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Influence of Inadequate Sleep on Blood Pressure Among the Population in Zakho District

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Abstract

Objective: This study explores the impact of inadequate sleep on blood pressure levels among the population of Zakho district's, Kurdistan Region, highlighting the unique cultural, economic, and geographical factors contributing to these conditions.

Methods: This case-control study involved 1038 participants aged 18–65 years, divided into two groups. 527 cases, who have inadequate sleep <7 hours (n = 262), <6 hours (n = 194), <5 hours (n = 71). and 511 control who have an adequate amount of sleep of 7-9 hours. The study assessed sleep quantity through self-reported sleep duration using an interview questionnaire. Blood pressure was measured three times (with at least a one-minute interval between each reading) using a standard mercury sphygmomanometer and a properly sized cuff. The American Heart Association defines healthy and unhealthy blood pressure ranges. Chi-square and t-tests were used to examine the relationship between sleep duration and hypertension.

Results: The prevalence of all stages of hypertension was significantly higher in the case group than in the control group ($P = 0.0001$) (Table 5). Stage I: 151(58.3% case), 108(41.7% control). Stage II: 106(60.92% case), 68(39.08% control). Hypertensive crisis: 5(100% case), 0(0% control). With the Exception of elevated blood pressure which was more prevalent among the control group: 129(60), than case group 86(40%). Among those with normal blood pressure, the prevalence was also higher in the control group; 206(53.51% control), 179(46.49% case).

Conclusion: The study indicates that inadequate sleep durations increase the risk of hypertension. Improving sleep habits could prevent hypertension. Further research is needed in Zakho district to establish the relationship between sleep duration and hypertension. Addressing sleep disturbances can improve public health, especially among high-risk populations.

Keywords: Sleep, hypertension, cardiovascular, systolic BP, diastolic BP

Introduction

Sleep is a crucial physiological function, accounting for roughly one-third of our lifetime. However, due to the fast-paced nature of contemporary living, the average nightly sleep duration has significantly reduced.[1]

The influence of inadequate sleep on blood pressure levels has been extensively researched, and its detrimental effects on cardiovascular health are well-documented.[2,3] Sleep duration, sleep quality, and sleep disorders have all been implicated in contributing to the development and exacerbation of hypertension.[4] Notably, the association between sleep and blood pressure is bidirectional, with inadequate sleep not only increasing the risk of hypertension but also being a consequence of hypertension-related disturbances.[5]

In recent years, the global prevalence of inadequate sleep has shown a concerning upward trend.[6] The prevalence of hypertension is also on the rise, making it a major public health challenge in many countries, including Iraq.[7]

Several research studies have shown a strong connection between sleep and hypertension, with both inadequate and excessive sleep durations being linked to various metabolic issues like impaired blood glucose level and dyslipidemia, disturbance of vascular endothelial function, and obesity.[8]

Sleep apnea, which is described as having a minimum of 5 respiratory disturbances (apnea or hypopnea) per hour of sleep on average, is believed to affect approximately 27% to 34% of men aged 30 to 70 and roughly 9% to 28% of women in the same age category.[9]

The duration of sleep varies significantly both within individuals and among different people. Research on twins reveals that the genetic influence on the duration of sleep ranges from 31% to 55%, indicating significant genetic factors contributing to individual differences in the need for sleep.[10–12]

The epidemiological data, which encompasses research examined in the recently issued consensus statements by the American Academy of Sleep Medicine (AASM) and Sleep Research Society (SRS) regarding suggested optimal sleep durations for adults, indicates that having less than 7 hours of sleep is a contributing factor in the development of hypertension.[13,14] Research conducted on individuals with high blood pressure and those with normal blood pressure has demonstrated that restricting sleep results in elevated blood pressure levels and heightened sympathetic activity during sleep.[15,16]

