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Association between sleep quality, duration and risk factor with hypertension among industrial workers - Case Control study

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ABSTRACT:
Introduction: Sleep duration and sleep quality have been reported to be linked to an increased risk of hypertension among industrial workers. This study aimed to explore this association among industrial workers.
Methods:A case-control study was conducted among 88 hypertensive patients and 175 control non-hypertensive groups from industrial workers. Data were collected using the Tamil-Pittsburg Sleep Quality Index (T-PSQI) by personal interview with the hypertensive and control groups. Logistic regression was used to analyze the relationship between sleep duration, sleep quality, and hypertension.
Result: Out of 263 industrial workers, hypertension prevalence was 33.4%. Among shift workers, 46.7% reported poor sleep. Data on sleep duration and quality were collected via questionnaires. There was a statistical association between poor sleep quality and sleep duration.
Conclusion: Sleeping more than 10 hours is associated with hypertension among industrial workers. Additionally, poor sleep quality is independently associated with ever-smoking individuals, and BMI is independently associated with short sleep duration (<7 hours) in these workers.
Keywords: Hypertension, sleep disorder, sleep duration, industrial workers

I. INTRODUCTION:

Hypertension, commonly known as high blood pressure (HBP), is a chronic condition where arterial blood pressure remains persistently high, contributing significantly to global morbidity and mortality(1). Recognizing its critical impact, the World Health Organization (WHO) highlighted "high blood pressure" as the theme for World Health Day in 2013(2). In India, approximately 25% of adults suffer from hypertension (3). Major risk factors for this condition include family history, sedentary lifestyle, poor diet, smoking, sex, race, and age. However, sleep—often overlooked—is an unconventional risk factor. Hypertension can lead to severe health issues such as coronary artery disease (CAD), hypertensive heart disease (HHD), stroke, myocardial infarction, atherosclerosis, peripheral vascular disease, vision loss, and chronic renal disease. Non-communicable diseases (NCDs) predominantly cause deaths globally, especially in low- and middle-income countries (1).

The "National Medical Journal of India" recommends 7-8 hours of sleep per night for adults(4), regulated by the brain's suprachiasmatic nuclei (SCN) in the hypothalamus. Sleep is crucial for repair, restoration, and overall health. However, a 2019 study by the National Sleep Policy in India reported that 33% of Indian adults suffer from insufficient sleep(5). Poor sleep quality is a public health concern recognized by WHO, as it increases the risk of various diseases, including cardiovascular disease, obesity, metabolic syndrome, diabetes mellitus, depression, cancer, and cognitive impairment(6).

Poor sleep also negatively affects personal relationships and raises premature mortality rates(7). It is well-documented that poor sleep quality correlates with obesity, metabolic syndrome, and impaired glucose metabolism, which are linked to hypertension(8). Epidemiological studies have identified short sleep duration as a potential hypertension risk factor. For example, Gangswich et al(9). Longitudinal analysis from the National Health and Nutrition Examination Survey (NHANES) supports this association. Adequate sleep is essential for maintaining homeostasis and cardiovascular health, with both short and long sleep durations increasing the risk of cardiovascular disease (CVD) events(10)(11).

Our study examines the relationship between sleep quality and duration and hypertension among industrial workers in Chennai.

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Using the Pittsburgh Sleep Quality Index and logistic regression analysis, we aim to explore how sleep duration and quality impact hypertension. Existing studies have shown varying results, with some associating both short and long sleep durations with hypertension, while others only link short sleep duration to increased hypertension risk (12).

