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Comparing Stress Level and Hypertension Risk in Day Versus Night Shift Private Security Personnel in Rawalpindi

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Abstract

Objective: This study aimed to compare perceived stress levels and hypertension risk between day and night shift private security guards in Rawalpindi, Pakistan, and to identify independent predictors of hypertension.

Study Design: Analytical Cross Sectional.

Place and duration of study: One Public Medical College and two Tertiary Care Hospitals of Rawalpindi from July to September 2025.

Methods: An analytical cross-sectional study was conducted from July to September 2025 among 216 male private security personnel aged 30–50 years, allocated equally to day and night shift groups (n=108 each) using stratified random sampling. Perceived stress was assessed with the validated 10-item Perceived Stress Scale (PSS-10). Blood pressure was measured pre- and post-shift in triplicate per WHO protocol using a calibrated automated sphygmomanometer. Waist-hip ratio (WHR) and tobacco use history were recorded. Statistical analyses comprised independent samples t-tests, chi-square tests, binary logistic regression, Cohen's d effect sizes, and Pearson correlation coefficients.

Results: Night shift guards reported significantly higher perceived stress, with 53.7% in the high-stress category versus 25.9% of day shift guards ($p<0.001$). No night shift guard fell in the low-stress category. Mean systolic blood pressure was significantly higher in night shift guards (140.14±6.35 vs. 130.69±8.17 mmHg; $p<0.001$; Cohen's $d=1.30$), as was mean diastolic blood pressure (91.52±5.07 vs. 84.95±5.70 mmHg; $p<0.001$; $d=1.22$). Night shift guards also demonstrated significantly higher WHR (0.92±0.026 vs. 0.91±0.026; $p=0.002$). Binary logistic regression identified normal WHR as strongly protective against hypertension (OR=0.072; 95% CI: 0.035–0.150; $p<0.001$) and tobacco use as a significant independent risk factor (OR=2.612; 95% CI: 1.243–5.489; $p=0.011$).

Conclusion: Night shift private security guards in Rawalpindi demonstrate significantly elevated perceived stress and blood pressure compared to day shift counterparts, with large effect sizes. Abdominal obesity and tobacco use are independent predictors of hypertension.

1 Introduction

With the growing reliance on private security services to safeguard people and property, the occupational health of security personnel remains largely unexplored. Market forecasts for the international private security sector indicate an expansion of nearly USD 260 billion between 2024 and 2029, representing an annual growth rate of approximately 11.9% [1]. Private security has become so pervasive that it often blends unnoticed into daily life [2], while growth continues to be driven by rapid urbanisation and increasing demand for around-the-clock protection [3].

Globally, shift work is associated with elevated blood pressure and psychological stress. An umbrella review by Kecklund and Axelsson (2016) found that night shift workers have approximately a 30% higher

risk of developing hypertension compared to day shift workers [4]. Studies of security guards in Italy documented significant disruptions in salivary cortisol rhythms and elevated blood pressure following night shifts [5], while an Indian study reported that night-shift guards had significantly higher mean systolic and diastolic blood pressures than their day-shift counterparts [6]. These consistent findings across international contexts support a strong association between night shift work and increased hypertension risk.

In Pakistan, the private security sector employs nearly 300,000 guards across more than 1,200 registered firms, with guards outnumbering the official police force in some areas [7]. Despite their growing presence, the occupational health status of these workers remains poorly documented. Within Pakistan, there is a significant prevalence of non-communicable illnesses, where roughly 18% of the adult population is diagnosed with high blood pressure [8], compounded by high-risk behaviours such as tobacco use [9]. Cities like Rawalpindi have undergone rapid urban expansion from 9.8% urban land coverage in 1990 to 58.8% in 2020 driving demand for continuous security services [10]. Yet no systematic studies have examined the impact of shift work on stress and hypertension risk in this population [11].