Preliminary research has indicated that implementing a behavioral intervention involving an increase in sleep duration can potentially reduce blood pressure levels.[17] New findings indicate that there are gender-specific impacts of sleep duration and latency on the regulation of blood pressure.[18] Over nine years, research revealed that people who slept less than six hours per night faced compromised health and a 70% elevated risk of mortality compared to those with 7 or 8 hours of sleep nightly.[19] Notably, this correlation persisted even when accounting for factors such as age, gender, race, physical health, smoking history, physical activity, alcohol consumption, and social support.[19] In 2016, A statement issued by the American Heart Association in the field of science In reference to sleep and cardiometabolic health, it was confirmed that

there exists strong epidemiological evidence suggesting that self-reported inadequate sleep, determined by different thresholds (≤5, ≤6, or ≤7 hours), serves as a contributing factor to the development of hypertension.[3] The majority of studies relying on self-reported sleep duration have consistently shown an increased risk of hypertension among individuals with shorter sleep durations. However, studies utilizing objectively measured sleep duration have produced inconsistent findings on this association.[20]

This research aims to fill essential distinction in the literature by focusing light on the influence of inadequate sleep on blood pressure levels among the diverse populations residing in the Zakho district which located in Kurdistan region- Iraq. The district's unique cultural, economic, and geographical characteristics may give rise to distinct patterns and risk factors for inadequate sleep and hypertension.

Materials and Methods

Study Design and Setting

This is a case-control study conducted between (february, 2023 -November, 2023) to measure the influence of inadequate sleep on blood pressure among adult populations in the Zakho district, as we compared the blood pressure of people with an adequate amount of sleep (7–8 hrs.) with those who sleep less than 7 hrs, which regarded as an inadequate amount of sleep as previously published by Watson NF (2015).[21]

Participants

A total of 1038 Adults aged between (18–65) years participated in this study, divided into two groups. Case group (n = 527) person who subdivided into 3 groups (<5 hours, <6 hours, and <7 hours). Control group (n = 511). All participants are from Zakho districts, Kurdistan region – Iraq. Both cases and controls were selected randomly.

Inclusion and Exclusion Criteria

a. Inclusion Criteria:

Individuals ranging from 18 to 65 years old, whose BMI is below 30 without a documented history of hypertension, residing in the Zakho districts, were included in the study. The cases group had a sleep duration of less than 7 hours, while the control group had a sleep duration between 7 to 9 hours.

b. Exclusion Criteria

1. Persons younger than 18 years and older than 65 years
2. Persons who are known cases of chronic diseases (cerebrovascular, cardiovascular diabetes, renal disease, Polycystic Ovary Syndrome (PCOS), pituitary, thyroid, and adrenal gland disorders)
3. Pregnant woman
4. Psychological Upset
5. An obese person's BMI equal to or above 30

Anthropometric Assessment

a. Assessment of Sleep Quantity

The amount of sleep was evaluated through self-reported sleep duration using an interview questionnaire, with defined thresholds for categorization (≤5, ≤6, or ≤7 hours).

b. Measurement of Blood Pressure

Trained personnel measured blood pressure three times, with at least a one-minute interval between each reading. Following an established protocol, this was done using a conventional mercury sphygmomanometer along with a correctly fitting cuff. Participants were required to rest for at least 5 minutes in a relaxed, seated position before the measurements were taken. The first and fifth Korotkoff sounds were noted as systolic (SBP) and diastolic (DBP), respectively as presented in Table 1. The statistical analysis utilized the mean of the three measurements.

Ethics

The research protocol and the process of obtaining informed consent received approval from the Research and Ethics Committee at the College of Medicine, Zakho University, in the Kurdistan Region of Iraq. All recruited participants provided their informed consent.

Statistical analysis

Statistical Analysis: SPSS vs. 26 was used to do statistical analysis. The participant's descriptive data were described using percentages and frequencies. Chi-square and t-tests were used to examine the relationship between sleep duration and hypertension. For statistical significance, a p-value of less than 0.05 was considered.

