

Association between Sleep Disorders among Adult Patients in a Tertiary Care Center in North IndiaSatish Kumar Budania¹, Prabhukiran V Gogi², Hemant Kumar³, Sachin B S⁴, Sunil Kumar⁵¹Associate Professor, Dept. of Psychiatry, Rajshree Medical Research Institute, Bareilly (UP).²Associate Professor, Dept. of Psychiatry, Gulbarga Institute of Medical Sciences, Kalaburagi, Karnataka³Assistant Professor, Dept. of Psychiatry, Government Medical College and Hospital, Bettiah, Bihar⁴Associate Professor, Dept. of psychiatry, SDM College of Medical Sciences and Hospital, Dharwad Karnataka.⁵Professor, Dept. of Psychiatry, Navodaya Medical College, Raichur, Karnataka

Received: 26-09-2023 / Revised: 24-10-2023 / Accepted: 23-11-2023

Corresponding Author: Sachin B S

Conflict of interest: Nil

Abstract**Objective:** This study aimed to evaluate the association between sleep duration and hypertension among adults in tertiary hospital in India.**Methods:** Baseline variables were collected from a representative sample of 200 adults aged 23–98 years in a tertiary hospital in North India who received physical examinations from January 2021 to December 2022. All participants were categorized into either a hypertension group or a non-hypertension group. Sleep duration was classified as short (<6 h/day), normal (6–8 h/day), or long (>8 h/day). Baseline variables were compared between individuals with and without hypertension by rank-sum tests for two independent samples or χ^2 tests for nonparametric data. Multivariate logistic regression analysis was performed to evaluate the association between sleep duration and hypertension.**Results:** The overall incidence of hypertension was 51.2%. Unadjusted analysis showed that the risk of hypertension was higher in individuals with short (<6h/day) or long (>8h/day) sleep durations compared with those with a normal (6–8 h/day) sleep duration. The risk of hypertension was significantly increased by 30.1% in participants with a long (>8h/day) sleep duration compared with those with a normal (6–8h/day) sleep duration (OR = 1.301, $P < 0.010$, 95%CI = 1.149–1.475). The risk of hypertension was also increased by 1.1% in participants with a short (<6h/day) sleep duration compared with participants with a normal (6–8h/day) sleep duration, but the difference was not significant (OR = 1.011, $P = 0.849$, 95%CI = 0.905–1.129). After fully adjusting for confounding factors (model 4), the risk of hypertension was increased significantly (by 25%) in individuals with a short (<6h/day) sleep duration (OR = 1.25, $P = 0.02$, 95%CI = 1.036–1.508) but not in those with a long (>8h/day) sleep duration (17.5% increase) compared with participants with a normal (6–8h/day) sleep duration (OR = 1.175, $P = 0.144$, 95%CI = 0.946–1.460).**Conclusion:** The results of this study indicate that a short (<6h/day) sleep duration is related to an increased risk of hypertension, suggesting that sleep helps to protect against hypertension.**Keywords:** Short sleep duration; Long sleep duration; HypertensionThis is an Open Access article that uses a funding model which does not charge readers or their institutions for access and distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>) and the Budapest Open Access Initiative (<http://www.budapestopenaccessinitiative.org/read>), which permit unrestricted use, distribution, and reproduction in any medium, provided original work is properly credited.**Introduction**

Hypertension is a leading cause of cardiovascular death, stroke, kidney failure, and disability. The early detection, appropriate treatment, and better control of hypertension have significant health and economic benefits. Current actions considered to reduce the risk of hypertension include: maintaining a healthy body weight (BMI = 18.5–24.9 kg/m²) and waist circumference (102 cm for men and 88 cm for women); addressing behavioral risk factors such as an unhealthy diet, harmful use of alcohol, lack of exercise, and smoking; following a diet including

more fruit and vegetables, and low-fat dairy products; and limiting sodium consumption from all sources.