II. MATERIALS & METHODS:

Study Setting & Participants:

In this case-control study, the sample size (n) was determined using the formula:$n=2PQ\ (Z\alpha + Z_\beta)^2 / (P_1-P_0)^2$. The parameters used for this calculation included a anticipated proportion of control with exposure of 50% and a odds ratio (R) of 2.5,with the significance level (α) of 0.05, and a power of 90% (β = 0.1). The study included 263 participants, comprising 88 physician-diagnosed hypertensive patients and 175 matched non-hypertensive controls from an industrial area in Chennai, observed over a period of six months.The inclusion criteria for this study were as follows: male industrial workers diagnosed with hypertension, male industrial workers on a shift basis, and those who have been employed for more than two months. Additionally, male industrial workers with hypertension and other comorbidities were included, whether they were on medication or not. The exclusion criteria comprised staff working in the administrative sector and individuals employed for less than two months. The sampling technique utilized was simple random sampling.

Study Methods:

Data were collected by personal interview with the hypertensive and control group using the tamil version of Pittsburgh Sleep Quality Index (T-PSQI) which is an effective instrument used to measure the quality and patterns of sleep in adults. Patients and controls were classified into two groups according to PSQI: Poor-sleeper group (PQSI > 5) and good-sleeper group (PQSI ≤ 5). The questionnaire included the relevant questions to collect the relevant data to fulfill the study objective; Socio-demographic characteristics of the patients and control including age, marital status, educational status, Work experience, alcohol and smoking, Height and weight and BMI was calculated.

Sleep quality: "The screening of sleep quality was done using PSQI. PSQI is a 19-item inventory with each item having a score ranging from 0 to 3 with higher score indicating more severe sleep problem. The 19 items are grouped into 7 components. The sleep component scores are summed to yield a total score ranging from 0 to 21 with the higher total score (referred to as global score) indicating worse sleep quality. In distinguishing good and poor sleepers, a global PSQI score >5 was considered to be indicator of sleep disturbances. The grading of quality of sleep using PSQI was done as follows: Score <5: No sleep problem, Score 5–10: Mild disturbances, Score >10: Moderate-to-severe disturbances, respectively".

Sleep Duration: "The duration of sleep was taken according to PSQI questionnaire. Self-reported and time spent in bed was calculated 'GO TO BED TIME' being subtracted from 'GET UP TIME'. Numerical value of sleep duration calculated by subtracting time spent in bed with sleep latency. Subjective sleep duration has been calculated by asking PSQI questionnaire, the value being subtracted from time spent in bed calculated total sleep duration numerical value was divided into categories. <6 h, 6–7 h, 7–9 h. We took 7 to 9 h as referent value a <7 h and ≥9 h in young adults have negative consequences to health such as metabolic, cardiovascular, and musculoskeletal disorders."

Ethical consideration: The study's proposal was presented to the scientific research committee and after their recommendations were included, was sent for institutional ethical clearance and clearance was obtained from The Tamil Nadu Dr.M.G.R. Medical University Review board IECNUMBER: ECMGR0309218. Participants were informed that participation is completely voluntary. No names were recorded on the questionnaires and protection of confidentiality and all questionnaires were kept safe.

Statistical analysis: The raw data was entered in epi data 3.1 (programmed data entry and data documentation for public health professional), and was verified by the primary investigator. Data were analyzed using IBM SPSS Statistics for Windows version 21.0. Quantitative data were expressed as mean (standard deviation), median and range. Qualitative data were expressed as number and percentage.Chi-square ($\chi 2$) test and Fisher's Exact Test were used for comparison regarding qualitative variables as appropriate. A 5% level was chosen as a level of significance in all statistical tests used in the study.

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III. RESULT:

263 participants were distributed as 88 cases and 175 controls. The mean age (S.D)was 34.7 ± 8.31 years in the hypertension group and 27.0 (8.36) years in the control group. A chi-square test indicated a significant association ($p < 0.05$) between hypertension and various sociodemographic factors.

