ISSN No:-2456-2165

Evaluation and Comparison of Sleep Quality and Prevalence of Sleep Disorders between Hypertensive and Normotensive Subjects

Radhika P, Mary Shalu Jose, Dr. Anjana Krishna
Department of Physiology
Little Flower Institute of Medical Science and Research-
Under Kerala University of Health Sciences
Angamaly, India

Abstract:- Hypertension is a prevalent life style disease and the existing literatures provide robust evidences of the disastrous effects of hypertension on almost all of the bodily functions separately, but there are least evidences comparing such parameters between hypertensive and normotensive adults. This study mainly concentrates on the comparing quality of sleep and emergence of sleep disorders between hypertensive and normotensive individuals. A set of 2 groups; a CASE and a CONTROL each constituting with a sample of 44 subjects between the age group 25-65 years of age were recruited in the study. The sleep quality scores of all hypertensive cases and normotensive controls were assessed by the Pittsburg Sleep Quality Index (PSQI). The possibility and prevalence rates of sleep disorders among the study group were evaluated using the Sleep Disorder Screening Questionnaire. Data were statistically analyzed using SPSS (Version 20.0). In the case group, 97.7% were poor sleepers and among the control group, about 88.6% were good sleepers. The differences between sleep quality scores among the case and control groups were found to be highly statistically significant (P<0.05). Out of the 4 sleep disorders, majority (95.5%) of the hypertensive group had Obstructive Sleep Apnea (OSA). Also 81.8%, 81.8% and 72.7% of the case group had high prevalence of insomnia, narcolepsy and Restless Leg Syndrome (RLS). On comparison, hypertensive cases recruited for the study had poor sleep quality and high prevalence of sleep disorders than normotensive controls. A poor sleep quality could possibly affect autonomic function and stress levels which could further elevate Blood Pressure, worsening the condition. Thus, a clinical evaluation of sleep quality and its related disorders might be helpful in the prognosis of hypertension.

Keywords:- *Hypertension, Normotension, Sleep Quality, Obstructive Sleep Apnea, Insomnia, Narcolepsy, Restless Leg Syndrome.*

I. INTRODUCTION

Hypertension is a very common and most prevalent public health challenge in both economically developing and developed countries of the world. Hypertension can be defined as a systolic BP level ≥140 mmHg and/or a diastolic BP level ≥ 90 mmHg. The number of hypertensive adults will reach 1.5 billion which is approximately 30% of the world population by the year 2025[1]. It is one of the inevitable risk factors of cardiovascular diseases related mortality. Poorly controlled Blood Pressure (BP) remains to be a strong reason of cardiovascular morbidity and mortality worldwide. Globally hypertension is regarded as a major health problem, because of its magnitude and associated risks, the degree of its difficulty to be managed, high medical and social costs concerning the condition, and that it causes chronic cardiovascular and renal complications .The major risk factors for hypertension may include old age, familial history, overweight or obesity, decreased physical activity levels, use of tobacco and alcohol, marital status, occupation, education, socioeconomic status and BMI [2].

Sleeping patterns and routine sleeping has a noteworthy correlation with blood pressure. Poor sleep is commonly found among hypertensive individuals and may be associated with reduced quality of life related to health. [3] Low sleep quality scores on assessment of Pittsburg Sleep Quality Index is significant in hypertensive patients indicating poor subjective sleep quality, sleep latency, sleep duration and habitual sleep efficiency. Day time dysfunctions, sleep disturbances and use of sleeping medications are also common. Also, individuals who sleep 5 hours or less than that at night may be at increased risk of developing hypertension or aggravating an already raised BP. During normal sleep, nocturnal BP typically falls by 10% or more than that and is referred to as 'nocturnal dipping'. [4]

Sleep disorders mainly Obstructive Sleep Apnea (OSA), Insomnia, Narcolepsy, Restless Leg Syndrome (RLS) and Periodic Limb Movements of Sleep (PLMS) are known to alter BP response and also tend to increase the risk of hypertension.[4] Hypertension and insomnia and also hypertension and OSA are deeply associated and are often