Sleep is a normal part of life, but an increasing number of people have insufficient sleep, which can seriously affect their health. Numerous studies have demonstrated that sleep is closely related to hypertension, with both short and long sleep duration associated with a series of metabolic disorders [4], such as abnormal blood glucose and lipids, impaired vascular endothelial function, and

obesity. However, there have been clear discrepancies among the findings of these studies. Certain studies found that both short and long sleep durations were associated with an increased risk of hypertension [1, 2, 13, 14], while several studies only identified a short sleep duration as associated with an increased risk of hypertension [3, 6, 7, 8, 12, 15], and yet other studies denied this association [5, 11, 17]. The objective of the current study was to evaluate the association between self-reported sleep duration and hypertension among adults in North India.

Material and Methods

Present Study was a cross-sectional study to evaluate the association between sleep duration and hypertension in a multi-stage stratified random sample of 200 adults who participated in medical examinations in North India from January 2021 to December 2022. We excluded 11 participants for whom important data were missing and 14 participants for whom information was inaccurate and incomplete, or for other reasons. Finally, 200 participants were included in this study. Participants with a systolic blood pressure ≥ 140 mmHg and/or a diastolic blood pressure ≥ 90 mmHg, or who were using antihypertensive medication were classified as the hypertension group, and the others were classified as the non-hypertension group. Subjects who met the inclusion criteria were informed of the research content and enrolled in the study after signing an informed consent form before the survey.

Methods

Participants were considered to have hypertension if they answered 'yes' to the question, 'Have you ever been told by a doctor that you have hypertension, also known as high blood pressure?', or if they self-reported antihypertensive drug use. Participants underwent blood pressure measurements three times with three minutes intervals on the right or left arm using an Omron electronic sphygmomanometer after being seated for at least 10 minutes. Systolic blood pressure (SBP) and diastolic blood pressure (DBP) were defined as the average of three readings, and SBP ≥ 140 mmHg or DBP ≥ 90 mmHg was also considered to indicate hypertension.

Assessment of Sleep Duration

Sleep duration was assessed using the question: 'How much sleep do you usually get at night per day?'. Sleep duration was divided into three categories: short (<6 h/day), normal (6–8 h/day), and long sleep duration (>8 h/day), with normal sleep duration used as the reference group.

Other Covariates

Heart rate (HR) was measured three times with 30-second intervals on the participants' right or left arm using an Omron electronic sphygmomanometer after being seated for at least 10 minutes, and HR was defined as the average of the three readings. Body height and weight were measured using multifunctional electronic scales while the participant was wearing a thin shirt and no shoes. Body mass index (BMI) (kg/m²) was calculated by dividing the body weight in kilograms by the height square in meters. Blood glucose was measured using a single glucometer measurement in the distal finger before breakfast.

The following baseline population information was input: demographic information (e.g. sex, age, educational status, BMI), lifestyle (e.g. smoking, drinking, outdoor activities, vegetable consumption, fruit consumption), as well as disease history (e.g. hypertension, diabetes, hyperlipidemia, hyperhomocysteinemia, coronary vessel disease (CVD), chronic hepatic failure (CHF), chronic renal failure (CRF), atrial fibrillation (AF), cerebral infarction, cerebral hemorrhage, use of antihypertensives, use of lipid-lowering agents). Data analysis and processing were carried out using SPSS26.0 statistical software. A two-sided $P < 0.05$ was considered significant.

Results

Baseline Characteristics of All Participants

A total of 200 participants aged 23–78 years were included in this study. The overall incidence of hypertension was 51%, including 44% men and 55% women. Overall, 74% of participants had a normal sleep duration, 19 % had a short sleep duration, and 6 % had a long sleep duration. Participants with hypertension were predominantly female, older, and had a higher BMI, faster HR, higher blood sugar, and lower educational status (Table 1). Analysis of the baseline characteristics of all participants showed that age, educational status, BMI, HR, blood sugar, smoking, outdoor activities, vegetable consumption, fruit consumption, sleep duration, diabetes, hyperlipidemia, hyperhomocysteinemia, CVD, CRF, AF, cerebral infarction, cerebral hemorrhage, use of antihypertensives, use of lipid-lowering agents all differed significantly between the two groups ($P < 0.05$). However, there were no significant differences with regard to sex, drinking, and CHF ($P > 0.05$).

