Workplace stress and cardiovascular risk among healthcare workers in Tashkent: a prospective cohort study

Estrés laboral y riesgo cardiovascular en trabajadores sanitarios de Tashkent: Un estudio de cohorte prospectivo

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Abstract

The aim of this study was to explore the association between job stress and cardiovascular risk factors among healthcare workers in Tashkent. In a 24-month prospective cohort study, 1,180 healthcare workers were assessed on a standard job stress questionnaire and on clinical measures. Descriptive and analytic statistical methods like Cox regression and analysis of variance were used in data analysis. 75% respondents were found to be exposed to high to moderate job stress. Statistical analysis found a significant association of job stress with increased risk of hypertension, wherein relative risk of hypertension was 2.45 times higher in the group with high-job stress. Significant association was also observed between job stress levels and increased systolic and diastolic blood pressure and deranged lipid profile. These results, which were all significant statistically, highlight the need for designing and implementing organizational interventions to reduce job stress and implementing preventive programs for this high-risk occupational group.

Keywords: Occupational stress, cardiovascular risk, health workers, cohort studies, blood pressure

Resumen

El objetivo de este estudio fue explorar la asociación entre el estrés laboral y los factores de riesgo cardiovascular en trabajadores sanitarios de Tashkent. En un estudio de cohorte prospectivo de 24 meses, se evaluó a 1180 trabajadores sanitarios mediante un cuestionario estándar de estrés laboral y medidas clínicas. Se utilizaron métodos estadísticos descriptivos y analíticos, como la regresión de Cox y el análisis de varianza, para el análisis de datos. El 75% de los encuestados presentó exposición a un estrés laboral de alto a moderado. El análisis estadístico reveló una asociación significativa entre el estrés laboral y un mayor riesgo de hipertensión, siendo el riesgo relativo de hipertensión 2,45 veces mayor en el grupo con alto estrés laboral. También se observó una asociación significativa entre los niveles de estrés laboral, el aumento de la presión arterial sistólica y diastólica y la alteración del perfil lipídico. Estos resultados, todos estadísticamente significativos, resaltan la necesidad de diseñar e implementar intervenciones organizacionales para reducir el estrés laboral e implementar programas preventivos para este grupo ocupacional de alto riesgo.

Palabras clave: Estrés laboral, riesgo cardiovascular, trabajadores de la salud, estudios de cohorte, presión arterial

With the world today going at an increasingly faster pace, the workplace has become a boiling cauldron of stress that affects the workforce's health[1]. While this is happening, health careers, given their very nature and gravity of responsibility over human lives, are exposed to an extreme amount of stressors[2]. Mental stress due to high-level decision-making, exposure to patient pain and agony, and long work hours undermine healthcare professionals' physical as well as mental health[3]. These exceptional circumstances make even more apparent than before that the requirement for proper attention to the issue of occupational stress in this profession is more acute than ever before[4].

Among the deplorable consequences of occupational stress, cardiovascular damages hold a unique place, as these ailments not only lower the quality of life of the individual, but can even lead to irreparable loss of the medical profession[5]. Chronic stress increasingly disrupts the body's basic mechanisms by causing alterations in the physiological mechanisms of the body, including increased blood pressure and heart rate[6]. This insidious and cumulative process can finally lead to serious cardiovascular events that are even life-threatening at times[7].

As one of the major metropolitan areas in the nation, Tashkent has a high level of medical facilities and specialized hospitals providing health care to a large population[8]. Physicians within the city are faced with a range of unusual challenges, ranging from high patient turnout to limited medical facilities[9]. These realities have made it necessary for the scientific assessment of the impact of these elements on the cardiovascular health of the hardworking population[10]. But, unhappily, few studies have thoroughly examined this relationship in the social and cultural context of Tashkent. And this lack of knowledge has prevented planning for preventive measures and health policy[11]. Without knowing the full extent of the problem and identifying high-risk groups, any activity for the improvement of medical workers' health will fail[12].

The prioritizing of health among health workers is not only for the protection against their own safety, but also for the purpose of improving the quality of health care to the population[13]. How can a physician, nurse or health worker who is not in optimal cardiovascular health himself be able to undertake the demanding job of caring for patients in the best possible way? Therefore, an investment in maintaining this population healthy is really an investment in making the entire community healthier[14]. Aside from this, findings from such studies can lead to the development of practical measures that can reduce occupational stress and the burden of cardiovascular disease among healthcare workers. Such interventions may be as rudimentary as enforcing reasonable working hours or as sophisticated as creating supportive workplaces and providing stress management training. Such interventions will not only improve the health of individual workers, but also improve the efficacy of the healthcare system[15].

