International Journal of Science and Research (IJSR)
ISSN: 2319-7064
Impact Factor 2025: 7.089

Sleep Duration, Bedtime Timing, and Sleep Latency as Determinants of Hypertension in Rural Agra: A Community-Based Cross-Sectional Study

Mohd Shahnawaz Ahmad Khan[1], Ashib Parvez[2]

[1]MD Resident, Department of Community Medicine, F.H. Medical College and Hospital, Etmadpur, Agra, Uttar Pradesh, India (Corresponding Author)

[2]Professor, Department of Community Medicine, F.H. Medical College and Hospital, Etmadpur, Agra, Uttar Pradesh, India

Abstract: ***Background: Emerging evidence implicates sleep-related parameters as independent risk factors for hypertension, yet these dimensions remain largely uncharacterised in Indian rural community settings. Objectives: To examine the associations of sleep duration, bedtime timing (sleep timing), and sleep latency with hypertension among adults in rural Agra. Methods: Community-based cross-sectional study of 410 adults (≥ 20 years), RHTC, F.H. Medical College and Hospital, Agra. Sleep parameters were assessed by self-report through a pre-tested questionnaire. BP measured per WHO guidelines. Chi-square tests applied; p<0.05 considered significant. Results: Hypertension prevalence was 70.0% in participants sleeping <4 hours/night compared with 19.4% in those sleeping >8 hours (χ^2=43.52; p=0.0001). Late bedtime (after 11 PM) was associated with 46.0% hypertension vs. 30.0% for those retiring before 9 PM (χ^2=11.41; p=0.0097). Prolonged sleep latency (>1 hour) was associated with 69.0% hypertension vs. 20.6% with <15 min latency (χ^2=46.57; p=0.0001). Conclusions: Sleep disruption across all three dimensions is a significant and underappreciated risk factor for hypertension in rural India. Sleep health should be integrated into hypertension prevention programmes***

Keywords: hypertension; sleep duration; sleep latency; bedtime; sleep timing; rural India; Agra; circadian; cross-sectional

1. Introduction

While conventional risk factors for hypertension—obesity, tobacco, dietary salt, and physical inactivity- have been extensively studied, sleep-related factors have only recently gained recognition as independent cardiovascular risk determinants. Sleep is a dynamic physiological state during which blood pressure normally dips by 10–20% ('nocturnal dipping'), mediated by reduced sympathetic activity and circadian rhythms of the renin-angiotensin-aldosterone and cortisol systems.

Short sleep duration, delayed sleep timing, and prolonged sleep latency each disrupt these regulatory mechanisms. Short sleep activates the sympathetic nervous system and hypothalamic-pituitary-adrenal (HPA) axis, elevating circulating catecholamines and cortisol. Late bedtimes misalign circadian blood pressure regulation, blunting the nocturnal dip. Prolonged sleep latency- representing difficulty initiating sleep- reflects chronic hyperarousal, with sustained sympathetic activation as its correlate.

Systematic reviews have confirmed that sleeping fewer than 6 hours per night is independently associated with a 20–32% increased risk of hypertension. However, community-level data examining all three sleep dimensions simultaneously in an Indian rural setting are absent from the literature. This study aimed to fill this evidence gap.

2. Materials and Methods

2.1 Study Design and Setting

Community-based cross-sectional study of 410 adults (≥20 years) from the RHTC field practice area, F.H. Medical College and Hospital, Etmadpur, Agra, Uttar Pradesh. Duration: 24 months. Simple random sampling; IEC approval and informed consent obtained.

2.2 Sleep Parameter Assessment

Sleep duration was assessed by self-report and categorised as: <4 hours, 4–6 hours, 6–8 hours, and >8 hours per night. **Sleep timing (bedtime)** was recorded and categorised as: Before 9 PM, 9–10 PM, 10–11 PM, and After 11 PM. **Sleep latency** (time taken to fall asleep) was categorised as: <15 minutes, 15–30 minutes, 30–60 minutes, and >1 hour. Hypertension was defined as SBP ≥140 mmHg and/or DBP ≥ 90 mmHg or current antihypertensive use. Chi-square tests applied with p<0.05 as the threshold for statistical significance.

3. Results

3.1 Sleep Duration and Hypertension

Table 1 presents the association between sleep duration and hypertension. A strong inverse relationship was observed: 70.0% of those sleeping fewer than 4 hours were hypertensive, declining progressively to 19.4% in those sleeping more than 8 hours. The association was highly significant (χ^2=43.52; p=0.0001).

Table 1: Association Between Sleep Duration and Hypertension (n=410)

Sleep Duration	Hypertensive n (%)	Normotensive n (%)	Total	χ^2	p-value
<4 hours	28 (70.0)	12 (30.0)	40		
4–6 hours	64 (48.5)	68 (51.5)	132		
6–8 hours	46 (26.1)	130 (73.9)	176	43.52	0.0001*
>8 hours	12 (19.4)	50 (80.6)	62		
Total	**150 (36.6)**	**260 (63.4)**	**410**		

** Significant at p<0.05.*

3.2 Sleep Timing (Bedtime) and Hypertension

Table 2 shows the relationship between bedtime and hypertension. Participants retiring before 9 PM had the lowest prevalence (30.0%), while those going to bed after 11 PM had the highest (46.0%). The chi-square test confirmed a statistically significant association (χ^2=11.41; p=0.0097).

