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CHRONOBIOLOGICAL STRAIN AND DESYNCHRONIZATION: A COMPREHENSIVE ANALYSIS OF THE NIGHT SHIFT BURDEN OF DRIVERS AND CONDUCTORS IN MAYILADUTHURAI DEPOT

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Abstract
Night-shift operation is an integral component of public road transport systems, requiring continuous service delivery during biologically unfavourable hours. Bus drivers and conductors engaged in night-duty work are exposed to circadian rhythm disruption, prolonged vigilance, and occupational stress, which may contribute to chronobiological strain and adverse health outcomes. Evidence at the depot level, particularly in semi-urban transport settings, remains limited. The study aimed to assess chronobiological strain and circadian desynchronization among bus drivers and conductors engaged in night duties at the Mayiladuthurai depot. Drivers reported higher occupational stress, whereas conductors exhibited greater sleep disturbance and health-related burden. Night-duty work imposes a multidimensional chronobiological and occupational burden on both drivers and conductors, emphasizing night-shift schedules as a key determinant of circadian strain rather than occupational role. System-level interventions addressing shift scheduling, fatigue management, and worker health support are warranted.

Keywords: Night-duty work; Chronobiological strain; Bus drivers; Bus conductors; Occupational health

1. Introduction

Night-shift operation has become an essential part of the infrastructure of the public road transport, which guarantees the constant movement of the economic, social, and emergency demand. The bus driver and bus conductor are the workforce in this system that deals with strenuous hours, long periods of alertness, and complicated working duties at night. According to the occupational health literature, commercial drivers are also prone to working under adverse conditions, which are manifested in psychosocial strain, long work shifts, and fewer chances to rest, which have a cumulative effect on the physical and mental state of health (Amoadu et al., 2024). Together, these aspects explain the need to pay special attention to the chronobiological strain and desynchronization in night-duty drivers and conductors at the Mayiladuthurai depot.

Research Objectives

1. To assess chronobiological strain and circadian desynchronization among bus drivers and conductors engaged in night duties at the Mayiladuthurai depot.
2. To examine the association between night-duty work characteristics, sleep quality, occupational stress, and self-reported health outcomes.

2. Methodology

2.1 Study Design

The study design was a cross-sectional, questionnaire-based, descriptive and analytical study to determine the chronobiological strain and circadian desynchronization of male bus drivers and conductors who work under the night shift. The design allowed the evaluation of occupational exposure and health-related outcomes at one point in time and allowed the analysis of differences in groups and correlation between night-duty characteristics and sleep quality, fatigue, occupational stress, and self-reported health status.

2.2 Study Setting

The research was done in Mayiladuthurai bus depot, Tamil Nadu, India. The depot has scheduled night and rotating night service and drivers and conductors with irregular working hours. It was an appropriate working environment to explore the chronobiological strain linked to the night-shift work in a semi-urban transit setting.

2.3 Sample Size and Sampling Technique

The study involved 60 male participants (30 drivers and 30 conductors). A purposive sampling technique with the support of stratified convenience sampling was used to select the participants to reflect the equal representation of the two occupational positions. The participants were entitled to be on night-duty or on night-shift that were rotating. Employees who are on long-term medical leave or only work on day shifts were not included so that they could have been exposed to pertinent nocturnal work-related chronobiological stressors.

2.4 Data Collection Tool

A structured questionnaire that had been specifically designed in the research was used to collect data. The tool had occupational role sections, night-duty scheduling features, sleep quality and fatigue signs, perceived chronobiological stress and circadian disturbance, work stress, and self-reported health outcomes. Everything was put in Likert-scale response options to enable quantitative examination of subjective experiences with regard to working on night duty.

2.5 Data Collection Procedure

The collection of the data was conducted in the form of the self-administered questionnaire, and the assistance of the interviewer was applied in cases when it was necessary to provide the proper understanding and full answers. All respondents gave informed consent and informed consent was provided by them to participation in the study about the purpose of the study. Anonymity and strict confidentiality was ensured and this was by virtue of choice.

