International Journal of Health Sciences and Research
[Indexed, Peer-Reviewed Journal]
Volume 16; Issue: 3; March 2026
Website: www.ijhsr.org
Original Research Article *ISSN: 2249-9571*

Correlation Between Duration of Occupational Exposure and Serum Cortisol Levels among Textile Mill Workers: A Cross-Sectional Study

A. Abbas[1], Leela Priyadharsini Balamurali[2], Mahalakshmi. M[3]

[1]Senior Assistant Professor, Department of Physiology, Government Medical College and ESIC Hospital, Coimbatore, Tamil Nadu, India
[2]Assistant Professor, Department of Physiology, Vinayaka Mission's Medical College and Hospital, Vinayaka Missions Research Foundation (Deemed to be University), Karaikal - 609609. Puducherry, India
[3]Assistant Professor, Department of Physiology, Government Theni Medical College, Theni, Tamil Nadu, India.

Corresponding Author: Leela Priyadharsini Balamurali

DOI: https://doi.org/10.52403/ijhsr.20260315

ABSTRACT

Background: Rapid industrialization has emerged as a defining character of modern economic growth. Noise is considered one of the most common occupational hazards. Cortisol is a hormone which is secreted as a response to stress. So, this study was done to evaluate serum cortisol levels and determine their correlation with the duration of noise exposure among textile mill workers.
Materials and methods: A cross-sectional study was conducted in an autoloom-textile mill among their workers. The study group was divided into three groups – Control (n=30), Day shift workers (n = 30) and night shift workers (n = 30). Serum cortisol was measured by electrochemiluminescence immunoassay (ECLIA) method.
Results: One- way ANOVA test revealed a statistically significant difference in mean serum cortisol levels among the three groups ($F = 13.60$, $p < 0.001$). Post-hoc analysis using the Tukey test demonstrated that the mean serum cortisol levels were significantly lower in Group 1 compared to Group 2 ($p = 0.0005$) and Group 3 ($p < 0.001$). Serum cortisol levels showed a significant positive correlation with duration of noise exposure in all the subjects ($r = 0.28$, 95% CI: 0.08-0.45, $p = 0.008$). This dose-response relationship was strongest in Day shift workers ($r = 0.41$, $p = 0.025$) and borderline significant in Night shift workers ($r = 0.35$, $p = 0.056$), but absent in Controls ($r = 0.12$, $p = 0.53$).
Conclusion: Chronic noise exposure in textile mill induces significant Hypothalamic-pituitary-adrenal axis activation ($F=13.60$, $p<0.001$), in which day shift workers show strongest positive correlation with duration of exposure to noise ($r=0.41$).

Keywords: Textile Industry; Hydrocortisone; Occupational Health; Noise, Occupational; Time Factors

INTRODUCTION

Rapid industrialization has emerged as a defining character of modern economic growth. Industries contribute significantly for nation's growth and generate employment opportunities for many people. But despite these advantages, industrial growth results in many disadvantages. Pollutants from industrial operations, like waste and noise, affects human health and the environment. Long term exposure to noise result in hearing loss. Despite this,

growing evidence suggests that noise acts a potent biological stress factor capable of altering homeostasis. Exposure to noise for a chronic period can alter the Hypothalamic-pituitary adrenal axis. [1] Globally, more than 600 million people are exposed to occupational noise above hazardous threshold level. [2]

Noise is considered one of the most common occupational hazards across both developed and developing countries, particularly in manufacturing and industrial sectors. Variations in sound pressure levels (SPL) and duration of exposure have been shown to significantly influence serum cortisol concentrations, supporting the concept that noise-induced stress can be assessed using hormonal biomarkers.[3]

Cortisol is the glucocorticoid secreted from the adrenal cortex. It is a hormone secreted in response to stress. The important function of this hormone includes mobilizing energy, regulating inflammation, and enhancing cognitive processes during stress. Despite these benefits, long term elevation of this hormone can result in harmful effects such as metabolic disorders, cardiovascular diseases and cognitive decline. [4]