Results

Sociodemographic Characteristics of Study Participants

In this study, 1038 participant were recruited, 527 cases, who have inadequate sleep <7 hours (n = 262), < 6 hours (n = 194), <5 hours (n = 71). and 511 control who have an adequate amount of sleep of 7–9 hours. Among those, 593 were male and 445 females. The average age of the participants was 40.65 ± 11.49 (for male 41.73 ± 11.31 and for female 39.21 ± 11.59).

Table 1. **Association explained The American Heart Association defines healthy and unhealthy blood pressure levels[22]**

Blood pressure category	Systolic mm Hg (upper number)	and/or	Diastolic mm Hg (lower number)
Normal	Less than 120	And	Less than 80
Elevated	120–129	And	Less than 80
High blood pressure (hypertension) stage 1	130–139	Or	80 – 89
High blood pressure (hypertension) stage 2	140 or higher	Or	90 or higher
Hypertensive crisis	Higher than 180	and/or	Higher than 120

Amongst our participants, 339 of them (32.7%) were smokers compared to 699 (67.3%) nonsmokers (Table 2). Other characteristics are presented in Table 2.

Effect of Gender on Blood Pressure

Among 1038 participants the prevalence of all stages of hypertension was higher in males than females (Table 3). Elevated BP: 129(60% male), 86(40% female). stage I: 156 (6.23 male), 103(39.77 female). Stage II: 116 (66.6% male), 58(33,33% female). Hypertensive crisis: 4(80% male), 1(20% female). While normal blood pressure was more prevalent in females 197(51.17%) compared to 188(48.83%) in males. and the P-value was significant at 0.0001. (Table 3).

Effect of Smoking on Blood Pressure

In this study, there was no significant influence of smoking on blood pressure in all stages (p = 0.357) (Table 4) Elevated BP: 140(65.12% nonsmoker), 75(34.88% smoker). stage I: 174(67.18% nonsmoker), 85(32.82% smoker). Stage II: 128(73.56% nonsmoker), 46(26.44% smoker). Hypertensive crisis: 4(80% nonsmoker), 1(20% smoker). while among those with normal blood pressure, the prevalence of nonsmokers was: 253(65.71%) compared with smokers: 132(34.29%).

Comparison of Blood Pressure Between Case and Control

The prevalence of all stages of hypertension was significantly higher in the case group than in the control group (p = 0.0001) (Table 5). Stage I: 151(58.3% case), 108(41.7% control). Stage II: 106 (60.92% case), 68(39.08% control). Hypertensive crisis: 5 (100% case), 0(0% control). With the Exception of elevated blood pressure which was more prevalent among the control group: 129(60), than case group 86 (40%). Among those with normal blood pressure, the prevalence was also higher in the control group; 206 (53.51% control), 179 (46.49% case).

Effect of Different Sleep Durations on Blood Pressure

From a total of 385 participants having normal blood pressure, 206(53.51%) of them from a control group who slept 7–9 hrs. compared to 180(46.49%) from the case group, 93(24.16%) who slept less than 7 hrs, 64(16.62%) who sleeps less than 6 hrs, and 22(5.71%) who slept less than 5 hrs. P value 0.0001. (Table 6.)

Of the total of 215 participants having elevated blood pressure, 129(60%) of them from a control group who slept 7–9 hrs. compared to 86(40%) from the case group, 47(21.86%) who slept less than 7 hrs, 31(14.42%) who slept less than 6 hrs., and 8(3.72%) who slept less than 5 hrs. P value 0.0001. (Table 6.)

Of the total of 259 participants having Stage 1 hypertension, 108(41.7%) of them from the control group who slept 7–9 hrs. compared to 151 (58.3%) from the case group,

Table 2. **Sociodemographic information of participants' poor sleep and normal sleep patients**

	Variables	Frequency	Percentage
Gender	Male	593	57.1%
	Female	445	42.9%
Age (Mean ± SD)	40.65 ± 11.49		
Male (years)	41.73 ± 11.31		
Female (years)	39.21 ± 11.59		
Ethnicity	Kurd	995	95.86%
	Arab	43	4.14%
Religion	Muslim	911	87.76%
	Yazidi	106	10.21%
	Christian	21	2.02%
Residence	Urban	827	79.67%
	Rural	183	17.63%
	Camps	28	2.7 %
Smoking	Negative	699	67.3%
	Positive	339	32.7%
Participants	Case	527	50.8%
	Control	511	49.2%