2.6 Data Analysis

The responses were recorded in Excel. Participant characteristics and some of the major domains of the study were summarized using descriptive statistics, frequencies, percentages, means, and standard deviations. The independent-samples t-tests were used to compare fatigue and chronobiological strain in drivers and conductors, Pearson correlation analysis was used to examine the relationship amongst sleep quality, fatigue, occupational stress, and health outcomes, and multiple linear regression was used to identify predictors of health outcomes. The level of statistical significance was assessed at a reasonable confidence level.

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3. Results

3.1 Demographic and Occupational Profile of Respondents

Sixty transport workers taking the night shifts were involved in the research study, and all were on either night-duty or rotating night shifts (Table 1). The sample consisted of equal occupation; there were 30 drivers (50.0%) and 30 conductors (50.0%) in the sample. The average age of the respondents was 43.0 ± 9.15 years, which implied that the workforce is mainly middle-aged. The respondents had an average service life of 14.38 ± 7.76 years, which is a good occupational experience. As the research targeted male night-duty workers only, all the respondents had homogenous gender and work schedule features.

Table 1. Demographic and occupational profile of respondents (N = 60)

Variable	Category / Statistic	n	% / Mean ± SD
Gender	Male	60	100.0
Occupational role	Driver	30	50.0
	Conductor	30	50.0
Work schedule	Night / Rotating night duty	60	100.0
Age (years)	Mean ± SD	-	43.00 ± 9.15
Total years of service	Mean ± SD	-	14.38 ± 7.76

3.2 Descriptive Statistics of Key Study Domains

Likert responses were used to calculate composite scores of sleep quality, fatigue and chronobiological strain, occupational stress, and health-related outcomes. In general, the mean values represented moderate levels of sleep disturbance, fatigue, occupational stress, and health burden in both occupational groups (Table 2). Conductors registered a mean score of sleep disturbance (2.66 ± 0.49) than drivers (2.49 ± 0.55). The scores of fatigue and chronobiological strain did not differ significantly between drivers (2.51± 0.55) and conductors (2.53 ± 0.44) as well. There was an increase in occupational stress among the drivers (2.78±0.49) as compared to the conductors (2.45 ± 0.54). Conductors had superior scores on health-related outcomes (2.75 ± 0.70) compared to drivers (2.43 ± 0.82).

Table 2. Mean and standard deviation of study domains by occupational role

Study Domain	Drivers (n = 30) Mean ± SD	Conductors (n = 30) Mean ± SD
Sleep quality	2.49 ± 0.55	2.66 ± 0.49
Fatigue / Chronobiological strain	2.51 ± 0.55	2.53 ± 0.44
Occupational stress	2.78 ± 0.49	2.45 ± 0.54
Health-related outcomes	2.43 ± 0.82	2.75 ± 0.70

A comparative visualization of the mean scores of sleep quality, fatigue and chronobiological strain, occupational stress, and health-related outcomes of drivers and conductors working on night duty will be introduced in Figure 1. The figure provides the summary of the distribution of the night-shift load in the two occupational roles by domain in terms of composite Likert-scale scores.

