25] . This study coincides with the above findings as the participants involved, who work in night duty are found to have stress.A study by Moreno et al[26] among the male pilots found that early shifts led to higher cortisol increase upon awakening, greater overall cortisol output, and slower decline compared to late shifts or rest days, despite shorter sleep duration and increased stress. Another finding by Yan et al [27]suggest a significant influence of early work shifts on the diurnal cortisol rhythm regardless of subjective mood or sleep duration. The results gained from our study exhibited that there is an increased salivary cortisol level for those who work in the regular night shifts and favours the above research study. A multicentric study by Zhang et al[28] and Li et al [29] examined cortisol rhythm in midwives with regular and irregular shift patterns, finding significant differences in cortisol levels despite equal weekly working hours, suggesting greater cortisol inhibition in those with irregular shifts. Night-shift work imposes abrupt changes in sleep and light-dark exposure, disrupting the endogenous circadian system and causing misalignment with the external environment reported by Kim et al [30]. Li et al [31] found that both simulated experiments and field studies indicate the resistance of the circadian system to adapt from a day- to a night-oriented schedule, leading to internal desynchronization among various circadian rhythms. This disruption extends beyond canonical clock genes to affect gene expression, metabolites, and overall health, contributing to increased risk of medical conditions revealed by Restrepo et al [32]. Despite some adaptation, most rhythmic transcripts in the human genome remain adjusted to a day-oriented schedule, while metabolites shift by several hours when working nights, exacerbating circadian and sleep-wake disturbance reported by Perez et al [33].Our study has significant implications for occupational health and safety, as it provides valuable insights into the potential health risks associated with shift work. Our findings can inform the development of interventions to mitigate the negative effects of shift work on workers' stress levels and overall well-being.

Limitations

Our study has limitations, including a small sample size and the potential for selection bias, which may impact the generalizability of our findings. Further research is needed to confirm our findings and to explore the potential confounding factors that may impact the relationship between shift work, stress, and cortisol secretion patterns.

Conclusion

In conclusion, the present study underscores the significant impact of shift work on stress levels and cortisol secretion patterns among workers, highlighting the need for further research to explore potential interventions and support systems for this vulnerable population. Future Scope: Future research could investigate the long-term effects of shift work on stress-related outcomes and explore the efficacy of personalized interventions, such as stress management training and flexible work schedules, in mitigating the negative impact of shift work on worker well-being.

Competing interests

The authors declare that they have no competing interests.

Funding

No external funding was received for this study.

References

1. Niu, S .F., Chung, M. H., Chen, C.H., & Hegney, D. (2011).The effect of shift rotation on employee cortisol profile, sleep quality, fatigue, and attention level: a systematic review. *Journal of Nursing Research,19*(1),68-81. https://doi.org/10.1097/jnr.0b013e31820c1879

2. Helmreich, R. L., & Merritt, A.C. (2017).Culture at work in aviation and medicine. *National, organizational and professional influences. Routledge*. https://doi.org/10.4324/9781315258690

3. Williams, C. (2003)Sky service. The demands of emotional labour in the airline industry. *Gender, Work & Organization,10*(5),513-50. http://dx.doi.org/10.1111/1468-0432.00210

4. Brum, M.C.B., Senger, M.B., Schnorr, C.C., & Ehlert, L.R.(2022). Effect of night-shift work on cortisol circadian rhythm and melatonin levels. *Sleep Science*,*15*(2),143-8. https://doi.org/10.5935/1984-0063.20220034

5. Boivin, D.B., Boudreau, P., & Kosmadopoulos, A.(2022). Disturbance of the circadian system in shift work and its health impact. *Journal of biological rhythms*,*37*(1),3-28. https://doi.org/10.1177/07487304211064218

6. Lindholm, H., Ahlberg, J., Sinisalo, J., & Hublin, C.(2012). Morning cortisol levels and perceived stress in irregular shift workers compared with regular daytime workers. *Sleep disorders.https://doi.org/10.1155/2012/789274*

7. Mohd Azmi, N.A.S., Juliana, N., Azmani, S., & Mohd Effendy, N.(2021). Cortisol on circadian rhythm and its effect on cardiovascular system. *International journal of environmental research and public health*,*18*(2),676. https://doi.org/10.3390/ijerph18020676

8. Fries, E., Dettenborn, L., & Kirschbaum, C.(2009). The cortisol awakening response (CAR): facts and future directions. *International journal of Psychophysiology*,*72*(1),67-73. https://doi.org/10.1016/j.ijpsycho.2008.03.014

9. Steptoe, A., &Serwinski, B.(2016). Cortisol awakening response. Stress: Concepts, cognition, emotion, and behavior. *Elsevier*, 277-83. http://dx.doi.org/10.1016/B978-0-12-800951-2.00034-0

10. Li, J., Bidlingmaier, M., Petru, R., Pedrosa, Gil, F., Loerbroks, A., &Angerer, P. (2018) . Impact of shift work on the diurnal cortisol rhythm: a one-year longitudinal study in junior physicians. *J Occup Med Toxicol*, *13*,23. https://doi.org/10.1186/s12995-018-0204-y

11. Law, R., & Clow, A.(2020). Stress, the cortisol awakening response and cognitive function. *International review of neurobiology*,*150*,187-217. https://doi.org/10.1016/bs.irn.2020.01.001

12. Merswolken, M., Deter, H.C., Siebenhuener, S., Orth-Gomér, K., &Weber, C.S. (2013).Anxiety as predictor of the cortisol awakening response in patients with coronary heart disease. *International journal of behavioral medicine*,*20*,461-7. https://doi.org/10.1007/s12529-012-9233-6