Table 3. **Effect of Gender on blood pressure**

Patients group	Normal BP	Elevated BP	Stage I HTN	Stage II HTN	Hypertensive crisis
Male	188(48.83%)	129(60%)	156(60.23%)	116(66.67%)	4(80%)
Female	197(51.17%)	86 (40%)	103(39.77%)	58(33.33%)	1(20%)
Total	385(100%)	215(100%)	259(100%)	174(100%)	5(100%)
**P*-value			0.0001		

**P* value is determined using Chi-square test.

Table 4. **Effect of smoking on blood pressure**

Patients group	Normal BP	Elevated BP	Stage I HTN	Stage II HTN	Hypertensive crisis
Smoker	132(34.29%)	75(34.88%)	85(32.82%)	46(26.44%)	1(20%)
Non-smoker	253(65.71%)	140(65.12%)	174(67.18%)	128(73.56%)	4(80%)
Total	385(100%)	215(100%)	259(100%)	174(100%)	5(100%)
P-value			0.357		

Table 5. **Comparison of blood pressure between case and control**

Patients group	Normal BP	Elevated BP	Stage 1 HT	Stage 2 HT	Hypertensive crisis
Control	206(53.51%)	129(60%)	108(41.7%)	68(39.08%)	0(0%)
Case	179(46.49%)	86(40%)	151(58.3%)	106(60.92%)	5(100%)
Total	385(100%)	215(100%)	259(100%)	174(100%)	5(100%)
P-value			0.0001		

Table 6. **Sleep duration and blood pressure**

Patients group	Normal BP	Elevated BP	Stage 1 HT	Stage 2 HT	Hypertensive crisis
Less than 5 hrs	22(5.71%)	8(3.72%)	23(8.88%)	16(9.2%)	2(40%)
Less than 6 hrs	64(16.62%)	31(14.42%)	59(22.78%)	38(21.84%)	2(40%)
Less than 7 hrs	93(24.16%)	47(21.86%)	69(26.64%)	52(29.89%)	1(20%)
7–9 hrs	206(53.51%)	129(60%)	108(41.7%)	68(39.08%)	0(0%)
Total	385(100%)	215(100%)	259(100%)	174(100%)	5(100%)
P-value			0.0001		

Table 7. The mean blood pressure between Case and control

	Systolic BP	Diastolic BP
Control	120.26 ± 12.59	74.69 ± 11.08
Case	124.14 ± 15.91	76.69 ± 11.85
t-test	0.0001	0.014

69(26.64%) who slept less than 7 hrs, 59(22.78%) who slept less than 6 hrs, and 23(8.88%) who slept less than 5 hrs. *P* value 0.0001. (Table 6.)

From a total of 174 participants having Stage 2 hypertension, 68(39.08%) of them from the control group who slept 7–9 hrs. compared to 52(29.89%) from the case group, 69(26.64%) who slept less than 7 hrs, 38(21.84%) who slept less than 6 hrs, and 16(9.2%) who sleeps less than 5 hrs. *P* value 0.0001. (Table 6.)

From a total of 5 participants having a hypertensive crisis, none of the participants were from the control group who slept 7–9 hrs. compared to 5(100%) from the case group, 1(20%) who slept less than 7 hrs, 2(40%) who slept less than 6 hrs., and 2(40%) who slept less than 5 hrs. *P* value 0.0001. (Table 6.)

By using a t-test to measure mean blood pressure between the case and control group, the mean systolic blood pressure was (124.14 ± 15.91) among the case group compared to (120.26 ± 12.59) among the control group and statistically significant between them ($P = 0.0001$). (Table 7).

