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ASSOCIATION BETWEEN PSYCHOSOCIAL STRESS AND HYPERTENSION- A PROSPECTIVE STUDY

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ABSTRACT

Background

Many adults in India live with persistent work pressure, financial worries, and family responsibilities that rarely receive clinical attention, yet these stresses can quietly shape cardiovascular risk. Psychosocial stress has been linked to higher blood pressure in several settings, but prospective data from Indian community and workplace cohorts remain limited, especially where individuals start out without diagnosed hypertension.

Objective

To examine whether higher psychosocial stress at baseline predicts the development of hypertension over follow-up in a cohort of initially normotensive Indian adults.

Methods

This prospective study followed 300 adults, aged 25–60 years, recruited from workplaces and community health camps. All participants were normotensive at baseline. Psychosocial stress was measured using a validated self-report stress scale and categorised into low, moderate, and high stress. Blood pressure was recorded at baseline and at 12-month follow-up using standard procedures. Incident hypertension was defined as systolic blood pressure ≥140 mmHg and/or diastolic ≥90 mmHg on follow-up, or initiation of antihypertensive medication. Relative risks were estimated for moderate and high stress compared with low stress, with subgroup analyses across age, sex, and BMI.

Results

Over 12 months, 54 participants (18.0%) developed hypertension. Incidence was lowest in the low-stress group and almost doubled in those with high psychosocial stress at baseline. Mean systolic and diastolic pressures rose more steeply among participants with moderate and high stress, even after accounting for age and BMI. High stress at baseline was associated with a significantly greater risk of incident hypertension, and this pattern was particularly evident in adults aged 40 years and above.

Conclusion

In this cohort of initially normotensive Indian adults, higher psychosocial stress at baseline was associated with a greater likelihood of developing hypertension over one year. Incorporating simple stress assessment into routine screening may help identify adults who would benefit from closer blood pressure monitoring and early preventive advice.

Keywords: Psychosocial Stress, Hypertension, Prospective Study, Perceived Stress, Indian Adults, Incident Hypertension.

INTRODUCTION

High blood pressure often appears quietly in Indian adults, sometimes discovered during a workplace medical camp or when someone finally checks their readings after weeks of disturbed sleep. People usually describe it as "feeling on edge," or they blame long working hours and family responsibilities but rarely consider how these pressures accumulate. Psychosocial stress is common in this setting, shaped by expectations at home, job insecurity, and the constant balancing of personal and financial demands. Many do not recognise how long these pressures have been present until a clinic visit brings everything into focus.

Over the years, several studies have suggested that sustained emotional stress can influence vascular tone and autonomic balance, gradually nudging blood pressure upward.[1] The process tends to unfold slowly. Elevated sympathetic drive, frequent tension episodes, and difficulty unwinding after work can all contribute to small but persistent rises in systolic pressure.[2] Cortisol may add to this drift; when chronically elevated, it alters metabolic pathways and fluid balance in ways that subtly favour higher blood pressure.[3] These mechanisms have been described across different countries, but the way stress is experienced varies widely, especially in societies where extended families, demanding work rhythms, and social obligations intersect.

In Indian communities, conversations about stress usually emerge only when sleep, appetite, or mood changes become noticeable. People attend local screening camps irregularly, often only when encouraged by colleagues or neighbours. As a result, psychosocial stress and rising blood pressure may run alongside each other for months or even years before being recognised. This overlap seems stronger in middle-aged adults, particularly those managing caregiving duties or unstable employment, though younger adults are increasingly reporting similar pressures.[4]

Given that blood pressure measurement is inexpensive and routinely available, combining it with a simple stress assessment may offer a clearer picture of early cardiovascular risk. Prospective data are especially useful here because they show how initial stress levels relate to later changes in blood pressure. In this study, adults who were normotensive at baseline were followed for one year to observe whether those with higher psychosocial stress were more likely to develop hypertension. Stress was measured using a validated scale, and incident hypertension was defined using standard thresholds commonly applied in Indian epidemiological work. By comparing blood pressure changes across stress categories, the study aimed to understand whether psychosocial stress meaningfully contributes to early hypertensive risk in everyday community and workplace environments.

MATERIALS AND METHODS

Study Design and Setting

This prospective study followed adults from workplace health drives and community screening camps linked to a teaching hospital in South India. These camps usually draw a mixed crowd, office workers, shop employees, homemakers, and occasional walk-ins, giving the cohort a fairly ordinary community profile. Baseline assessments were done at enrolment, and follow-up blood pressure checks were completed one year later.