Table 1: The sociodemographic variables among industrial workers with and withouthypertension:

Parameters	Frequency(n)	Hypertension		X^2	p-value
		Yes	No		
Age					
18-25	111	51	60		
26-35	92	52	40	5.31	0.15
36-45	40	23	17		
>=46	20	14	6		
Education Level					
Professional	53	25	28		
graduate	60	16	44		
Intermediate	122	32	90		
High school	18	10	8	15.0	
Middle school	9	5	4		0.010
Illiterate	1	0	1		
Married level Status					
Unmarried	155	18	137	82.2	<0.001
Married	107	70	37		
Widower	1	0	1		
Job status					
Junior level	86	7	79		
Intermediate level	60	24	36	38.1	<0.001
Senior level	117	57	60		
Smoking Status					
Yes	78	32	46	2.85	*Fisher's exact test 0.62
No	185	56	129		
Alcohol consumption					
Yes	162	65	97	8.41	0.003
No	101	23	78		
BMI					
Underweight	27	1	26		
Normal	148	34	114		
Overweight	82	50	32	46.6	<0.001
Obese	6	3	3		
Work experience					
>6 months	49	2	47		
>2 years	52	8	44	42.3	<0.001
>4 years	162	78	84		
Sleep Quality					
Good sleep (<=5)	140	33	107	13.1	<0.001
Poor sleep (>5)	123	55	6		
Sleep duration					

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<7 hours	189	64	125	1.94	0.37
7 to 8 hours	45	15	30		
>=9 hours	18	9	9		

Among the participants, 65 individuals reported alcohol consumption. A significant difference was observed in alcohol consumption between the cases and the control group (p-value = 0.003). Additionally, 55 participants were diagnosed with hypertension, and a significant association was found between sleep quality and hypertension (p-value = 0.001). Of the participants, 78 had hypertension with more than four years of work experience, compared to 84 participants without hypertension. A significant difference was also observed when comparing the length of service with the prevalence of hypertension (p-value = 0.001).

Table 2: Results of logistic regression analysis investigating the association between sleep quality and the risk factor of hypertension among industrial workers.

Variables	**Odds ratio(CI)**	**p-value**
Age		
26-35	0.65(0.37-1.14)	0.13
36-45	0.62((0.30-1.30)	0.21
>=46	0.36(0.13-1.01)	0.05
BMI		
Underweight	0.94(0.41-2.14)	0.88
Overweight	1.12(0.65-1.92)	0.68
Obese	1.17(0.23-6.02)	0.84
Alcohol	0.81(0.51-1.52)	0.66
Smoke	2.11(1.18-3.78)	0.01
Work Experience		
>2 years	0.59(0.27-1.30)	0.19
>4 years	0.60(0.31-1.14)	0.12
Hypertension		
Systolic	1.01(0.99-1.03)	0.82
Diastolic	0.99(0.96-1.02)	0.80

The results of the logistic regression indicated that individuals aged 26-35 had a significantly higher odds ratio for hypertension compared to those over 36 years (odds ratio, 11.61; 95% CI 1.154-116.916). After adjusting for smoking, individuals who had ever smoked had a significantly higher odds ratio for hypertension compared to those who had never smoked (odds ratio, 2.11; 95% CI 1.18-3.78)above table show that.

Parameter	<7 hours	**p-value**	>=9 hours	**p-value**
	Odds ratio(CI)		Odds ratio(CI)	
Age	1.02(0.78-1.31)	0.15	0.89(0.53-1.48)	0.66
BMI	2.26(1.08-4.75)	0.03	1.85(0.39-8.78)	0.43
Alcohol	1.06(0.38-2.96)	0.90	0.26(0.01-3.79)	0.32
Smoke	0.60(0.23-1.87)	0.44	1.99(0.17-22.9)	0.57
Work Experience	0.25(0.76-0.83)	0.02	0.95(0.32-2.78)	0.92
Education level	0.86(0.57-1.29)	0.48	1.84(0.75-4.48)	0.17
Physical activity	0.82(0.47-1.43)	0.49	0.92(0.23-3.59)	0.91
Hypertension	0.97(0.56-1.70)	0.93	3.25(1.23-8.77)	0.02

Table 3: Results of logistic regression analysis investigating the association between sleep duration and the risk of hypertension among industrial workers.