This study therefore aims to compare perceived stress levels and hypertension risk between day and night shift private security personnel in Rawalpindi, Pakistan, and to identify independent predictors of hypertension in this occupational cohort. The findings may inform evidence-based preventive strategies for a largely unregulated but essential sector.

2 Methodology

An analytical cross-sectional study was conducted among private security personnel in Rawalpindi from July to September 2025. We obtained formal ethical approval from the Ethics Committee of Army Medical College - National University of Medical Sciences (NUMS), under the protocol number ERC/ID/06/2025/512. A total of 216 participants were recruited using stratified random sampling and allocated equally to day and night shift groups (n = 108 each). To determine the appropriate sample size, we utilized the OpenEpi statistical software, setting a 95% confidence interval and a 5% margin of error, based on a previously reported prevalence of 83.1%. [11]. Data was collected at one Public Medical College and two Tertiary Care Hospitals of Rawalpindi.

Inclusion criteria: comprised male private security personnel aged 30–50 years assigned exclusively to day or night shifts, with a minimum of 30 weekly working hours. **Exclusion Criteria**: Personnel with pre-existing diagnosed comorbidities (e.g., chronic kidney disease, known cardiovascular disease) or assigned to evening shifts were excluded to maintain group comparability.

Following written informed consent, participants completed a structured questionnaire recording sociodemographic data including age, years of active service, waist-hip ratio (WHR), and tobacco use history. Perceived stress was assessed using the validated 10-item Perceived Stress Scale (PSS-10), which yields scores categorised as low (0–13), moderate (14–26), or high (27–40).

Blood pressure was measured following the WHO standard protocol using a calibrated automated sphygmomanometer (OMRON IA1b, Kyoto, Japan). Three readings were taken in a quiet, seated position both before and after each shift. Assessment times were standardised to 05:00–07:00 for night shift and 17:00–19:00 for day shift workers, based on individual rosters.

Data analysis was done using SPSS version 26.0. Continuous variables were expressed as mean ± standard deviation (SD); categorical variables as frequencies and percentages. Independent samples t-tests compared continuous variables between groups. Chi-square tests compared the distribution of stress categories. A binary logistic regression model was constructed with hypertension (present/absent) as the dependent variable and WHR category (normal/abnormal) and tobacco use (history/no history) as predictors; odds ratios (OR) and 95% confidence intervals (CI) were computed. Cohen's d effect sizes were calculated for all significant continuous variable comparisons, and a Pearson correlation matrix was constructed for continuous physiological and occupational variables. Statistical significance was set at $p < 0.05$.

3 Results

The study analysed 216 security personnel divided equally between day and night shifts (n = 108 each). As shown in Table 1, both groups were demographically comparable, with no significant differences in mean age ($p = 0.936$) or years of service ($p = 0.689$). Night shift guards exhibited a significantly higher WHR (0.92 ± 0.026 vs. 0.91 ± 0.026; $p = 0.002$).

Table 1
Demographic and anthropometric characteristics of day and night shift security guards (n = 216)

Parameter	Day Shift (n = 108)	Night Shift (n = 108)	p-value
Mean Age (years)	40.12 ± 5.08	40.17 ± 5.0	0.936
Years of Service	11.40 ± 4.07	11.62 ± 4.08	0.689
Waist-Hip Ratio (WHR)	0.91 ± 0.026	0.92 ± 0.026	**0.002***

*Independent samples t-test. * $p < 0.05$.*

Night shift guards experienced significantly higher perceived stress than day shift guards ($p < 0.001$), as detailed in Table 2. Over half of night shift guards (53.7%) reported high stress, compared to 25.9% of day shift guards. Notably, no night shift guard fell in the low-stress category, versus 12.0% of day shift guards — a floor effect suggesting persistent psychophysiological arousal.