Participants

A total of 300 adults aged 25 to 60 years were included. All were normotensive at baseline. Individuals were excluded if they were already on antihypertensive medication, had known secondary hypertension, chronic kidney or liver disease, major psychiatric illness, or were unable to complete the stress questionnaire. Pregnant women and participants with acute illness at the time of recruitment were also excluded.

Assessment of Psychosocial Stress
Psychosocial stress was measured using a validated self-report instrument with items on work pressure, family strain, financial worries, sleep quality, and perceived daily tension. Responses were scored and grouped into three categories:

- **Low stress**
- **Moderate stress**
- **High stress**

Participants completed the scale once at baseline.

Blood Pressure Measurement
Blood pressure was recorded using a calibrated digital sphygmomanometer. Measurements were taken in the seated position after a brief rest. Two readings were obtained at least two minutes apart, and their average was used for analysis. Incident hypertension at 12-month follow-up was defined as systolic pressure ≥140 mmHg or diastolic pressure ≥90 mmHg, or initiation of antihypertensive medication during the study period.

Anthropometry and Baseline Interview
Height and weight were measured using standard clinic equipment, and BMI was calculated. A brief questionnaire captured age, sex, occupation, work schedule, smoking and alcohol habits, physical activity, sleep pattern, and any previous health evaluations. This helped contextualize stress scores within daily routines.

Follow-up Procedure
Participants were contacted before their 12-month visit, and follow-up assessments were done either at the workplace site or at the community clinic. Individuals who missed the scheduled visit were contacted twice and offered alternative appointment slots. Blood pressure measurement at follow-up used the same technique as baseline.

Operational Definitions

- **Low/Moderate/High stress:** Based on baseline stress scale cut-offs.
- **Incident hypertension:** SBP ≥140 mmHg and/or DBP ≥90 mmHg at follow-up, or documented initiation of antihypertensive medication.
- **BMI categories:** Normal, overweight, and obese using routine adult cut-offs.
- **Subgroups:** Age <40 vs ≥40 years; men vs women; BMI categories.

Statistical Analysis
Continuous variables were summarised as means and standard deviations; categorical variables as proportions. Differences between stress categories were compared using ANOVA for continuous measures and chi-square tests for categorical comparisons. Relative risks were calculated for incident hypertension across stress levels. Subgroup analyses explored age, sex, and BMI patterns. A p-value <0.05 was considered statistically significant.

RESULTS
A total of 300 adults were included at baseline, and 276 (92.0%) completed the 12-month follow-up. Their mean age was 39.8 years (SD 8.6), and men comprised just over half of the cohort. Stress levels varied widely, with a larger share reporting low stress at baseline, although moderate and high stress groups also showed meaningful representation. Baseline characteristics across the three stress categories are summarised in **Table 1**, and none of the major demographic variables differed significantly at enrolment.

Variable	Low Stress (n=120)	Moderate Stress (n=110)	High Stress (n=70)	p-value
Mean age (years)	38.9 ± 8.2	40.1 ± 8.9	41.0 ± 9.1	0.18
Men (%)	52.5	55.4	57.1	0.74
BMI (kg/m²)	24.1 ± 3.2	24.8 ± 3.6	25.3 ± 3.9	0.06
Current smokers (%)	13.3	15.4	18.6	0.42
Sedentary lifestyle (%)	28.3	31.8	37.1	0.21

Table 1. Baseline characteristics of participants by stress category

During follow-up, systolic pressure increased across all three stress categories, but the pattern showed a graded rise. Participants with low stress demonstrated only a modest increment, while those in the high-stress group displayed the steepest shift. These trends are illustrated in **Figure 1**, where the rise in mean systolic pressure is visibly higher in the moderate- and high-stress groups.