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The results of the binominal logistic regression analysis showed that only BMI was independently associated with less than 7 hours of sleep duration. The crude odds ratio (OR) for subjects with a higher BMI having less than 7 hours of sleep was 2.26 (95% CI 1.08-4.75). Additionally, sleeping more than >=9 hours is associated with hypertension among industrial workers, (odds ratio 3.25;95% CI 1.23-8.77).

IV. DISCUSSION:

Sleep and hypertension (high blood pressure) have a significant and complex relationship. Numerous studies have demonstrated that poor sleep quality, insufficient sleep duration, and sleep disorders can contribute to the development and worsening of hypertension. From our study we found that among socio demographic factors occupation and educational level may be associated with hypertension. As professional and intermediate level of education workers have higher prevalence of hypertension when compared to other groups. This may be due their sedentary life style. This pattern is entirely different from developed countries where the prevalence is more among lower education and occupational groups. But studies in India reveal those highly educated and higher work experience groups are at higher risk. So this implies public awareness regarding hypertension risk factors is needed among all industrial workers. All modifiable risk factors studied vis-à-vis obesity, lack of physical activity, inadequate fruits and vegetable intake, diabetes, smoking, and alcohol use were significantly different in proportion among cases and controls. Obesity, lack of physical activity, smoking, and diabetes were found to be significant risk factors for hypertension after adjusting for other risk factors (Pilakkadavath & Shaffi, 2016).

Smoking

Based on the Chi Square statistical test, the value of p = 0.04 was obtained. This shows a significant relationship between smoking and hypertension with OR value of 0.62 obtained in smoking variable. smokers are found to have a higher risk of developing hypertension compared to nonsmokers. This result has in line with previous study which mentioned no significant associations were found between smoking and the risk of incident respiratory diseases, hypertension, and myocardial infarction in the group younger than older (Gao et all, 2017). Among the study participants in two age groups, smoking showed a positive association 62 with the risk of developing respiratory diseases, hypertension, and myocardial infarction from a life course perspective. Additionally, this risk increased as participants grew older. In contrast, the results from a current view showed inverse associations between smoking and the risk of the diseases mentioned above (Gao et al., 2017).

PSQI

In a case-control research with participants, one group was hypertensive, and the other group was made up of industrial workers who were not hypertension. The Pittsburgh Sleep Quality Index (PSQI) was used in the study to evaluate sleep quality in hypertension patients and compare score differences between the two groups.A sizable percentage of hypertension patients reported having terrible sleep, while a smaller percentage said they had decent sleep. Similar results were seen in the control group of people without hypertension, with statistical significance (p=0.001).In a different study, the global PSQI score showed that most hypertension patients had poor sleep quality, whereas just a small percentage had good sleep quality.

Sleep duration

The present study provides epidemiologic evidence that both short habitual sleep durations are associated with prevalent hypertension in community-dwelling middle-aged and older adults. The biologic mechanisms underlying an association of short sleep duration and hypertension are uncertain. Sleep deprivation has been reported to cause an increase in sympathetic nervous system activity, which may cause sustained hypertension, although the importance of this mechanism in the apparent hypertensive response to sleep deprivation has been questioned. Sleep deprivation also alters activity of the hypothalamic-pituitary adrenal axis, with short-term partial sleep deprivation causing a shorter quiescent period of cortisol secretion and slower clearance of free cortisol and the resultant elevated cortisol levels may increase blood pressure.

BMI

The prevalence of hypertension was higher among individuals categorized as overweight based on their BMI. There was a strong statistical association between body mass index and hypertension. This was similar of the finding of Pearson et al. who found that obese patient had difficulty with sleep. This result was consistence to

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the findings of Anne et al. However, Abdul Salam et al. found no significant correlation between age, weight, height and BMI.

V. CONCLUSION:

Hypertension and sleep deprivation among industrial workers were found to be associated in this study. Key determinants of hypertension included age, poor sleep quality, BMI, work experience, job status, and alcohol consumption. Regular medical check-ups could mitigate hypertension risk and improve health outcomes. Targeted interventions addressing these factors may enhance well-being and productivity in industrial settings.

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