Experimental research has demonstrated that even acute exposure to loud occupational noise can lead to measurable physiological changes. Individuals exposed to continuous background noise exceeding 75 dB(A) even for a short period exhibited significantly elevated morning serum cortisol levels, along with disturbances in sleep pattern and cardiovascular parameters. These findings highlight the capacity of noise to provoke a generalized stress response.[5]

Many studies have found that occupational noise exposure results in increased serum cortisol level in the industrial workers. [6][3]

Despite expanding research on occupational noise, data examining hormonal stress responses among textile mill workers remain limited. By measuring the serum cortisol level, the workers who are at risk of developing adverse effects can be identified early and measures can be done to prevent the chronic problems. So, this study was done to evaluate serum cortisol levels and determine their correlation with the duration of noise exposure among textile mill workers.

MATERIALS & METHODS

This cross-sectional study was conducted in Tamil Nadu. The study participants were recruited from an auto loom textile mill. After getting Institutional ethical clearance participants were enrolled in the study and written informed consent was got from all the subjects. The study participants were divided into three groups – Day shift workers, Night shift workers and control. Totally there were 90 participants in the study. Each group had 30 participants. All the workers were working for a 12 hours shift. The working days were 6 days a week. The workers who were working in administration department were included as controls for the study. All the study participants were in the age group of 20 – 50 years. Mextech SL 4012 digital sound level meter was used to measure the noise intensity. The sound pressure levels at administrative department and in the textile, mill were 59 dB (A) and 94 dB (A) respectively. People who were hypertensive, had known hearing impairment, were under medications which alter cortisol function, who were of any endocrine disorders were excluded from the study. The baseline data were collected from the study participants. Then the venous blood was collected and analyzed for serum cortisol concentration. The sample was collected from 7.30 AM to 8.30 AM for the controls and day shift workers and the sample was collected from 7.30 PM to 8.30 PM for the night shift workers. Serum cortisol was separated and analyzed by electrochemiluminescence immunoassay (ECLIA) method using Cobas e 411 immunoassay analyzer.

Statistical Analysis

The data were analyzed using SPSS version 21. The continuous variables were presented as mean $\pm$ Standard deviation. Statistical analysis was performed using one-way

analysis of variance (ANOVA) followed by Tukey's post-hoc test for multiple comparisons. Gender distribution across study groups was compared using a chi-square test of homogeneity. Pearson's correlation was used to find the correlation between the variables. A p value less than 0.05 was considered statistically significant.

RESULT

In this study, the serum cortisol level was compared between day shift workers, night shift workers and the control group.

Table 1: Baseline Characteristics of participants across the study groups:

Variable	Control (n=30)	Dayshift workers (n=30)	Night shift workers (n=30)	p-value
Age (years) Mean ± SD	35.8 ± 3.9	33.4 ± 7.1	34.6 ± 6.6	0.31 (ANOVA)
Gender, n (%)				0.49 (Chi-sq)
Male	21 (70%)	22 (73.3%)	24 (80%)	
Female	9 (30%)	8 (26.7%)	6 (20%)	

Data presented as mean ± standard deviation (SD) or number (percentage). * p <0.05 was considered statistically significant

Table 1 summarizes baseline characteristics of participants. Age (mean ± SD) was similar across groups: 35.8 ± 3.9 years (Controls), 33.4 ± 7.1 years (Day shift), and 34.6 ± 6.6 years (Night shift) (ANOVA, p = 0.31). No significant differences were found in gender distribution across the three groups (χ^2 (2) = 1.43, p = 0.49), indicating comparable male-to-female ratios as baseline.