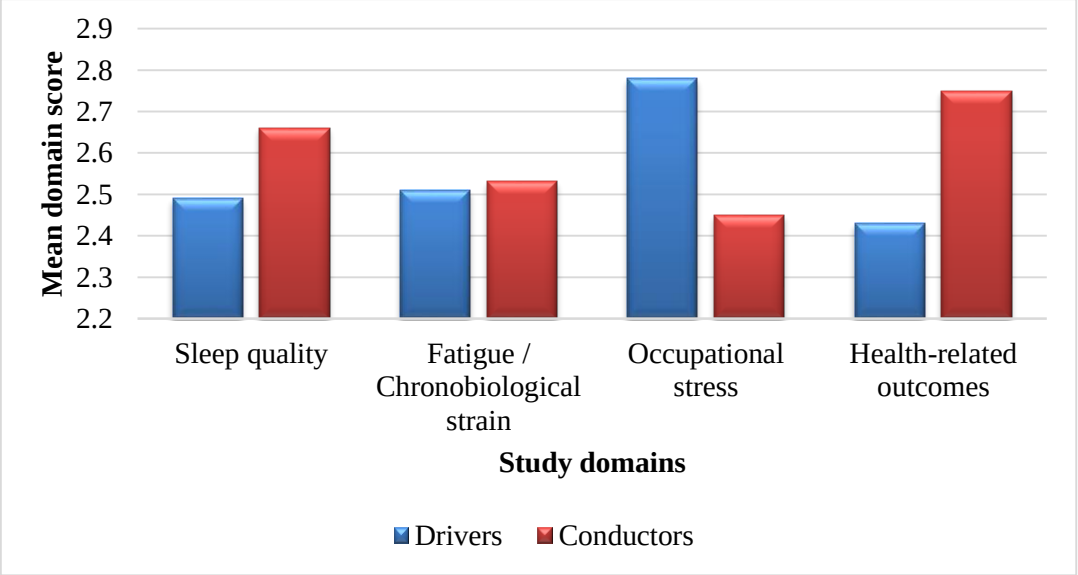

Figure 1. Night-duty burden among drivers and conductors

The drivers and conductors showed moderate scores in all the domains evaluated as was seen in Figure 1. The mean occupational stress scores were greater in drivers and the mean sleep disturbance and health-related outcome scores were greater in conductors. The two groups had equal fatigue and chronobiological strain scores, which means that they were both exposed to circadian disruption in line with the night-duty schedules.

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3.3 Comparison of Fatigue and Chronobiological Strain Between Drivers and Conductors

The independent-samples t-test was applied to determine the difference in fatigue and chronobiological strain among drivers and conductors who were hired to work on night duties (Table 3). The comparison revealed that there was no statistically significant between the two occupational groups. There was no significant difference in mean fatigue and chronobiological strain scores between drivers (2.51 ± 0.55) and conductors (2.53 ± 0.44) indicating that there was no difference in the levels of circadian strain in drivers and conductors that is related to night-shift working hours.

Table 3. Independent-samples t-test comparing fatigue and chronobiological strain

Group	Mean ± SD	t	df	p-value
Drivers (n = 30)	2.51 ± 0.55	−0.156	55.55	0.876
Conductors (n = 30)	2.53 ± 0.44			

3.4 Correlation Between Sleep Quality, Fatigue, Occupational Stress, and Health Outcomes

The correlation analysis was conducted through Pearson correlation to determine the relations between sleep quality, fatigue and chronobiological strain, occupational stress, and health-related outcomes. The quality of sleep was weakly positively related to fatigue and chronobiological strains ($r = 0.21$, $p = 0.111$) and weakly associated with health-related outcomes ($r = 0.17$, $p = 0.200$) as shown in Table 4. The relationship between occupational stress and other study areas showed little interrelation. In general, all the correlations were low, and not significant statistical values showed a complexity and multifactorial interrelationship among sleep, fatigue, stress, and perceived health among night-duty transport workers.

Table 4. Pearson correlation analysis among key study domains (N = 60)

Variable Pair	r	p-value
Sleep quality - Fatigue / Chronobiological strain	0.208	0.111
Sleep quality - Occupational stress	0.052	0.693
Sleep quality - Health-related outcomes	0.168	0.200
Fatigue/Chronobiological strain - Health-related outcomes	−0.003	0.979

3.5 Aggregate Night-Shift Burden Among Transport Workers

On the whole, the mean scores in the whole sample reflected moderate degrees of night-duty load. The average sleep quality rating was 2.58 ± 0.52, fatigue and chronobiological strain was 2.52 ± 0.50, occupational stress was 2.62 ± 0.53, health-related results was 2.59 ± 0.77 and there was a similar trend of circadian disruption and occupational stress among night-duty transport workers (Table 5).

Table 5. Overall night-duty burden across study domains (N= 60)

Study Domain	Mean	SD
Sleep quality	2.58	0.52
Fatigue / Chronobiological strain	2.52	0.50
Occupational stress	2.62	0.53
Health-related outcomes	2.59	0.77

To display the general-night-duty-related burden among the whole study population, the mean composite scores that were obtained were used to determine sleep quality, fatigue and chronobiological strain, occupational stress, and health-related outcomes. Figure 2 indicates the distribution trend of these mean domain scores of the entire sample of night-duty transport workers.