ISSN No:-2456-2165

found to co-exist. [5, 6] Several studies suggests that disordered sleep, particularly sleep apnea and deprivation is linked with an increased BP and increased risk of hypertension [4, 5, and 6]. Restless leg syndrome, narcolepsy and insomnia with objective short sleep duration may impact the control of Blood Pressure. [7] Any sort of decline in both quality and quantity of sleep may be connected with a rise in nocturnal BP which could contribute in the development or worse control of hypertension. [8]

II. SIGNIFICANCE OF THE STUDY

Hypertension has evolved to be one of the routine lifestyle disorder that causes cardiovascular diseases associated mortality worldwide. Being a devastating endemic, hypertension require special emphasis to be studied for its complications and consequences. "High blood pressure or hypertension kills nearly 1.5 million people every year in South East Asia," says Dr. Panda (Cardiac Surgeon in Bandra East). According to the World Heath Statistics 2012 report, 23.10% men and 22.60% women > 25 years in India suffer from hypertension. Fortunately, India has small rates of hypertension compared to world figures (*Times of India, article, May 17, 2018)*Hypertension, being a leading public health challenge requires similar studies as a part of awareness to the general public. Future investigations may quantitatively analyze the effect of hypertension on sleep and its related disorders so as to make the ideas more clear.

III. MATERIALS AND METHODS

A total of 88 subjects divided into a set of 2 groups; a CASE and a CONTROL each constituting with a sample of 44 subjects between the age group 25-65 years of age were recruited in the study. The case group of 44 hypertensive patients were randomly chosen from the Out Patient Department (OPD) of Little Flower (LF) Hospital Angamaly and the control group of 44 normotensive individuals were chosen randomly from the staffs of various departments of the same hospital. The heterogeneous population of patients in the OPD was divided into 2 strata:

CASE : 44 subjects already diagnosed with hypertension within the specified age group.
CONTROL: 44 normotensive subjects within the specified age group.

The samples were then recruited randomly from these strata considering the inclusion and exclusion criteria. Male and female patients between the age group 25 and 65 already diagnosed with hypertension and Male and female normotensive participants between the age group ranges 25-65 were included in the study. Patients suffering from any major diseases like cancer, chronic infectious diseases etc., patients undergoing any therapy or treatment, hypotensive and normotensive subjects suffering from any other serious medical conditions like renal tubular defects, hormonal excess or insufficiency etc. that can affect Blood Pressure were excluded from the study. A total of six months duration between December 2018 and June 2019 was taken for completing the study. The study was approved by the Ethical Committee of Little Flower Institute of Medical Science and Research (LIMSAR), Angamaly. Permission was also obtained from the OPD in-charge to collect data from the patients. A written informed consent was obtained from all the subjects before data collection.

➢ *Assessment of sleep quality*

- Using Pittsburgh Sleep Quality Index (PSQI) questionnaire: The case group and control group were given the PSQI questionnaire which is used as standardized tool to assess sleep quality and sleep disturbances over a 1- month time interval. It consists of a 19- individual items with seven "component" scores that assesses: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction.[9] The score of each component was added up to obtain a Global PSQI score which finally determines the overall quality of sleep among the case group and control group. Subjects with a score >5 were considered to be poor sleepers and subjects with a score< 5 were considered to be having good quality of sleep.

➢ *Evaluation of sleep disorders:*

- Using Sleep Disorder Screening Questionnaire (SDSQ): This questionnaire is a screening tool for sleep disorders mainly insomnia, narcolepsy, movement disorders and Obstructive Sleep Apnea (OSA). It is a 34- item scale with 4 domains evaluating the presence of sleep disorders. Questions 1-12: indicates symptoms of Sleep Apnea – a potentially serious disorder which leads to stop breathing repeatedly, often hundreds of times in the night during sleep. Questions 13-19: symptoms of Insomnia, a persistent inability to fall asleep or stay asleep. Questions 20-27: symptoms of Narcolepsy – a life-long disorder characterized by uncontrollable sleep attacks during the day. Questions 28-34: symptoms of Periodic Limb Movement Disorder / Un-controllable leg or arm jerks during sleep or Restless Leg Syndrome – uncomfortable feelings in the legs at night. Presence of these disorders are marked if the respondent checks more than 3 questions in each domain.