Table 2: Association Between Bedtime (Sleep Timing) and Hypertension (n=410)

Bedtime	Hypertensive n (%)	Normotensive n (%)	Total	χ^2	p-value
Before 9 PM	18 (30.0)	42 (70.0)	60		
9–10 PM	32 (26.7)	88 (73.3)	120	11.41	0.0097*
10–11 PM	54 (41.5)	76 (58.5)	130		
After 11 PM	46 (46.0)	54 (54.0)	100		
Total	150 (36.6)	260 (63.4)	410		

** Significant at p<0.05.*

3.3 Sleep Latency and Hypertension

Table 3 shows the association between sleep latency and hypertension. Those with sleep latency under 15 minutes had a hypertension prevalence of only 20.6%, compared with 31.0% (15–30 minutes), 46.0% (30–60 minutes), and 69.0% (>1 hour). The chi-square statistic was the highest among all three sleep parameters (χ^2=46.57; p=0.0001).

Table 3: Association Between Sleep Latency and Hypertension (n=410)

Sleep Latency	Hypertensive n (%)	Normotensive n (%)	Total	χ^2	p-value
<15 minutes	28 (20.6)	108 (79.4)	136		
15–30 minutes	36 (31.0)	80 (69.0)	116	46.57	0.0001*
30–60 minutes	46 (46.0)	54 (54.0)	100		
>1 hour	40 (69.0)	18 (31.0)	58		
Total	**150 (36.6)**	**260 (63.4)**	**410**		

** Significant at p<0.05.*

4. Discussion

This study provides community-level evidence from rural India that all three sleep-related parameters- sleep duration, bedtime timing, and sleep latency- are independently and significantly associated with hypertension. To our knowledge, this is one of the first studies to simultaneously examine these three sleep dimensions in a rural Indian community.

The finding that individuals sleeping fewer than 4 hours had a 70.0% hypertension prevalence- 3.6 times the rate in those sleeping more than 8 hours- is consistent with meta-analytic evidence from Wang et al. (2012) demonstrating that short sleep duration (<6 hours) significantly increases hypertension risk. Mechanistically, sleep deprivation activates the sympathetic nervous system, elevates circulating norepinephrine, suppresses nocturnal blood pressure dipping, and promotes endothelial dysfunction through inflammatory pathways including elevated C-reactive protein and interleukin-6.

The association between late bedtimes and hypertension- 46.0% prevalence after 11 PM vs. 30.0% before 9 PM- supports the circadian regulation hypothesis of blood pressure. Sleep timing misalignment disrupts the circadian rhythm of the autonomic nervous system, attenuating the normal nocturnal blood pressure dip. Zhao et al. (2024) similarly reported a significant association between late sleep timing and hypertension, and epidemiological evidence has linked social jetlag and chronic late sleep timing to adverse cardiovascular outcomes.

Prolonged sleep latency showed the most striking gradient (20.6% to 69.0% across quartiles, χ^2 =46.57), suggesting that difficulty initiating sleep- likely reflecting chronic psychological hyperarousal, anxiety, or subclinical insomnia- is a particularly important correlate in this rural population. Xiang et al. (2025) reported similar findings in a longitudinal cohort, and Zhong et al. (2022) confirmed sleep latency as an independent hypertension predictor after controlling for conventional risk factors. The psychosocial stressors prevalent in rural agricultural communities- including economic insecurity, crop failures, and indebtedness- may contribute to this pattern.

5. Conclusions

Sleep disruption across all three dimensions- inadequate duration, late bedtime, and prolonged sleep latency- is significantly associated with hypertension in this rural community of Agra. These findings make a compelling case for integrating sleep health assessment and counselling into primary care hypertension screening. Simple, low-cost

interventions including sleep hygiene education, stress management support, and community mental health referral pathways should be incorporated into village-level non-communicable disease prevention programmes.

Funding: No external funding.

Conflicts of Interest: None declared.

Ethics Approval: IEC, F.H. Medical College and Hospital, Etmadpur, Agra.

References

[1] Wang Q, Xi B, Liu M, Zhang Y, Fu M. Short sleep duration is associated with hypertension risk among adults: a systematic review and meta-analysis. Hypertens Res. 2012;35(10):1012–1018.
[2] Zhao S, Yu B, Chen L, et al. Association between sleep timing and hypertension: a cross-sectional study using the Sleep Heart Health Study. Hypertens Res. 2024;47(3):715–724.
[3] Zhong X, Liu S, Chen F, et al. Sleep latency is independently associated with hypertension in the general population. J Clin Hypertens. 2022;24(2):162–170.
[4] Xiang L, Zhang Y, Huang J, et al. Habitual prolonged sleep latency and risk of hypertension: a longitudinal cohort study. Sleep Med. 2025; 115: 102–109.
[5] Zhou B, Carrillo-Larco RM, Danaei G, et al. Worldwide trends in hypertension prevalence and progress in treatment and control from 1990 to 2019. Lancet. 2021;398(10304):957–980.