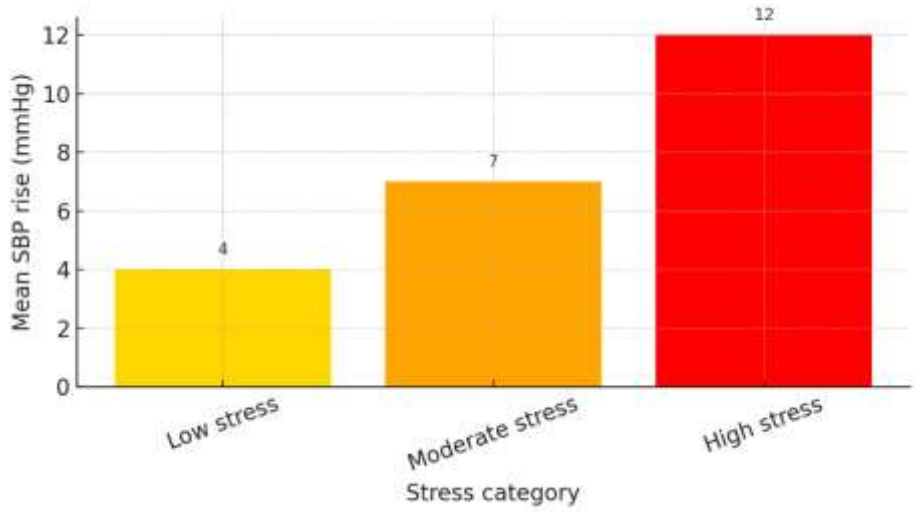

Figure 1. Mean systolic blood pressure rise over 12 months

Mean rise in systolic blood pressure over 12 months across low, moderate, and high psychosocial stress categories

Incident hypertension was documented in 54 participants (18.0%). The proportion rose steadily from low to high stress: 10.0% in low stress, 16.4% in moderate stress, and 34.3% in the high-stress group. These differences were statistically significant on chi-square testing ($\chi^2 = 18.6$, $p < 0.001$). **Figure 2** presents the relative proportions with clear separation between the stress categories.

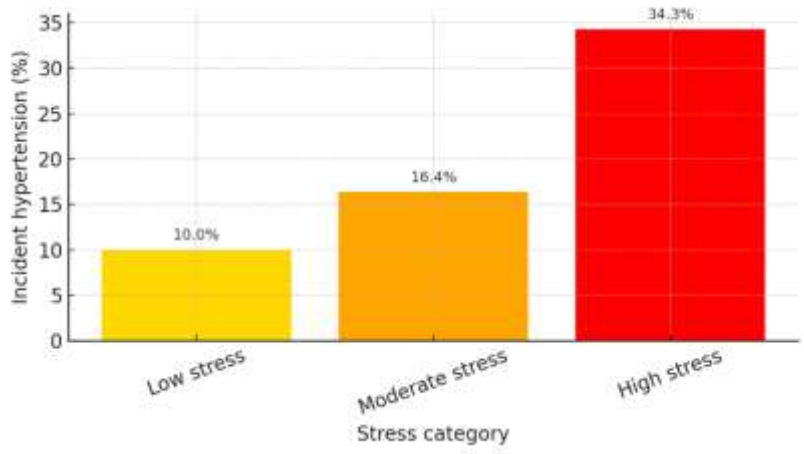

Figure 2. Proportion of participants developing hypertension across stress levels

Proportion of participants who developed incident hypertension during follow-up, shown separately for each baseline stress category

Stress Category	Developed HTN n (%)	Relative Risk (RR)	95% CI
Low (n=120)	12 (10.0%)	Reference	,
Moderate (n=110)	18 (16.4%)	1.64	0.82–3.28
High (n=70)	24 (34.3%)	3.43	1.85–6.35

Table 2. Incident hypertension across stress levels (12-month follow-up)

The elevated risk among the high-stress group persisted across age and BMI subgroups. Adults aged ≥40 years showed particularly strong gradients, with 41.7% of those in the high-stress category developing hypertension compared with only 12.5% in the low-stress group in the same age band. Men and women showed similar directional trends, though percentages were slightly higher among men.

To contextualise the overall outcome distribution, **Figure 3** summarises the entire cohort, distinguishing those who remained normotensive from those who crossed the diagnostic threshold during the study period.