IV. STATISTICAL ANALYSIS

Data were analyzed in the Statistical Package for Social Sciences (20.0). Descriptive statistics of the data were presented as frequencies, percentages and mean ± SD. Comparison of means between the hypertensive cases and normotensive controls were done using the Independent sample T- test

ISSN No:-2456-2165

V. RESULTS

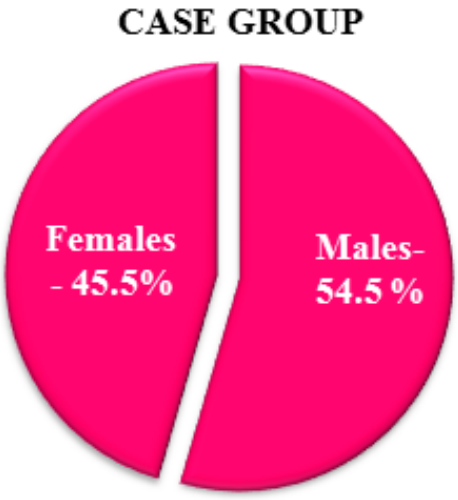
Studies regarding the deleterious effects of hypertension are gaining increased significance in the present scenario. Hypertension is known to cause several secondary health conditions affecting cardiovascular systems, sleep patterns, kidney functions, autonomic function etc. Two of these parameters mainly, sleep quality and its related disorders have been considered in this study and are compared with those of the normotensive group.

➢ *Baseline Characteristics of the Data*

AGE(IN YEARS)	CASE		CONTROL	
MEAN±SD	55.11±8.83		39.11±11.81	
	F	%	F	%
25-35	2	4.5	21	47.7
36-45	5	11.4	12	27.3
46-55	13	29.5	4	9.1
56-65	24	54.5	7	15.9
TOTAL	44	100.0	44	100.0

Table 1:- Age distribution of the study population:

The mean age of the case group were distributed as 55.11±8.83 and that of control group were distributed as 39.11±11.81. Majority (54.5%) of the hypertensive patients belonged to the age group of 56-65 years and in that of control group majority (47.7%) of the normotensive individuals belongs to the age group of 25-35 years. Minor population (4.5%) of hypertensive cases belongs to the age group of 25-35 years and in that of control group minority (9.1%) of the normotensive individuals belong to the age group 46-55 years of age.



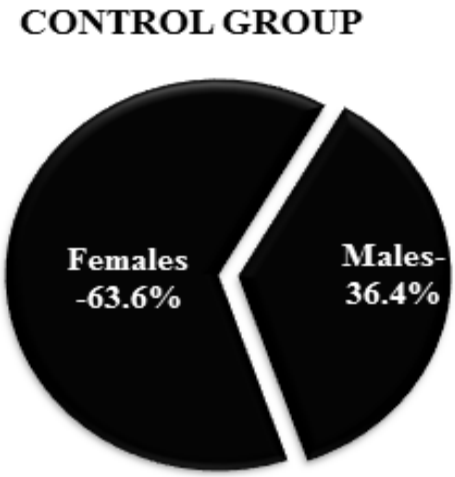


Fig 1&2:- Gender distribution of the study population

54.5% of the case group were males and 45.5% were females. In the control group, majority (63.6%) were females and only 36.4% were males.

BMI (In Kg/m^2)	CASE		CONTROL	
MEAN±SD	24.41±3.83		24.23±4.04	
	F	%	F	%
Below 18.5 (Underweight)	0	0	3	6.8
18.5-24.9 (Normal weight)	24	54.5	25	56.8
25.0-29-9 (Pre-obesity)	15	34.1	13	29.5
30.0-34.9 (Obesity class I)	5	11.4	3	6.8
TOTAL	44	100	44	100.0

Table 2:- BMI Distribution of the study population:

The study group were classified into the following Categories as per the WHO guidelines for Body Mass Index.*

Almost half of the cases (54.5%) and controls (56.8%) come under the category of normal weight. About 34.1% of the case group were pre-obese in nature and about 11.4% were obese in nature which attributes to the fact that obesity is a risk factor for hypertension. About 29.5% of the control group were pre-obese, 6.8% were obese and about 6.8% of them were underweight in nature.