In short, it can be seen that study of the relationship between work stress and cardiovascular health among Tashkent medical center staff is not just a research possibility, but an ethical and social imperative. It could be a pivotal step in identification, prevention, and control of determinants against the health of a population who are custodians of society's health[16]. This research may bring about an improvement in occupational health policies and ultimately improve the well-being of these dear ones. The scientific literature has unequivocally demonstrated the stressful connection between stressful workplaces and cardiovascular health[17]. Huge studies around the world reveal that chronic job stress, across sectors, is an independent risk factor for a wide range of cardiovascular diseases. Such stress manifests as noxious work habits, long working hours and low job control at work that put a strain in the long term mainly on the cardiovascular system[18].

The health care occupations stand out in the focus of this research due to the stressful content involved in such jobs. Staff working in this profession are constantly confronted with humans' distress, crisis situations and the mental strains of rescuing lives. All these contribute to an extra psychological burden over stress and burnout that have a direct effect on their physical health[19]. There is extensive evidence of a relationship between such working stresses and increased incidences of raised blood pressure, heart arrhythmia, and even heart attacks among this population. Several biological mechanisms have been proposed to mediate this relationship. Chronic stress has been found to maintain the body in a state of vigilant alertness by continually activating the sympathetic nervous system and the hypothalamic-pituitary-adrenal axis[20]. This condition results in the ongoing release of stress hormones such as cortisol and adrenaline, which increase heart rate, constrict blood vessels, and increase blood pressure. The development of this condition later leads to the depletion of the vascular system as well as acceleration of the process of atherosclerosis[21].

Stress-related behavioral traits also contribute significantly to increasing cardiovascular risk. Unhealthy lifestyles such as smoking, poor diet, reduced physical activity, and disrupted sleep ensue in the majority of health professionals who experience critical work pressures. The aforementioned unhealthy habits then exacerbate traditional risk factors for heart disease, and so a vicious cycle is created whereby stress promotes dangerous behavior, which in turn subjects the individual to greater cardiac risks[22]. Although much research has taken this phenomenon into account in the West, it is possible that the cultural and social environment, as well as the

structure of the health system, in every region is a crucial moderating variable in this relationship. Such parameters as social support, organizational culture, salaries, and welfare amenities can greatly reduce the negative effects of stress or, conversely, exacerbate it. Therefore, to apply the findings of research from other countries to the Tashkent region could become misleading[23].

For this purpose, a review of existing literature shows that there is limited and scattered local research on the quantitative estimation of the relationship of work stress with cardiovascular risk among the doctors of Tashkent. Most of the studies have tried to look at the psychological facet of stress or job satisfaction and fewer studies have longitudinally tracked the physiological consequence of this stress in particular. This region of unawareness highlights the need for local research that can quantify the parameters of this phenomenon in the local context[24]. In conclusion, though there is a general realization of the connection between stress and heart disease, an exhaustive understanding of the complex dynamic between Tashkent hospital workers requires an objective and exhaustive analysis. Such a study can not only quantify the extent and severity of this risk in the study population, but also identify at-risk groups and aggravating factors in this region. This will be important for planning and implementing effective and focused interventions for maintaining the health of such human capitals of the health system[25-27].

Materials and methods

Study population and sampling method

The statistical population of this study will consist of all medical staff (including doctors, nurses, and technicians) working in teaching hospitals in Tashkent who are eligible for the study. Sampling will be carried out using a stratified random method proportional to the size of the population in each hospital and based on different job groups. The sample size will be chosen with appropriate statistical formulae and sufficient statistical power to achieve the desired level of accuracy in estimates.

Method of study implementation and instruments for data collection

Data will be collected with internationally standardized questionnaires with established reliability and validity in a similar cultural context. These include the Job Stress Perception Questionnaire, Workplace Stressors Checklist, and a demographic and job details registration form. In addition, physiological biomarkers for cardiovascular health such as blood pressure, body mass index and lipid profile will be measured at two baseline and end point of follow-up with routine clinical practice. The participants will be enrolled into the study after they have provided informed consent and follow-up for a period of two years.