13. Weber, C., Fangauf, S.V., Michal, M., Ronel, J., Herrmann,L. C., &Ladwig, K.H. (2022).Cortisol awakening reaction and anxiety in depressed coronary artery disease patients. *Journal of clinical medicine*,*11*(2),374. https://doi.org/10.3390%2Fjcm11020374

14. Clow, A., &Smyth, N.(2020). Salivary cortisol as a non-invasive window on the brain. *International Review of Neurobiology*,*150*,1-16. https://doi.org/10.1016/bs.irn.2019.12.003

15. Bae, Y.J., Reinelt, J., Netto, J., Uhlig, M., Willenberg, A., &Ceglarek, U.(2019). Salivary cortisone, as a biomarker for psychosocial stress, is associated with state anxiety and heart rate. *Psychoneuroendocrinology*,*101*,35-41. https://doi.org/10.1016/j.psyneuen.2018.10.015

16. Adam, E.K., &Kumari, M.(2009). Assessing salivary cortisol in large-scale, epidemiological research. *Psychoneuroendocrinology*,*34*(10),1423-36. https://doi.org/10.1016/j.psyneuen.2009.06.011

17. Cohen, S., Kamarck, T., & Mermelstein, R.(1994). Perceived stress scale. Measuring stress: A guide for health and social scientists,*10*(2),1-2. https://doi.org/10.4236/psych.2010.11001

18. Saedpanah, K., Ghasemi, M., Akbari, H., Adibzadeh, A., &Akbari, H.(2022). Effects of workload and job stress on the shift work disorders among nurses: PLS SEM modeling. *European journal of translational myology*,*33*(1). https://doi.org/10.4081/ejtm.2022.10909

19. Lindholm, H., Ahlberg, J., Sinisalo, J., Hublin, C., Hirvonen, A., &Partinen, M.(2012). Morning cortisol levels and perceived stress in irregular shift workers compared with regular daytime workers. *Sleep disorders*. https://doi.org/10.1155/2012/789274

20. Bostock, S., &Steptoe, A.(2013). Influences of early shift work on the diurnal cortisol rhythm, mood and sleep: within-subject variation in male airline pilots. *Psychoneuroendocrinology*,*38*(4),533-41. https://doi.org/10.1016%2Fj.psyneuen.2012.07.012

21. Huang, X., Jiang, X., Zheng, Q., &Chen, X.(2022). The association between circadian rhythm of cortisol and shift work regularity among midwives—A multicenter study in Southeast China. *Frontiers in Public Health*,*10*. https://doi.org/10.3389/fpubh.2022.965872

22. Gerding, T., &Wang, J. (2022).Stressed at Work: Investigating the Relationship between Occupational Stress and Salivary Cortisol Fluctuations. *International journal of environmental research and public health*,*19*(19). https://doi.org/10.3390/ijerph191912311

23. Helena, C., Kaltenegger., Mathew, D., Marques., Linda,B., &Nicolas.(2024).Prospective associations of technostress at work, burnout symptoms, hair cortisol, and chronic low-grade inflammation.*Brain, Behavior, and Immunity*, 117. https://doi.org/10.1016/j.bbi.2024.01.222

24. Zhang, M., Liu, B., & Ke, W. Correlation analysis between occupational stress and metabolic syndrome in workers of a petrochemical enterprise: based on two assessment models of occupational stress. *BMC Public Health, 24*, 802 (2024). https://doi.org/10.1186/s12889-024-18305-3

25. Khosravipour, M., Shahmohammadi, M., Athar, H.V.(2019). The effects of rotating and extended night shift work on the prevalence of metabolic syndrome and its components. *Diabetes Metab Syndr,13*(6),3085–9. https://doi.org/10.1016/j.dsx.2019.11.006.

26. Moreno, F. A., Tian, L., &Huebner, E.S.(2020). Occupational Stress and Employees Complete Mental Health: a cross-cultural empirical study. *Int J Environ Res Public Health,17*(10),3629. https://doi.org/10.3390/ijerph17103629

27. Yan, T., Ji, F., Bi ,M., Wang, H., Cui, X.,& Liu, B. (2022).Occupational stress and associated risk factors among 13,867 industrial workers in China. *Front Public Health,10*. https://doi.org/10.3389/fpubh.2022.945902.

28. Zhang, Y., Huang L, Wang Y, Lan Y, & Zhang Y.(2021). Characteristics of publications on occupational stress: contributions and trends. *Front Public Health,9*. https://doi.org/10.3389/fpubh.2021.664013.

29. Li ,X., Yang, X., Sun, X., Xue, Q., Ma, X., & Liu, J. (2021).Associations of musculoskeletal disorders with occupational stress and mental health among coal miners in Xinjiang, China: a cross-sectional study. *BMC Public Health,21*(1),1327. https://doi.org/10.1186/s12889-021-11379-3.

30. Kim, S.Y., Shin, Y.C., Oh, K.S., Shin, D.W., Lim, W.J, & Kim, E.J . (2020).The association of occupational stress and sleep duration with anxiety symptoms among healthy employees: a cohort study. *Stress Health,36*(5),675–85. https://doi.org/10.1002/smi.2948.

31. Li ,Y., Chu ,L., & Zha, Z.(2022). Job stress and satisfaction in southwest Chinese hospitals: a cross-sectional study. *Med (Baltim)*,*101*(3). https://doi.org/10.1097/MD.0000000000028562.

32. Restrepo, J., & Lemos, M.(2021). Addressing psychosocial work-related stress interventions: a systematic review. *Work*,*70*(1),53–62. https://doi.org/10.3233/WOR-213577.

33. Perez, D., Caballero,G. A., Del ,T., & Bello, H.J. (2021) . Stress salivary biomarkers variation during the workday in emergencies in healthcare professionals. *Int. J. Environ. Res. Public Health, 18.* https://doi.org/10.3390/ijerph18083937