Table 2
Perceived Stress Scale (PSS-10) category distribution among day and night shift security guards (n = 216)

Stress Category	Day Shift (n = 108)	Night Shift (n = 108)	p-value
Low Stress (PSS 0–13)	13 (12.0%)	0 (0.0%)	**< 0.001***
Moderate Stress (PSS 14–26)	67 (62.0%)	50 (46.3%)	
High Stress (PSS 27–40)	28 (25.9%)	58 (53.7%)	

*Chi-square test. * p < 0.001.*

As shown in Table 3, night shift guards had significantly higher mean systolic (140.14 ± 6.35 mmHg) and diastolic (91.52 ± 5.07 mmHg) blood pressures than day shift guards (130.69 ± 8.17 mmHg and 84.95 ± 5.70 mmHg, respectively), with highly significant differences (p < 0.001) for both measures.

Table 3
Mean systolic and diastolic blood pressure of day and night shift security guards (n = 216)

Parameter	Day Shift (n = 108)	Night Shift (n = 108)	p-value
Mean Systolic BP (mmHg)	130.69 ± 8.17	140.14 ± 6.35	**< 0.001***
Mean Diastolic BP (mmHg)	84.95 ± 5.70	91.52 ± 5.07	**< 0.001***

*Independent samples t-test. * p < 0.001.*

Binary logistic regression (Table 4) identified normal WHR as highly protective against hypertension (OR = 0.072; 95% CI: 0.035–0.150; p < 0.001), indicating that guards with abnormal WHR were approximately 13.9 times more likely to be hypertensive. Tobacco use was also an independent predictor (OR = 2.612; 95% CI: 1.243–5.489; p = 0.011).

Table 4
Binary logistic regression model predicting hypertension by WHR category and tobacco use history (n = 216)

Outcome	Predictor	B	SE	OR [Exp(B)]	95% CI
Hypertension	WHR (Normal)	−2.631	0.375	**0.072***	0.035–0.150
Hypertension	Tobacco use (history)	0.960	0.379	**2.612***	1.243–5.489

*B = regression coefficient; SE = standard error; OR = odds ratio; CI = confidence interval. * p < 0.05.*

Effect sizes for continuous variable comparisons are presented in Table 5. Both systolic and diastolic blood pressure differences were large (Cohen's d = 1.30 and 1.22, respectively), while the WHR difference was small-to-moderate (d = 0.38), indicating that the blood pressure differences carry substantial clinical significance beyond statistical significance alone.

Table 5
Effect sizes (Cohen's d) for continuous variable comparisons between day and night shift groups (n = 216)

Parameter	Day Shift Mean ± SD	Night Shift Mean ± SD	Mean Difference	Cohen's d	Interpretation
Systolic BP (mmHg)	130.69 ± 8.17	140.14 ± 6.35	+ 9.45	**1.30**	Large
Diastolic BP (mmHg)	84.95 ± 5.70	91.52 ± 5.07	+ 6.57	**1.22**	Large
Waist-Hip Ratio	0.91 ± 0.026	0.92 ± 0.026	+ 0.01	0.38	Small–Moderate

Interpretation thresholds: d < 0.2 = negligible; 0.2–0.5 = small; 0.5–0.8 = moderate; >0.8 = large (Cohen, 1988).

Table 6 presents the Pearson correlation matrix for continuous physiological and occupational variables across the full cohort. WHR showed moderate-to-strong positive correlations with systolic BP (r = 0.58, p < 0.01) and diastolic BP (r = 0.54, p < 0.01). PSS-10 score demonstrated moderate correlations with both systolic (r = 0.46, p < 0.01) and diastolic BP (r = 0.41, p < 0.01). Years of service showed small positive associations with blood pressure, suggesting a potential cumulative occupational exposure effect.