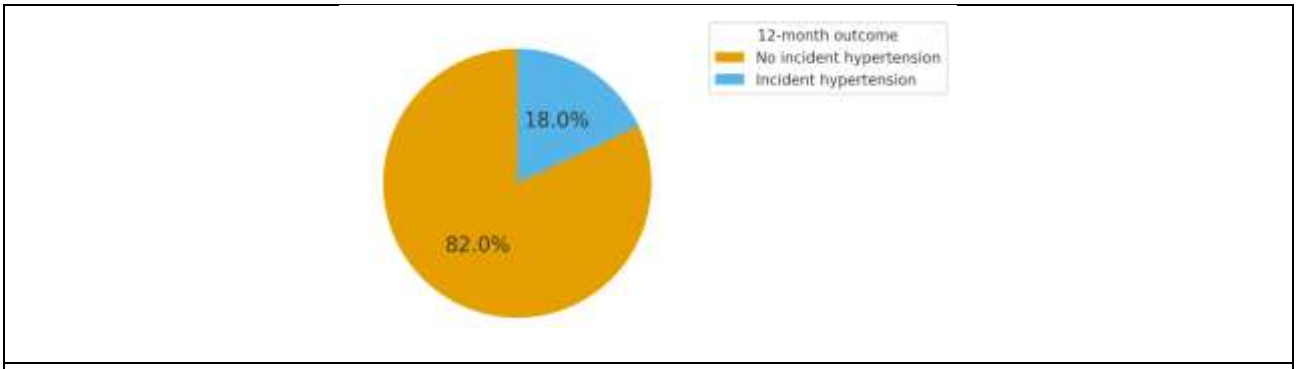

Figure 3. Distribution of incident vs non-incident hypertension

Overall distribution of participants with and without incident hypertension at the end of the 12-month follow-up period

When examining only the participants who developed hypertension, high stress accounted for nearly half of the cases. This composition is shown in **Figure 4**, where red dominates the ring, reflecting a substantial clustering of new hypertension among high-stress adults.

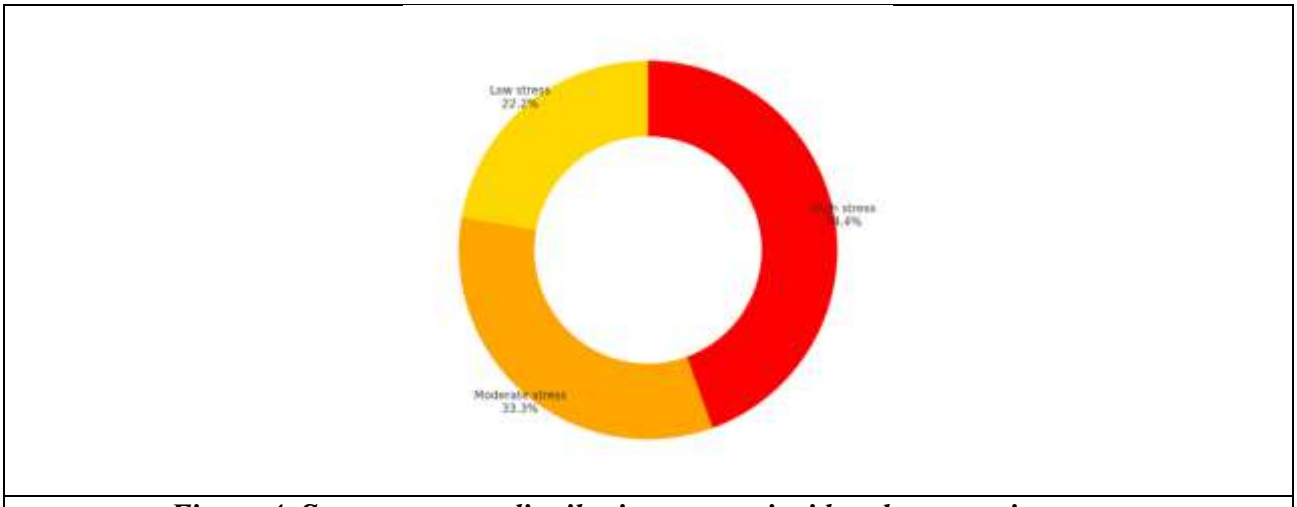

Figure 4. Stress category distribution among incident hypertension cases

Stress-level composition among participants who developed hypertension, demonstrating the relative contribution of low, moderate, and high stress groups.

Parameter	Low Stress	Moderate Stress	High Stress	p-value
Mean SBP rise (mmHg)	4.0 ± 2.1	7.0 ± 3.0	12.0 ± 4.2	<0.001
Mean DBP rise (mmHg)	2.1 ± 1.4	3.4 ± 1.9	5.6 ± 2.5	<0.001
BMI (kg/m²)	24.1 ± 3.2	24.8 ± 3.6	25.3 ± 3.9	0.07
Table 3. Mean BP changes and BMI across stress levels				

The relationship between psychosocial stress and blood pressure rise remained consistent in sensitivity analyses excluding participants lost to follow-up. No major differences were observed in baseline health behaviours that could independently explain the gradient. Together, these findings indicate that psychosocial stress at baseline was associated with a higher likelihood of incident hypertension and a steeper increase in both systolic and diastolic pressures over one year.