Table 2: Intergroup comparison of serum Cortisol levels:

Groups	Serum Cortisol Mean ± SD	F Value	p-value
Controls (n=30)	10.42 ± 3.38	13.60	<0.001*
Dayshift (n=30)	14.79 ± 4.79		
Nightshift (n=30)	15.91 ± 4.62		

Data presented as mean ± standard deviation (SD). * p <0.05 was considered as statistically significant

Table 3: Post- hoc Pairwise Comparison of Serum Cortisol Levels among the study groups using Tukey's HSD test:

Comparison	Mean Difference	p-value	Significance
Control vs Dayshift	4.37	0.0005	Significant
Control vs Nightshift	5.49	<0.001	Significant
Dayshift vs Nightshift	1.12	0.57	Not significant

Table 2 depicts the intergroup comparison of serum cortisol level. One- way ANOVA test revealed a statistically significant difference in mean serum cortisol levels among the three groups (F = 13.60, p <0.001). Post-hoc analysis using the Tukey test demonstrated that mean serum cortisol levels were significantly lower in Group 1 compared to Group 2 (p = 0.0005) and Group 3 (p <0.001). No statistically significant difference was observed between Group 2 and Group 3 (p = 0.57) which is mentioned in table 3.

Table 4: Pearson Correlation Between Serum Cortisol and Duration of noise Exposure

Group	n	r	p-value	95% CI	Interpretation
All study participants	90	0.28	0.008*	0.08 to 0.45	Moderate, Significant
Controls	30	0.12	0.53	-0.23 to 0.43	Weak, non-significant
Dayshift workers	30	0.41	0.025*	0.05 to 0.66	Moderate, Significant
Night shift workers	30	0.35	0.056	-0.01 to 0.62	Moderate, Borderline

Pearson's correlation coefficient (r) between serum cortisol (µg/dL) and duration of noise exposure (years). * p <0.05 considered statistically significant. 95% confidence intervals calculated using Fisher's z-transformation. Correlation strength: |r| < 0.3 = weak, 0.3-0.5 = moderate, >0.5 = strong.

For all subjects, Serum cortisol levels showed a significant positive correlation with duration of noise exposure (r = 0.28, 95% CI: 0.08-0.45, p = 0.008) which is denoted in table 4. This dose-response relationship was strongest in Day shift workers (r = 0.41, p = 0.025) and borderline significant in Night shift workers (r = 0.35, p = 0.056), but absent in Controls (r = 0.12, p = 0.53). These findings reveal that HPA axis is activated with prolonged shift work exposure.

DISCUSSION

In our study, we observed that there is a significant difference in elevation of serum cortisol levels in textile mill workers exposed to chronic noise compared to controls (F = 13.60, p< 0.001), with Day shift (14.79 ± 4.62 µg/dL) and Night shift (15.91 ± 4.92 µg/dL) both significantly higher than controls (10.42 ± 3.58 µg/dL; p < 0.001). Tukey's HSD post-hoc analysis confirmed Controls vs Day shift (mean difference 4.37, p < 0.001) as significant, while Day vs Night shift (1.12, p = 0.57) showed no difference [Table 2, Table 3].

A significant positive correlation between duration of noise exposure and serum cortisol (r = 0.28, p = 0.008) establishes clear dose-response relationship across all subjects, strongest in Day shift workers (r = 0.41, p = 0.025). This pattern aligns with noise-induced HPA axis dysregulation, where prolonged auditory stress provoked disruption in the normal circadian rhythm.

From table 2 it was found that there is comparable cortisol elevation across both shift types (14.8 vs 15.9 µg/dL), which suggests that the effect of noise exposure is more than the effect of circadian rhythm disruption in the textile mill workers. There is no significant difference between day and night shift workers which signifies that there is equivalent HPA burden regardless of timing, contrasting typical shift work studies emphasizing circadian misalignment.

Experimental exposure to high intensity noise of 100 dB(A) on Wistar rats showed elevated plasma cortisol in long time exposure and control groups. This chronic phase elevation of cortisol may be due to stress response through hypothalamic-pituitary-adrenal axis as a result of chronic auditory stimulation by noise. This also causes cellular changes and behavioural changes increasing cortisol secretion. [7][8]

Fe'li et al did a systematic review and found that there is a strong relationship between occupational noise exposure and cortisol hormone elevation. They concluded that noise could be a occupational health concern which should be addressed. [9]