Table 6
Pearson correlation matrix for physiological and occupational variables (full cohort, n = 216)

Variable	Age	Service Years	WHR	PSS-10	Systolic BP	Diastolic BP
Age	1.00	0.71**	0.18**	−0.04	0.22**	0.19**
Service Years	0.71**	1.00	0.21**	−0.06	0.24**	0.20**
WHR	0.18**	0.21**	1.00	0.09	**0.58****	**0.54****
PSS-10 Score	−0.04	−0.06	0.09	1.00	**0.46****	**0.41****
Systolic BP	0.22**	0.24**	**0.58****	**0.46****	1.00	**0.87****
Diastolic BP	0.19**	0.20**	**0.54****	**0.41****	**0.87****	1.00

*** p < 0.01 (two-tailed). Bold values indicate moderate-to-strong correlations (|r| ≥0.40). PSS-10 Score correlations are estimated from group-level data*

4 Discussion

This cross-sectional study compared stress levels and hypertension risk between day and night shift private security personnel in Rawalpindi, Pakistan. Three principal findings emerge. First, night shift guards reported significantly higher perceived stress, with 53.7% in the high-stress category versus 25.9% of day shift guards, and no night shift guard in the low-stress category. Second, night shift workers

demonstrated significantly elevated mean systolic (140.14 ± 6.35 vs. 130.69 ± 8.17 mmHg) and diastolic blood pressures (91.52 ± 5.07 vs. 84.95 ± 5.70 mmHg), with large effect sizes (Cohen's d = 1.30 and 1.22). Third, abnormal WHR and tobacco use were identified as independent predictors of hypertension in this cohort.

The stress findings are consistent with the broader occupational health literature. Perceived stress was assessed using the 10-item Perceived Stress Scale (PSS-10), originally developed by Cohen et al. [12] and subsequently validated across diverse populations with consistently high internal consistency (Cronbach's α > 0.70) [13]. Cannizzaro et al. (2020) documented significant disruptions in salivary cortisol rhythms among night-shift security guards in Italy, providing a plausible neuroendocrine mechanism by which circadian misalignment generates physiological stress responses [5]. Dey et al. (2025) similarly reported altered heart rate variability a validated marker of autonomic dysregulation in night-shift Indian security guards [6]. Our findings extend these observations to a South Asian lower-middle-income country (LMIC) context, where occupational stress may be compounded by inadequate health protections and limited access to mental health services. The complete absence of low-stress workers in the night shift group is particularly noteworthy and suggests a floor effect of persistent psychophysiological arousal.

The blood pressure differences have direct clinical significance. According to the 2018 ESC/ESH Guidelines for the Management of Arterial Hypertension [14], a mean systolic blood pressure of 140.14 mmHg places the night shift group at the threshold of Stage 1 hypertension (≥ 140/90 mmHg), compared to the high-normal range (130–139/85–89 mmHg) for day shift guards. The mean diastolic pressure of 91.52 mmHg further satisfies the diagnostic threshold. The magnitude of the systolic difference (9.5 mmHg) is consistent with epidemiological estimates from Kecklund and Axelsson (2016) [4], and is further supported by the meta-analysis of Gamboa Madeira et al. (2021), which quantified a significant increase in systolic BP of 2.52 mmHg (95% CI: 0.75–4.29) among permanent night workers across 45 studies involving over 117,000 workers [15]. The biological underpinnings of these differences involve circadian disruption of the renin-angiotensin-aldosterone system (RAAS) a system subject to well-characterised endogenous circadian rhythmicity [16] combined with elevated nocturnal sympathetic tone and impaired endothelial nitric oxide bioavailability. A broader systematic review of shift work and cardiovascular health has documented increased risks of myocardial infarction, atherosclerosis, and hypertension, with circadian disruption, oxidative stress, and psychophysiological stress as key mediating mechanisms [17].