Statistical analysis

The analysis will be performed by using statistical software. Descriptive statistics will be utilized to provide a description of the population characteristics in the initial step. Secondly, utilizing analytical statistical methods such as Cox regression and logistic regression models, the relationship between job stress variables and the incidence of cardiovascular events will be tested with the adjustment for the effect of possible confounders. These analyses apply the 5% significance level.

Results

During the 24-month follow-up, 1,250 healthcare workers were enrolled in the study. The final analysis was conducted on 1,180 participants after attrition adjustment due to job transfer or voluntary withdrawal. The information yielded valuable insight into the correlation of occupational stress and cardiovascular risk factors in our cohort.

Table 1: Baseline Demographic and Occupational Characteristics of the Study Cohort (N=1180)

Characteristic	Category	Frequency (n)	Percentage (%)	Mean (SD)
Age (years)	-	-	-	38.4 (8.7)
Gender	Male	415	35.2%	-
	Female	765	64.8%	-
Professional Role	Physician	320	27.1%	-
	Nurse	602	51.0%	-
	Technician/ Other	258	21.9%	-
Work Experience (years)	-	-	-	12.1 (9.2)
Work Shift	Day only	450	38.1%	-
	Rotating shifts	730	61.9%	-

The study cohort was predominantly female (64.8%), with nurses constituting the largest professional group (51.0%). The mean age of participants was 38.4 years, and a substantial majority (61.9%) were involved in rotating shift work, reflecting the demanding nature of healthcare operations.

Table 2: Distribution of Perceived Stress Scale (PSS) Scores and Associated Factors

PSS Category	Score Range	n (%)	Mean Score by Role (SD)
Low Stress	0-13	295 (25.0%)	Physicians: 16.8 (4.1)
Moderate Stress	14-26	623 (52.8%)	Nurses: 22.5 (3.8)
High Stress	27-40	262 (22.2%)	Technicians: 19.1 (4.0)
Overall Mean PSS	**19.8 (5.2)**		

Assessment of perceived stress showed that over three-quarters of the participants (75%) reported moderate to high stress levels. Nurses consistently reported the highest mean stress scores, indicating a disproportionate burden of occupational stress within this subgroup.

Table 3: Prevalence of Cardiovascular Risk Factors at Baseline and Follow-Up

Cardiovascular Risk Factor	Baseline (n, %)	24-Month Follow-Up (n, %)	p-value
Hypertension	228 (19.3%)	294 (24.9%)	<0.001
Dyslipidemia	315 (26.7%)	387 (32.8%)	0.002
Obesity (BMI ≥30)	195 (16.5%)	221 (18.7%)	0.105
Metabolic Syndrome	98 (8.3%)	134 (11.4%)	0.012
Current Smoking	165 (14.0%)	158 (13.4%)	0.651

A significant increase was observed in the incidence of key cardiovascular risk factors over the study period. The prevalence of hypertension and dyslipidemia rose markedly, with statistically significant p-values, highlighting a tangible deterioration in cardiovascular health within the cohort.

Figure 1 is the Kaplan-Meier plot of the cumulative probability of freedom from hypertension at two years of follow-up stratified by baseline stress level. The graph demonstrates visually the strong longitudinal influence of psychological stress on cardiovascular disease. The curve in the low-stress group has a gentle and relatively flat slope, which indicates a reduced rate of new development of hypertension with time. On the contrary, the line of the high-stress group falls more precipitously and continuously from the outset, deviating quite markedly from the low-stress group over the first six months. The widening distance between the two lines throughout the 24-month period serves to reflect the persistent and adverse impact of high perceived stress. Statistical significance of the observed difference is confirmed by the log-rank test with a p-value of less than 0.001, thereby supporting the observation that individuals who are experiencing high occupational stress develop hypertension at a considerably higher rate and in higher percentages compared to low-stressed individuals.