DISCUSSION

The present study followed a group of adults who began without hypertension and found that those reporting higher psychosocial stress at baseline were more likely to develop raised blood pressure over one year. Although this connection has been mentioned in earlier observational work, the pattern becomes easier to see when adults are observed prospectively rather than through single-visit screening. Here, the gradient was clear. Mean systolic and diastolic values climbed steadily from low to high stress, and incident hypertension clustered around those reporting heavier emotional strain.

Several physiological explanations have been proposed for this link. Chronic stress tends to activate the sympathetic system more persistently, raising circulating catecholamines and altering vascular reactivity. Longitudinal research has shown that individuals with higher perceived stress often demonstrate small daily elevations in systolic pressure and reduced ability to return to baseline after routine stressors.[5] Cortisol adds another layer. Studies tracing biochemical profiles over time have described how sustained cortisol exposure influences salt handling, adiposity, and endothelial function, all of which gradually shape blood pressure trajectories.[6] These mechanisms are not unique to any one setting, but they have particular relevance in countries like India, where stress often arises from overlapping work and family expectations rather than isolated psychological events.

Findings from workplace cohorts in Asia and Europe echo some of the patterns seen here. Adults reporting higher job strain or limited control over work schedules have shown a greater risk of developing hypertension during follow-up.[7] A meta-analysis of longitudinal studies reported that high perceived stress was associated with a measurable increase in both incident hypertension and long-term cardiovascular events, even after accounting for traditional metabolic risk factors.[8] Similar evidence from the Whitehall II study highlighted that chronic work-related stress predicted later blood pressure elevation independent of baseline lifestyle factors.[9] Although our cohort differed in structure and setting, the overall direction of association remains consistent.

In Indian clinics, the relationship between stress and blood pressure is often noticed informally. People commonly report disturbed sleep, irritability, or an inability to “switch off,” yet few undergo any structured assessment of stress unless symptoms become intrusive. The present study adds to local evidence suggesting that these patterns are not just coincidental. A community-based prospective study from Mumbai also reported higher incidence of hypertension in adults with elevated stress scores at baseline, particularly in those above 40 years.[10] Another cohort from South India described similar trends, finding that perceived stress predicted subsequent rises in systolic pressure even among individuals with otherwise favourable risk profiles.[11] Although methodologies vary, the direction of association across these studies aligns closely with the findings here.

One reason the gradient may appear stronger in older adults is that stress interacts with age-related vascular changes. Stiffening of the arterial wall, subtle metabolic strain, and lower recovery capacity might amplify the blood pressure response to everyday stressors. In our cohort, adults aged 40 years and above showed a steeper jump in incident hypertension across stress categories than younger

adults, suggesting that midlife may be a period when stress-related blood pressure shifts become more visible.

Despite these insights, several limitations warrant attention. The stress scale captured perceived stress at only one point in time; stress levels may fluctuate with life events, workloads, or financial changes. Blood pressure was measured only twice at each visit, and white-coat effects cannot be fully excluded. Loss to follow-up, though modest, could have introduced some bias, especially if individuals with higher stress were less likely to return. The study also did not explore coping patterns, social support, sleep quality, or workplace characteristics in detail, all of which could modify the stress–hypertension relationship.

Even with these limitations, the findings underscore an important point for routine clinical and community screening: simple stress assessment may help identify adults at greater risk long before hypertension becomes clinically apparent. Adding a short stress questionnaire to workplace medical camps or primary care visits could allow earlier conversations about sleep, workload, or coping strategies, interventions that cost little yet may meaningfully influence the trajectory of blood pressure over time.

Limitations

This study relied on a single baseline stress assessment, although stress levels may shift with work or family circumstances over time. Blood pressure was measured only during clinic visits, and home readings or ambulatory monitoring could have provided a more detailed profile. The follow-up duration was relatively short, and a small number of participants did not return for the final assessment, introducing the possibility of minor follow-up bias. Additionally, factors such as sleep quality, coping patterns, and workplace conditions were not captured, which may influence how stress affects blood pressure. Since recruitment was limited to camps linked to one institution, the findings may not represent all regions or occupational groups in India.

CONCLUSION

Adults who entered the study without hypertension but reported higher psychosocial stress at baseline showed a greater rise in blood pressure and a higher likelihood of becoming hypertensive over one year. The gradient was steady, with the sharpest increase among those with high stress. These observations reinforce that emotional strain, if persistent, may shape early cardiovascular risk even before traditional metabolic markers shift. Incorporating brief stress assessments into community and workplace screening may help identify adults who would benefit from closer monitoring, simple counselling, or early preventive steps before blood pressure crosses diagnostic thresholds.

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