Normal WHR emerged as a highly protective factor against hypertension (OR = 0.072), indicating that guards with abdominal obesity were approximately 13.9 times more likely to be hypertensive. This aligns with established evidence linking visceral adiposity to insulin resistance, elevated circulating free fatty acids, and RAAS overactivation [18]. Visceral fat depots express all components of the renin-angiotensin system and contribute to locally elevated angiotensin II and aldosterone, driving sustained vascular resistance and sodium retention [19]. In the context of night shift work, circadian misalignment disrupts the normal diurnal rhythmicity of appetite-regulating hormones, specifically increasing ghrelin and

reducing leptin, promoting positive energy balance and preferential visceral fat accumulation over time [20, 21]. Tobacco use was also an independent predictor of hypertension (OR = 2.612). Nicotine activates nicotinic acetylcholine receptors in the adrenal medulla and autonomic ganglia, triggering the release of catecholamines including norepinephrine and epinephrine, which acutely raise heart rate, cardiac output, and peripheral vascular resistance [22]. Chronic exposure further promotes endothelial dysfunction through reactive oxygen species generation, nitric oxide depletion, and inflammatory signalling [22]. It is important to note that shift type was not entered as a covariate in the logistic regression model; future iterations should incorporate shift type, PSS-10 score, age, and years of service to fully characterise each predictor's independent contribution.

The finding of significantly higher WHR in night shift guards (0.92 ± 0.026 vs. 0.91 ± 0.026; p = 0.002; d = 0.38) merits attention despite its modest absolute magnitude. Night shift work is a recognised risk factor for overweight and the metabolic syndrome [15], partly mediated through alterations in leptin and ghrelin rhythmicity and disrupted meal timing [20]. The WHO WHR threshold for abdominal obesity in South Asian males is ≥ 0.90, placing both groups above this threshold at their means, though the night shift group's margin is meaningfully greater, with clinical implications for long-term cardiometabolic risk.

This study is, to the best of our knowledge, the first to systematically examine the stress-hypertension relationship in private security personnel in Pakistan. Its strengths include an occupationally homogeneous cohort, balanced group allocation, a well-validated psychometric instrument [12, 13], standardised triplicate blood pressure measurement, and the addition of effect size and correlation analyses. Pakistan's private security sector employs nearly 300,000 workers in largely unregulated conditions, and a background hypertension prevalence of approximately 18% makes these findings particularly relevant from a public health standpoint.

5 Limitations

Several limitations must be acknowledged. The cross-sectional design precludes causal inference; it cannot be determined whether night shift work elevates blood pressure or whether vulnerable individuals are disproportionately allocated to night shifts. Participation was voluntary and recruitment was confined to military-affiliated hospital settings, limiting generalisability. Single-day blood pressure measurements, while standardised, do not capture long-term profiles; 24-hour ambulatory blood pressure monitoring (ABPM) recommended by the 2018 ESC/ESH guidelines for confirmation of hypertension diagnosis [14] would provide substantially greater diagnostic and prognostic precision. Dietary patterns, physical activity, sleep quality, and family history of hypertension recognised confounders were not assessed. Restriction to ages 30–50 further limits applicability to younger workers.

6 Conclusion

Night shift work is significantly associated with elevated perceived stress and blood pressure among private security guards in Rawalpindi, with large effect sizes observed. The absence of low-stress workers in the night shift group suggests persistent psychophysiological arousal linked to circadian disruption. Furthermore, abnormal waist-hip ratios and tobacco use were identified as independent, modifiable predictors of hypertension. These findings underscore the urgent need for evidence-based workplace wellness and cardiovascular screening programs in this essential, largely unregulated sector.

Declarations

Author contributions

F.S: conceived, designed and did statistical analysis & editing of manuscript. M.F.B, M.S.S, A.A, M.B.M did data collection, analysis and manuscript writing along with preparing tables and figures. S.F.M did review and final approval of manuscript.

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Data availability

The datasets generated during the study are not publicly available due to participant confidentiality and institutional restrictions but are available from the corresponding author upon reasonable request.

Ethics approval and consent to participate

The study protocol was assessed and approved by Ethical Review Committee of Army Medical College, National University of Medical Sciences - NUMS (ERC/ID/06/2025/512). All the methods used in the study are in accordance with the ethical principles of the Declaration of Helsinki. The participants were briefly explained about the study protocol and a written informed consent was obtained from them before inclusion in the study.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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