ISSN No:-2456-2165

SBP RANGE (IN mmHg)*	CASE		SBP RANGE (IN mmHg)*	CONTROL	
MEAN±SD	129.09±21.43		MEAN±SD	113.41±11.19	
	F	%		F	%
OPTIMAL(<120)	12	27.3	OPTIMAL(<120)	26	59.1
NORMAL(120-129)	11	25.0	NORMAL(120-129)	9	20.5
HIGH NORMAL(130-139)	7	15.9	HIGH NORMAL(130-139)	9	20.5
GRADE 1- HYPERTENSION(140-159)	8	18.2	GRADE 1-HYPERTENSION(140-159)	0	0
GRADE-2 (160-179)	4	9.1	GRADE-2 (160-179)	0	0
GRADE- 3(≥180)	2	4.5	GRADE- 3(≥180)	0	0

Table 3:- Distribution of Resting Systolic BP (SBP) in the Study population *ESC/ESH Hypertension Guidelines [10- 12]

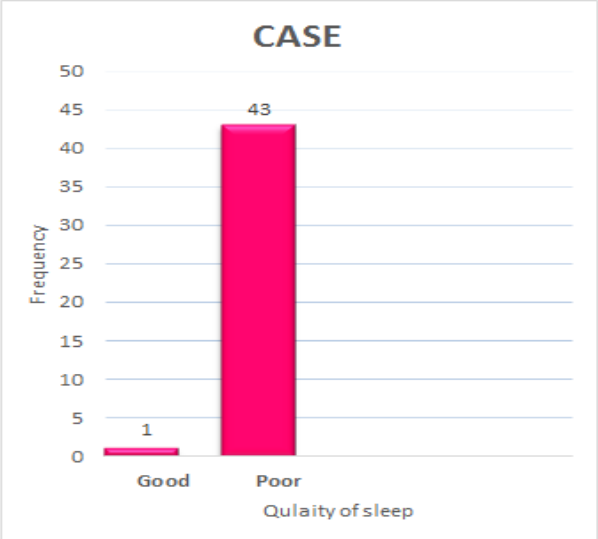
According to the ESC/ESH guidelines, among the case group about 27.3% had an optimal range of SBP, about 25% had normal range of SBP and about 15.9% had high normal SBP possibly attained through medication. Remaining 18.2%, 9.1% and 4.5% had grade-1, 2 and 3 hypertension respectively indicating the prevalence of systolic pre- hypertension and hypertension in most of the cases. Among the control group, 59.1% of the samples had an optimal resting systolic BP and the remaining 20.5% had normal and high normal SBP, with very few of the samples presenting with pre-systolic hypertension susceptive of anticipatory hypertension or due to any other reasons.

DBP RANGE (IN mmHg)	CASE GROUP		DBP RANGE (IN mmHg)	CONTROL GROUP	
MEAN±SD	82.27±11.78		MEAN±SD	73.07±7.64	
	F	%		F	%
OPTIMAL(<80)	15	34.1	OPTIMAL(<80)	27	61.4
NORMAL(80-84)	12	27.3	NORMAL(80-84)	15	34.1
GRADE 1(85-89)	11	25.0	GRADE 1(85-89)	2	4.5
GRADE 2(90-99)	5	11.4	GRADE 2(90-99)	0	011.4
GRADE 3(≥110)	1	2.3	GRADE 3(≥110)	0	0
Total	44	100.0	Total	44	100.0

Table 4:- Distribution of Resting Diastolic BP (DBP) in the study population *ESC/ESH Hypertension Guidelines [10-12]

About 34.1% and 27.3% of the hypertensive cases had an optimal and normal DBP respectively probably attained due to medication. About 25%, 11.4% and 2.3% had grade-1, grade -2 and grade- 3 diastolic hypertension respectively indicating the prevalence of both diastolic pre-hypertension and hypertension in the resting state. Among the normotensive controls, majority 61.4% had optimal DBP, 34.1%had a normal DBP and only a few (4.5%) had grade – 1 diastolic hypertension possibly due to some other reasons.