Table 1: Baseline characteristics of all participants by hypertension status.

VARIABLE	HYPERTENSION		P
	YES	NO	
Sex(%)			0.378
male	44%	43%	
female	55%	56%	
Age	71 ± 8	66 ± 11	<0.01
BMI	25 ± 3	24 ± 3	<0.01
HR	74 ± 11	73 ± 11	<0.01
Blood glucose	6.0 ± 2.0	5.9 ± 1.8	0.002
Educational status(%)			<0.01
primary	74%	68%	
Smoking(%)			0.007
never	78	76	
current	13	15	
Drinking(%)			0.428
never	82	82	
current	15	16	
Sleep duration(%)			<0.01
6–8	74	77	
<6	19	15	
Use of antihypertensives(%)			<0.01
yes	73	0	
no	27	100	
Use of lipid-lowering agents(%)			<0.01
Yes	4	2	
no	96	98	

Unadjusted and Adjusted Analysis of the Association Between Sleep Duration And Hypertension

There were significant differences among the sleep-duration groups in terms of hypertension ($\chi^2 = 46.2$, $P < 0.01$) (Table 2). Unadjusted analysis showed that participants with short (<6 h/day) and long (>8 h/day) sleep durations had greater risks of hypertension than those with a normal (6–8 h/day) sleep duration.

Table 2: Sleep Duration and Hypertension

SLEEP DURATION	TOTAL	HYPERTENSION (%)		χ^2 TEST		LOGISTIC REGRESSION ANALYSIS		
		NO	YES	χ^2	P	OR	P	95%CI
Normal (6–8h/day)	15,160	7,567 (49.9)	7,593 (50.1)	46.2	<0.01	*		
Short (<6h/day)	3,516	1,534 (43.6)	1,982 (56.4)	#		1.011	0.849	0.905–1.129
Long (>8h/day)	1,377	691 (50.2)	686 (49.8)			1.301	<0.010	1.149–1.475

The risk of hypertension was significantly increased by 30 % in participants with a long (>8 h/day) sleep duration compared with those with a normal (6–8 h/day) sleep duration (OR = 1.301, $P < 0.01$, 95% CI = 1.149–1.475), while the risk of hypertension was increased by 1% higher in participants with a short (<6 h/day) sleep duration compared with those with a normal (6–8 h/day) sleep duration, but the difference was not significant (OR = 1.011, $P = 0.849$, 95% CI = 0.905–1.129).

The risk of hypertension was significantly increased by 24.2% in participants with a short (<6 h/day) sleep duration compared with those with a normal (6–8 h/day) sleep duration after adjusting for age, education status, smoking, vegetable consumption, fruit consumption, outdoor activities, diabetes, hyperhomocysteinemia, CVD, CRF, AF, cerebral infarction, cerebral hemorrhage, use of antihypertensives, use of lipid-lowering agents, and

blood sugar (OR = 1.242, $P < 0.023$, 95% CI = 1.030–1.496). I

In contrast, the increase of 14.7% in participants with a long (>8 h/day) sleep duration was not significant (OR = 1.147, $P = 0.210$, 95% CI = 0.925–1.423). Similar results were obtained after adding BMI, hyperlipidemia or HR as confounding factors. After fully adjusting for confounding factors (model 4), the risk of hypertension was thus increased significantly by 25% in participants with a short (<6 h/day) sleep duration compared with those with a normal (6–8 h/day) sleep duration (OR = 1.25, $P = 0.020$, 95% CI = 1.036–1.508), while the increase of 17.5% in participants with a long sleep duration was not significant (OR = 1.175, $P = 0.144$, 95% CI = 0.946–1.460).