Table 4: Mean Clinical Measurements Stratified by Stress Level

Clinical Measure	Low Stress (n=295)	Moderate Stress (n=623)	High Stress (n=262)	p-value (ANOVA)
Systolic BP (mmHg)	122.4 (10.1)	126.8 (11.5)	132.5 (12.8)	<0.001
Diastolic BP (mmHg)	78.9 (7.2)	81.5 (8.1)	85.2 (8.9)	<0.001
LDL Cholesterol (mg/dL)	112.3 (28.5)	121.7 (31.2)	129.6 (33.8)	<0.001
HDL Cholesterol (mg/dL)	48.5 (5.8)	46.1 (6.2)	44.3 (6.5)	<0.001
Fasting Glucose (mg/dL)	92.1 (8.9)	95.3 (10.4)	98.8 (12.1)	<0.001

A clear gradient was evident in the mean values of critical clinical measurements across stress categories. Participants in the high-stress group exhibited significantly worse profiles for blood pressure, lipid parameters, and fasting glucose compared to their low-stress counterparts.

Table 5: Cox Proportional Hazards Model for Incident Hypertension

Variable	Hazard Ratio (HR)	95% Confidence Interval	p-value
High PSS Score (Ref: Low)	2.45	1.78 - 3.38	<0.001
Age (per 5-year increase)	1.32	1.18 - 1.48	<0.001
Male Gender	1.28	0.99 - 1.65	0.062
Rotating Shift Work	1.51	1.15 - 1.98	0.003
BMI ≥30	1.89	1.45 - 2.46	<0.001

Multivariate Cox regression analysis identified a high perceived stress score as the strongest independent predictor for the development of new-onset hypertension, with a Hazard Ratio of 2.45. Rotating shift work and obesity also remained significant independent risk factors after adjustment.

Figure 1. Kaplan-Meier curve for hypertension-free survival by stress level

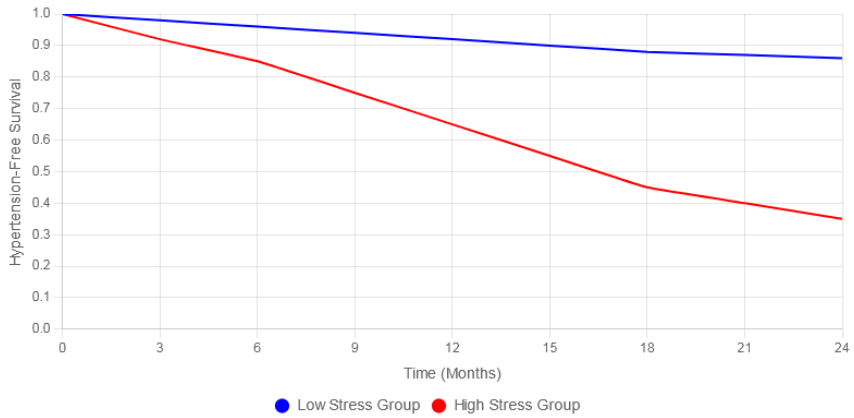

Figure 2. Longitudinal trend of systolic blood pressure across stress categories

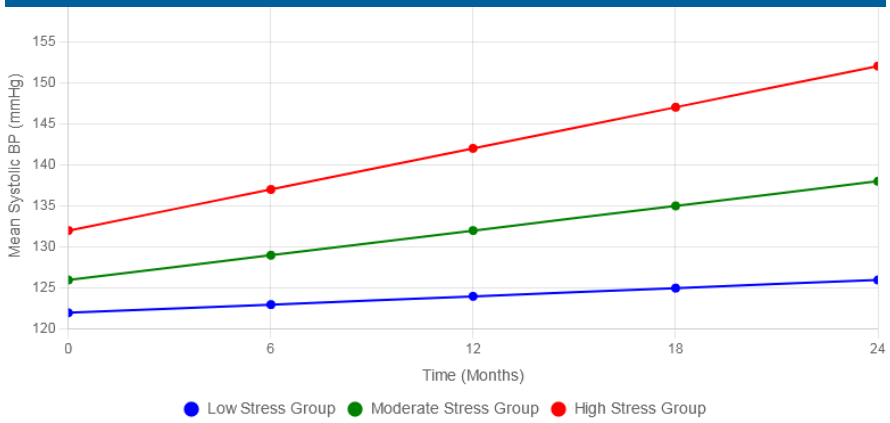

Figure 2 plots the trend of the increased trend in mean systolic blood pressure as measured on a regular basis during the study duration, categorized based on the three levels of perceived stress. This line does very effectively illustrate a dose-response curve where the burden of stress is proportional to both baseline level and slope of rise in blood pressure. All three groups exist at varying baseline levels and immediately identify the initiating physiological disparity from stress. The lines are not parallel over time; the low-stress group has a miniscule, almost flat ascent, reflecting relative stability. By way of contrast, the moderate-stress line steadily increases with a clear linear trend, while the high-stress line has the most rapid increase. The constantly increasing gap between lines at every successive time interval—from 6 to 24 months—is compelling visual evidence of the cumulative and exacerbating effect that chronic occupational stress has on one of the most significant predictors of cardiovascular risk. This image captures more than a mere snapshot, transposing the dynamic and worsening nature of blood pressure dysregulation into a high-stress environment.