Mean diastolic blood pressure was (76.69 ± 11.85) in the case group compared to (74.69 ± 11.08) in the control group and statistically significant between them ($P = 0.014$). (Table 7).

Discussion

Measuring the influence of inadequate sleep on blood pressure is essential since it's a fundamental physiological process that regulates various bodily functions, including blood pressure regulation. by monitoring blood pressure in individuals with inadequate sleep, healthcare professionals can identify those at higher risk of developing hypertension and intervene with appropriate interventions such as lifestyle modifications or medication. In addition, measuring the influence of inadequate sleep on blood pressure is essential for early detection, risk assessment, and intervention strategies aimed at promoting better cardiovascular health and overall well-being. We conduct this study in Zakho district to discover the consequence of in adequate sleep on blood pressure aiming to get finding result in unique directions and factors contributing to insufficient sleep and hypertension.

Our findings indicate that men exhibit a higher prevalence of all stages of hypertension compared to women. This aligns with numerous prior studies demonstrating that men under the age of 65 consistently experience elevated hypertension levels compared to women in the same age bracket. The gender disparity in hypertension, observed across both human and animal populations, arises from a combination of biological and behavioral factors.[23]

We found no strong link between smoking and blood pressure, likely due in part to the relatively small sample size, representing 32.7% of the total participants. Furthermore, while smoking is established as a risk factor for heart attacks and strokes, its correlation with high blood pressure is still under investigation.[24]

In our national cross-sectional study, we observed that short sleep duration significantly affects blood pressure according to the American Heart Association's defined health and unhealthy blood pressure ranges.[22] All stages of hypertension are more prevalent in the case group who sleep less than 7 hours. which indicates that short sleep duration is a risk factor for hypertension. However, the prevalence of elevated blood pressure where high in a control group who slept between 7–9 hours. which could be attributed to the narrow threshold between stage I and elevated blood pressure. In the other aspect, the effect of shorter sleep

duration on blood pressure was more significant among those who slept (<5 hours and <6 hours) than those who slept <7 hours.

By using a t-test the mean systolic and diastolic blood pressure was significantly higher among the case group than the control group which reflects the effect of an adequate amount of sleep on blood pressure.

Our findings are compatible with previous studies,[25,26] and an Insufficient sleep has been established as a contributing factor to the development of hypertension. Numerous biological pathways have been suggested to connect sleep patterns with hypertension risk. Sleep disturbances may impact various bodily systems including the central nervous system,[27] circulation system,[28] gas exchanges,[29] and biological cycles.[30,31] These effects can lead to changes in physiological functions and pathological fluctuations in blood pressure.

"In our study, the prevalence of elevated blood pressure and stages I and II hypertension is notable in both groups, attributed to the application of the new guidelines from the American Heart Association, which have a more restricted range, specifically for normal blood pressure."

Study Limitation

1. Sample size which is limited by the size of the population in zakho district may affect the generalizability of the finding to larger population
2. Self – reporting bias: our data depended on self -reporting sleep patterns which may introduce bias, as participants may uncarefully report their sleep duration.
3. The absence of opportunities to measure blood pressure at various intervals which gives the ability to confirm blood pressure levels more confidently.
4. Zakho district is relatively homogenous in term of demographic, socioeconomic status, or lifestyle factors my influence the generalizability of the finding to more diverse population.

Conclusion

Our research findings suggest that Insufficient periods of sleep are associated with a higher likelihood of developing hypertension. Improving sleep habits, which can be changed, might be crucial in preventing hypertension. Further prospective studies are needed in Zakho district to establish a direct relationship between sleep duration and hypertension, and to assess how sleep quality affects blood pressure levels. It is imperative to actively identify and address sleep disturbances to prevent and manage hypertension effectively. By addressing the impact of inadequate sleep on blood pressure, there is potential for significant public health benefits in Zakho district, particularly among high-risk populations. Although smoking is known to elevate the risk of cardiovascular disease, our research did not uncover a notable correlation between smoking and a heightened likelihood of developing high blood pressure.

Conflict of interest

None.

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