Discussion

Given the potential association between sleep duration and hypertension, this study evaluated the association between self-reported sleep duration and hypertension among adults in selected study population. Multivariate logistic regression analysis demonstrated that the risk of hypertension was increased in participants with either a short (<6 h/day) or a long (>8 h/day) sleep duration compared with participants with a normal (6–8 h/day) sleep duration. The Study showed that a short (<6 h/day) sleep duration significantly increased the risk of hypertension by 24 % compared with participants with a normal (6–8 h/day) sleep duration (OR = 1.242, $P < 0.023$, 95% CI = 1.030–1.496), while a long (>8 h/day) sleep duration increased the risk by 14 %, which was not significant (OR = 1.147, $P = 0.21$, 95% CI = 0.925–1.423). These results indicated that participants with a short (<6 h/day) sleep duration were much more prone to develop hypertension, suggesting that sleep had a protective effect against hypertension among adults in the selected study pool.

Our study concluded that insufficient sleep was associated with an increased risk of hypertension, which was consistent with the results of most previous studies [1, 2, 3, 6, 7, 8, 12–15]. However, our results demonstrated that participants with only a short (<6 h/day) sleep duration had a greater risk of hypertension, while a long (>8 h/day) sleep duration did not significantly increase the risk of hypertension.

Hypertension is a common chronic disease that represents a significant risk factor for cardiovascular disease worldwide. Cardiologists have recently become concerned about the association between sleep duration and hypertension. Several studies have demonstrated the biological mechanism underlying the association between sleep duration and hypertension, and have proposed various possible mechanisms, including the effects of insufficient sleep on biological rhythms [10, 16] and

hemodynamic changes [9], which are due to increased sympathetic nerve activity, the hypothalamic-pituitary axis, and the oxidative stress response. [18]

Compared with previous studies, the current study had several strengths. The sample was from part of North India, which was previously unexplored in this topic making it representative of this region. The results thus provide a basis for future studies on the association between sleep duration and hypertension on a bigger scale. However, the study also had some limitations. First, sleep duration was based on self-reported data and was thus very subjective, potentially leading to errors in the grouping of some participants. Second, sleep duration did not include the duration of daytime sleep or the time of naps, and the effect of daytime sleep or the time of naps on hypertension was thus unclear. Third, sleep quality was not included in this study, and the effect of sleep quality on hypertension was thus unknown. Therefore further research is needed using more accurate measurements and evaluation methods for collecting sleep-duration information. More prospective studies are needed to determine the association between sleep duration and hypertension.

Conclusion

The results of this study suggest that a short (<6 h/day) sleep duration is related to an increased risk of hypertension and is an independent risk factor for hypertension among adults in selected study sample in North India. Individuals with a short (<6 h/day) sleep duration are thus more likely to have hypertension, indicating that sleep may help to protect against the development of hypertension. The result of this study has some degree of guiding importance in preventing hypertension in clinical practice.

References

1. Yao FF, Zhao J, Cui Y, et al. Daytime sleep as compensation for the effects of reduced nocturnal sleep on the incidence of hypertension: A cohort study. *Nature and Science of Sleep*. 2021; 13: 1061–1074. DOI: <https://doi.org/10.2147/NSS.S316113>
2. Luo SY, Ye YX, Sun MY, et al. Relationship of quality and duration of sleep with hypertension among adults in Guangzhou. *Zhonghua Yu Fang Yi Xue Za Zhi [Chinese Journal of Preventive Medicine]*. 2021; 55(7): 853–859. DOI: <https://doi.org/10.3760/cma.j.cn112150-20210204-00125>
3. Yang F, Zhang YY, Qiu RY, et al. Association of sleep duration and sleep quality with hypertension in oil workers in Xinjiang. *PeerJ*. 2021; 9: e11318. DOI: <https://doi.org/10.7717/peerj.11318>