➢ *Sleep Quality*



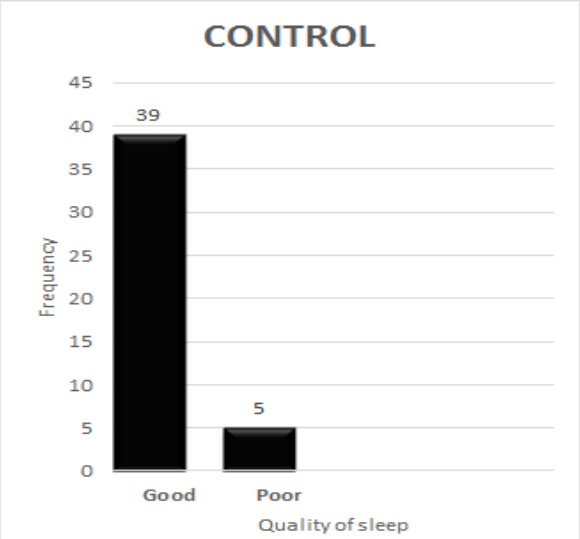


Fig 3 & 4: Distribution of Sleep Quality among case and control groups.*Pittsburg Sleep Quality Index

ISSN No:-2456-2165

The mean global PSQI scores of the case group was distributed as 7.73±2.11 and that of control group was distributed as 3.57±2.08. In the case group 97.7% were poor sleepers and only 2.3% were good sleepers. Among the control group, about 88.6% were good sleepers wherein only 11.4% were indicated with poor sleep.

GROUPS	N	MEAN(Global PSQI scores)	STANDARD DEVIATION	MANN-WHITNEY U-VALUE	P -VALUE
Hypertensive	44	7.73	2.117	-6.933	0.000
Normotensive	44	3.57	2.084		

Table 6:- Comparison of sleep quality among case and control groups. *Mann- Whitney U test, P<0.05 are considered to be statistically significant.

The mean sleep quality scores of the hypertensive group were distributed as 7.73±2.117 and that of the normotensive group were distributed as 3.57± 2.084. The differences between sleep quality scores among the case and control groups were found to be highly statistically significant (P<0.05) indicating that hypertensive individuals had higher sleep quality scores compared to that of the control group (Mean global PSQI scores> 5)

➢ *Sleep Disorders*

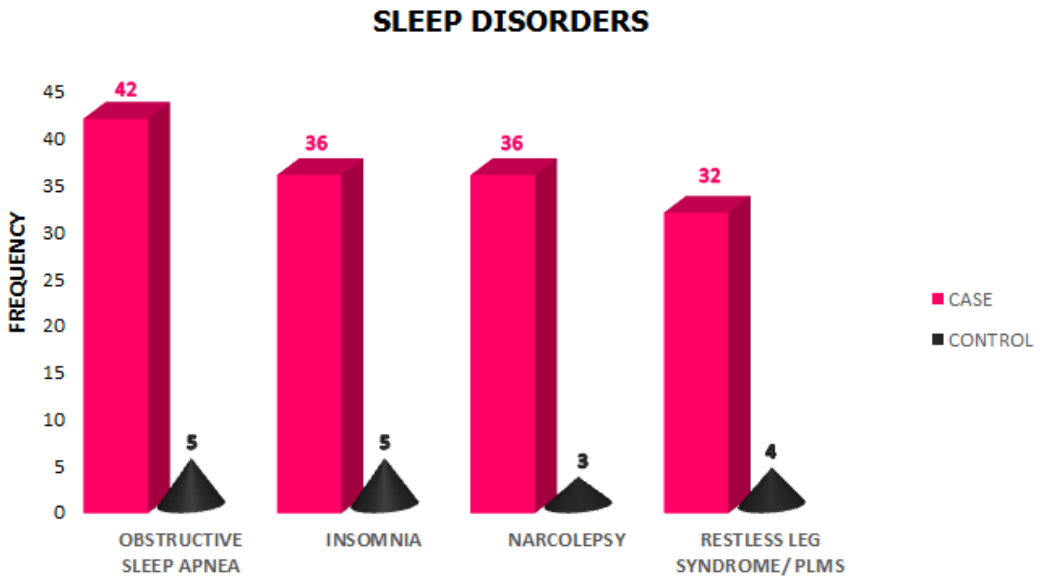


Fig 5:- Distribution of sleep disorders among the study population *Sleep Disorder Screening Questionnaire

Out of the 4 sleep disorders, majority (95.5%) of the hypertensive group were suffering from Obstructive Sleep Apnea (OSA). Also 81.8%, 81.8% and 72.7% of the case group had high incidence and prevalence of insomnia, narcolepsy and Restless Leg Syndrome (RLS) or Periodic Limb Movements of Sleep (PLMS) respectively. Among the control group only a 5% had OSA, another 5% with insomnia, 3% had narcolepsy and only 4% had RLS.