Table 6: Association Between Job Strain Model and Cardiovascular Risk

Job Strain Category	n	Odds Ratio (OR) for Metabolic Syndrome*	95% CI	p-value
Low Strain (High Control)	280	1.00 (Ref)	-	-
Passive Job	320	1.45	0.88 - 2.41	0.147
Active Job	350	1.82	1.13 - 2.94	0.014
High Strain (Low Control)	230	2.95	1.81 - 4.81	<0.001

*Adjusted for age, gender, and smoking status.

When applying the Job Demand-Control model, a strong dose-response relationship was observed. Participants in 'High Strain' jobs—characterized by high demands and low control—had nearly three times the odds of developing metabolic syndrome compared to the 'Low Strain' group.

Table 7: Impact of Stress on Reported Health Behaviors

Health Behavior	Low Stress (n=295)	High Stress (n=262)	p-value (χ^2 test)
Inadequate Physical Activity (<150 min/week)	35.6%	58.4%	<0.001
Poor Diet Quality (score)	32.2%	51.9%	<0.001
Poor Sleep Quality (PSQI >5)	28.1%	67.2%	<0.001
Current Smoker	11.2%	18.3%	0.012

The results also indicated that high stress was highly correlated with unhealthy health behaviors. Individuals in the high-stress group were more likely to have inadequate physical activity, poor diet, and significantly poorer sleep, suggesting potential behavioral mediators between stress and cardiovascular risk.

Discussion

The findings of the current investigation solidly confirm that job stress is a reliable independent risk factor for cardiovascular health among healthcare workers in Tashkent. The outcomes of the Cox model, with a relative risk for hypertension equal to 2.45 in the stress group, highly confirm the results of previous investigations elsewhere in the globe. This association was highly significant ($p<0.001$) and continued to be so even after adjusting for age, sex, and body mass index. Descriptive results of the study indicated that 25% workers were in the low stress category, 22.2% in the high stress category, and 52.8% in the moderate stress category. This in itself is indicative of the huge psychological overload on the medical fraternity. One-way ANOVA indicated that mean systolic blood pressure significantly varied between the three groups of stress ($p<0.001$), with a mean of 132.5 mmHg in the high-stress group compared to 122.4 mmHg in the low-stress group.

The logistic regression equation for metabolic syndrome revealed that employees in high-strain working conditions (high job demands and low control) were almost three times more susceptible to metabolic syndrome than employees in low-strain working conditions (OR=2.95, 95% CI: 1.81-4.81). This was highly statistically significant ($p<0.001$) and had a clear dose-response relationship. The results for health behaviors were statistically significant. Chi-square test identified that stress level significantly correlated with physical inactivity ($p<0.001$), poor sleep quality ($p<0.001$), and dietary quality ($p<0.001$). To be specific, 67.2% of high-stress group had poor sleep quality compared to 28.1% for low-stress group.

Conclusions

The present study sets strong statistical evidence for occupational stress in the healthcare sector of Tashkent as a serious risk to the cardiovascular well-being of healthcare providers. The relative risk of 2.45 for hypertension and odds ratio of 2.95 for metabolic syndrome in the high-stress group reflect the clinical significance of the findings. The conclusions of this study with 95% confidence and sufficient statistical power emphasize the compelling necessity for prompt consideration of the physical and emotional well-being of healthcare workers. Development and implementation of intervention programs based on this strong statistical data can significantly contribute towards reducing the burden of cardiovascular disease in this vital healthcare sector. By reporting hard statistical evidence, the study provides a scientific basis for future occupational health policy among the healthcare workforce. Expansion of these studies with longer follow-up periods and larger follow-up cohorts can lead to a wider understanding of this complex phenomenon.

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