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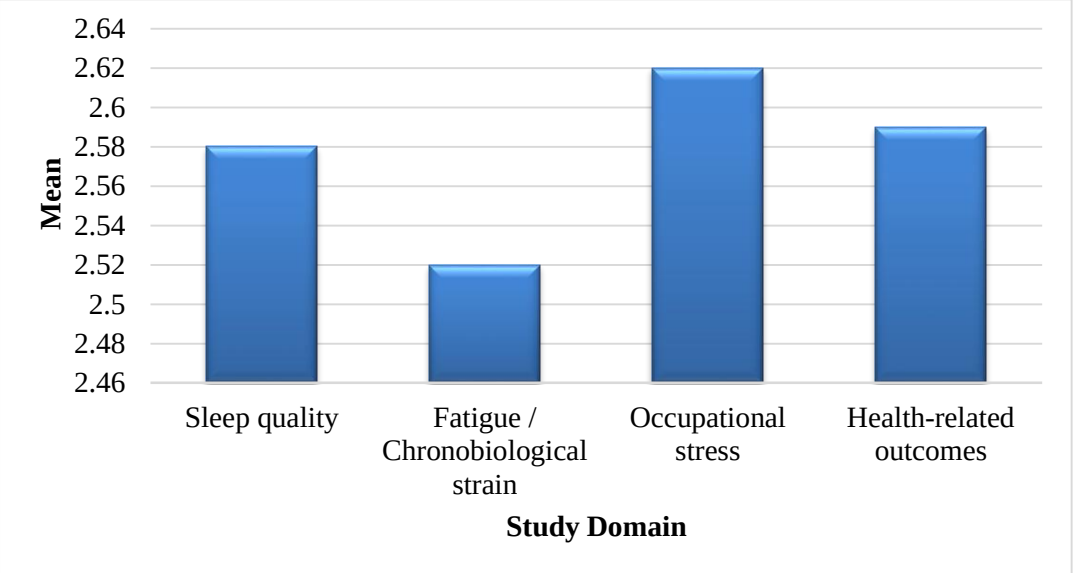

Figure 2. Overall night-duty burden across study domains

Figure 2 indicated that occupational stress had the largest mean score compared to other tested domains, then the health-related outcomes and sleep quality. Fatigue and chronobiological strain presented a relatively lower mean value, but this remains the evidence of a moderate portion of burden on night duties. These results represent a regular trend of circadian disturbance and work-related stress in various areas in night-duty transport workers.

4. Discussion

Chronobiological strain and burden associated with working in the night shifts were considered in the current study among male bus drivers and conductors who work in the night in the Mayiladuthurai depot. The results show that occupational disturbance, fatigue, and chronobiological strain, occupational stress, and health-related burden among the two occupational groups are moderate in nature and that the effects of night-shift shift in the operations of the public transport are widespread. The trend as a whole indicates that work on night duty, in itself is a major occupational stressor regardless of the job designation. Drivers had relatively better occupational stress scores, but conductors had high scores of sleep disturbance and adverse health-related outcome scores. Such role-specific differences could be variations in the task requirement in night operations, including extended vigilance and decision making among the drivers and extended physical activity, contact with passengers and schedule anomaly among conductors. Notably, fatigue and chronobiological strain were identified to be similar in drivers and conductors indicating that circadian disruption is a congruent occupational exposure that is caused by night shifts work and not necessarily due to assigned tasks. The correlation analysis showed weak and unimportant correlations between sleep quality and fatigue with occupational stress and health outcomes. These were statistically insignificant relationships, but the trends that were observed suggest that circadian disruption and perceived health status are interacting in a complex and multifactor way. The lack of significant statistical correlations can also be explained by the fact that the sample is quite small and the night-shift exposure is more homogenous among the participants, which can decrease the diversity of the responses. The investigation of organizational and environmental determinants of the burden of night shifts would also help in the formulation of a holistic occupational health intervention that can be applied to the transport workers.

5. Conclusion

The study provided an analysis of chronobiological strain and night-shift burden among male bus drivers and conductors that have to work in the night at the Mayiladuthurai depot. The results also indicate that night-shift work is linked to moderate sleep disturbance, fatigue and chronobiological strain, work-related stress, and poor health-related outcomes in both occupational jobs, which highlight the widespread effects of night work on the state of the state in the area of transport. Occupational stress was found to be relatively high among drivers and more sleep disturbance and health-related burden among conductors were reported, which was an aspect of role-specific task demands when making night operations. General domain-level analysis showed that there is a strong tendency towards occupational strain, which is similar in sleep, stress, fatigue, and health outcomes, and the multidimensional nature of night-duty-related issues. The results obtained indicate that interventions at the system level aimed to streamline the schedules of shifts, increase the opportunities to rest and recover, and enhance the mechanisms of supporting the health of the occupation in the organization of public transport are necessary. The study offers depot-level empirical evidence and contributes to the improved comprehension of chronobiological strain in night-duty transport workers and contributes to the development of the specific strategies to improve the level of well-being and the safety of the operations performed by the workers in the night shifts transportation.