While prior studies have established noise intensity effects on cortisol [3][1][10], to our knowledge, this represents the first demonstration of a dose-response relationship between duration of noise exposure and serum cortisol levels specifically in auto loom textile mill workers (r = 0.28, p = 0.008). The systematic review by Fe'li et al. (2022) identified no studies examining cumulative exposure duration, confirming our findings' novelty and establishing a critical foundation for future occupational health research. [9]

Limitations

The cross-sectional design prevents temporality assessment, as noise exposure duration and cortisol levels were measured simultaneously. Despite, the correlation between duration of exposure and serum cortisol level found positive association, prospective cohort studies should to done to confirm this finding in a larger population. Also, future studies should be done to measure the inflammatory markers like CRP, IL-6 to find the molecular pathways involved in the cortisol elevation, which was found in this study.

CONCLUSION

From this study, it was found that chronic noise exposure in textile mill induces significant Hypothalamic-pituitary-adrenal axis activation (F=13.60, p<0.001), in which day shift workers show strongest positive correlation with duration of exposure to

noise (r=0.41). Tukey's HSD confirms significant elevation of cortisol of 4.37 µg/dL in day shift workers and 5.49 µg/dL in night shift workers, which strongly confirms that there is an urgent need for noise control measures in high-risk industries. Personal protective instruments to reduce the impact of noise like earplugs and earmuffs should be worn by the workers to prevent chronic impact of noise on their health.

Declaration by Authors

Ethical Approval: Approved

Acknowledgement: We acknowledge the participants who participated in this study.

Source of Funding: None

Conflict of Interest: The authors declare no conflict of interest.

REFERENCES

1. Dehaghi BF, Khademian F, Angali KA. Non-auditory effects of industrial chronic noise exposure on workers; change in salivary cortisol pattern. J Prev Med Hyg 2021;61(4): E650–3.
2. Zhao S, He D, Zhang H, et al. Health study of 11,800 workers under occupational noise in Xinjiang. BMC Public Heal 2021;21(1):460.
3. Zare S, Baneshi MR, Hemmatjo R, et al. The Effect of Occupational Noise Exposure on Serum Cortisol Concentration of Night-shift Industrial Workers: A Field Study. Saf Health Work 2019;10(1):109–13.
4. Anliana, Sitorus HP, Silitonga M. The Role of cortisol in the stress response. Int J Ecophysiol 2025;7(1):48–58.
5. Gitanjali B, Ananth R. Effect of Acute Exposure to Loud Occupational Noise during Daytime on the Nocturnal Sleep Architecture, Heart Rate, and Cortisol Secretion in Healthy Volunteers. J Occup Health 2003;45(3):146–52.
6. Naderyan Fe'li S, Monazzam Esmaielpour MR, Hokmabadi R, et al. Effect of occupational noise exposure on cortisol hormone level: A systematic review. Noise Vib Worldw 2022;53(11):579–88.
7. Monsefi M, Bahoddini A, Nazemi S. Effects of Noise Exposure on the Volume of Adrenal Gland and Serum Levels of Cortisol in Rat. Iran J Med Sci 2006; 31:5–8.
8. Özcankaya R, Delibaş N, Doğru H, et al. Comparison of Magnesium and Cortisol Levels in Different Anxiety Degres in Workers At Noisy Environment. Med J Süleyman Demirel Univ 2009;3(3).
9. Naderyan Fe'li S, Monazzam Esmaielpour MR, Hokmabadi R, et al Effect of occupational noise exposure on cortisol hormone level: A systematic review. Noise Vib Worldw 2022;53(11):579–88.
10. Sivakumaran K, Ritonja JA, Waseem H, et al. Impact of Noise Exposure on Risk of Developing Stress-Related Metabolic Effects: A Systematic Review and Meta-Analysis. Noise Health 2022;24(115):230.

How to cite this article: A. Abbas, Leela Priyadharsini Balamurali, Mahalakshmi. M. Correlation between duration of occupational exposure and serum cortisol levels among textile mill workers: a cross-sectional study. *Int J Health Sci Res.* 2026; 16(3):123-127. DOI: *https://doi.org/10.52403/ijhsr.20260315*

******