4. Chasens ER, Imes CC, Kariuki JK, et al. Sleep and metabolic syndrome. *The Nursing Clinics of North America*. 2021; 56(2): 203–217. DOI: <https://doi.org/10.1016/j.cnur.2020.10.012>
5. Shivashankar R, Kondal D, Ali MK, et al. Associations of sleep duration and disturbances with hypertension in metropolitan cities of Delhi, Chennai, and Karachi in south Asia: A cross-sectional analysis of the CARRS study. *Sleep*. 2017; 40(9): zsx119. DOI: <https://doi.org/10.1093/sleep/zsx119>
6. Wu WW, Wang WR, Gu YH, et al. Sleep quality, sleep duration, and their association with hypertension incidence among low-income oldest-old in a rural area of China: A population-based study. *Journal of Psychosomatic Research*. 2019; 127: 109848. DOI: <https://doi.org/10.1016/j.jpsychores.2019.109848>
7. Yang H, Haack M, Gautam S, et al. Repetitive exposure to shortened sleep leads to blunted sleep-associated blood pressure dipping. *Journal of Hypertension*. 2017; 35(6): 1187–1194. DOI: <https://doi.org/10.1097/HJH.0000000000001284>
8. Bathgate CJ, Edinger JD, Wyatt JK, et al. Objective but not Subjective short sleep duration associated with increased incidence for hypertension in individuals with insomnia. *Sleep*. 2016;39(5):1037–1045. DOI: <https://doi.org/10.5665/sleep.5748>
9. Yang D, Rundek T, Patel SR, et al. Hemodynamics in sleep apnea and actigraphy determined sleep duration in a sample of the hispanic community health study/study of latinos. *Journal of Clinical Sleep Medicine*. 2019; 15(1): 15–21. DOI: <https://doi.org/10.5664/jcsm.7560>
10. Makarem N, Shechter A, Carnethon MR, et al. Sleep duration and blood pressure: Recent advances and future directions. *Current Hypertension Reports*. 2019; 21(5): 33. DOI: <https://doi.org/10.1007/s11906-019-0938-7>
11. Ramos AR, Weng J, Wallace DM, et al. Sleep patterns and hypertension using actigraphy in the hispanic community health study/study of latinos. *Chest*. 2018; 153(1): 87–93. DOI: <https://doi.org/10.1016/j.chest.2017.09.028>
12. Meng L, Zheng Y, Hui RT. The relationship of sleep duration and insomnia to the incidence of hypertension incidence: A meta-analysis of prospective cohort studies. *Hypertension Research*. 2013; 36(11): 985–995. DOI: <https://doi.org/10.1038/hr.2013.70>
13. Guo XF, Zheng LQ, Wang J, et al. Epidemiological evidence for the link between sleep duration and high blood pressure: a systematic review and meta-analysis. *Sleep medicine*. 2013; 14(4): 324–332. DOI: <https://doi.org/10.1016/j.sleep.2012.12.001>
14. Wang QJ, Xi B, Liu M, et al. Short sleep duration is associated with hypertension incidence among adults: A systematic review and meta-analysis. *Hypertension Research*. 2012; 35(10): 1012–1018. DOI: <https://doi.org/10.1038/hr.2012.91>
15. Gottlieb DJ, Redline S, Nieto FJ, et al. Association of usual sleep duration with hypertension: The sleep heart health study. *Sleep*. 2006; 29(8): 1009–1014. DOI: <https://doi.org/10.1093/sleep/29.8.1009>
16. Friedman O, Logan YSAG. Relationship between self-reported sleep duration and changes in circadian blood pressure. *American Journal of Hypertension*. 2009; 22(11): 1205–1211. DOI: <https://doi.org/10.1038/ajh.2009.165>
17. Berg JFVD, Tulen JHM, Neven AK, et al. Sleep duration and hypertension are not associated in the elderly. *Hypertension*. 2007; 50(3): 585–589. DOI: <https://doi.org/10.1161/HYPERTENSIONAHA.107.092585>