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Reference

1. Amoadu, M., Sarfo, J. O., & Ansah, E. W. (2024). Working conditions of commercial drivers: a scoping review of psychosocial work factors, health outcomes, and interventions. *BMC Public Health*, *24*(1), 2944.
2. Anund, A., Ahlström, C., Fors, C., & Åkerstedt, T. (2018). Are professional drivers less sleepy than non-professional drivers?. *Scandinavian Journal of Work, Environment & Health*, 88-95.
3. 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.
4. Carneiro, D., Novais, P., Augusto, J. C., & Payne, N. (2017). New methods for stress assessment and monitoring at the workplace. *IEEE Transactions on Affective Computing*, *10*(2), 237-254.
5. Cheng, W. J., & Cheng, Y. (2017). Night shift and rotating shift in association with sleep problems, burnout and minor mental disorder in male and female employees. *Occupational and environmental medicine*, *74*(7), 483-488.
6. de Alcantara, V. C. G., Silva, R. M. C. R. A., Pereira, E. R., da Silva, D. M., & Flores, I. P. (2019). The experience in traffic and its effects on the health of bus drivers: A phenomenological descriptive study. *Revista de Enfermagem Referência*, *4*(23), 21-29.
7. Diez, J. J., Vigo, D. E., Lloret, S. P., Rigters, S., Role, N., Cardinali, D. P., & Chada, D. P. (2011). Sleep habits, alertness, cortisol levels, and cardiac autonomic activity in short-distance bus drivers: differences between morning and afternoon shifts. *Journal of Occupational and Environmental Medicine*, *53*(7), 806-811.
8. Garbarino, S., Durando, P., Guglielmi, O., Dini, G., Bersi, F., Fornarino, S., ... & Magnavita, N. (2016). Sleep apnea, sleep debt and daytime sleepiness are independently associated with road accidents. A cross-sectional study on truck drivers. *PloS one*, *11*(11), e0166262.
9. George, N., Kiran, P. R., Sulekha, T., Rao, J. S., & Kiran, P. (2018). Work–life balance among Karnataka state road transport corporation (KSRTC) workers in anekal town, South India. *Indian journal of occupational and environmental medicine*, *22*(2), 82-85.
10. Halin, A., Verly, J. G., & Van Droogenbroeck, M. (2021). Survey and synthesis of state of the art in driver monitoring. *Sensors*, *21*(16), 5558.
11. Jiang, Y., Wu, C., Hu, T., Chen, M., Liu, W., Zhou, Y., ... & Xu, X. (2020). Association for combined exposure to job strain, shift work on mental health among Chinese railway workers: a cross-sectional study. *BMJ open*, *10*(10), e037544.
12. Lim, Y. C., Hoe, V. C., Darus, A., & Bhoo-Pathy, N. (2020). Association between night-shift work, sleep quality and health-related quality of life: a cross-sectional study among manufacturing workers in a middle-income setting. *BMJ open*, *10*(9), e034455.
13. Mehta, M. (2022). Meenu: Occupational stress among bus drivers: a literature review. *Pharma Innov J*, *11*, 175-9.
14. Ni, L., Li, K., Jiang, L., Chen, J., Chen, Y., Li, X., ... & Deng, R. (2020). A Nurse's Perspective on Visual Rehabilitation of Outpatients With Low Vision in China. *Rehabilitation Nursing Journal*, *45*(1), 45-53.
15. Rajan, V., Pradeep, T. S., Chandrappa, M., & Rajan Sr, V. (2024). Occupational Stress and Its Effect on Health Status Among Karnataka State Road Transport Corporation (KSRTC) Bus Drivers: A Cross-Sectional Study. *Cureus*, *16*(9).