VI. DISCUSSION

Hypertension is a life threatening public health challenge irrespective of age groups and is associated with several complications mainly affecting cardiovascular functions, sleeping patterns and quality, autonomic nervous system functions, level of stress, renal functions and much more. Existing evidences focused on the impact of hypertension on sleep quality and prevalence of sleep disorders as separate parameters and no comparative studies were conducted yet to analyze the possible differences and to arrive at accurate conclusions. The present study aims to understand the effects of hypertension on quality of sleep in hypertensive subjects and also to compare those with normotensive subjects. Also screening was conducted to identify the prevalence of sleep disorders among hypertensive and normotensive subjects for comparison and to understand the incidence and prevalence of hypertension among a wide range of age group.

Florentine *et.al* in their study assessed the disorders related to the quality of sleep in hypertensive patients and in poor sleepers, the prevalence of hypertension found was 87.1%. Also, the conclusions says that Sleep Disordered Breathing and poor sleep quality are significantly associated to hypertension.[13] As per the results from the National Health and Nutrition Examination Survey held between 2005- 2008, it was found that, people with sleep disorders and short sleep duration had increased likelihood

of hypertension compared to those with none and may be possibly due to the fact that sleep deprivation affects sympathetic nervous system activity and possibly elevates BP.[14-17]

According to the evidence from a canine model demonstrated by D. Brooks *et.al,* OSA has been found as one of the systemic cause for elevation in day and night-time BP levels and is thus a significant predictor of hypertension. Several studies also indicate the association of insomnia with hypertension, [17, 4] RLS with hypertension [18-21] and certain other neurological disorders like narcolepsy, sleep- related bruxism, cataplexy etc. [22]

This study aims to forecast the differences in sleep patterns, quality and prevalence of sleep disorders between hypertensive and normotensive subjects. Out of the 44 hypertensive cases included in the study, 97.7% were found to be poor sleepers with sleep quality scores >5 when compared to the normotensive controls where, only a few (11.4%) were poor sleepers. On screening for sleep disorders, majority of the case group had OSA, insomnia, narcolepsy and Restless Leg Syndrome while only a few among the control group suffered from such sleep disorders as per their self- reports. This indicates that, hypertensive cases had a very poor sleep quality with majority of the group being poor sleepers and furthermore, majority of them duly suffered from all the 4 most common sleep disorders and thus the sleep pattern of hypertensive cases can be conclusively altered. Also, it can be used as a confirmatory evidence for the fact that hypertensive patients have poor sleep quality and increased prevalence of sleep disorders.

VII. CONCLUSION

Results obtained from this study highlights a strong statistical significance between the differences in the sleep quality and stress status between hypertensive and normotensive subjects indicating that compared to the normotensive individuals of the same age group, hypertensive patients had worse sleep quality. As per the data obtained through self- reporting of the subjects, sleep disorders mainly OSA and insomnia are highly prevalent among hypertensive individuals and almost half of the them suffer from narcolepsy and Restless Leg Syndrome or PLMS and among the controls a very few only had an incidence of these disorders and may be possibly due to some other reasons which require further research to be explored in detail.

RECOMMENDATION

This study puts- forth further investigations in the area of quantitative analysis regarding the aspects of sleep quality and sleep disorders, as the data collected were self-reported. Employing more number of samples in the future research may prove the facts and relationships in a better possible way.

REFERENCES

[1]. Kearney PM, Whelton M, Reynolds K, Muntner P, Whelton PK, He J Global burden of hypertension: analysis of worldwide data.2005. Lancet 365: 217–223.
[2]. Shikha Singh, Ravi Prakash, Gyan Prakash Singh. “Prevalence and Associated Risk Factors of Hypertension: A Cross-Sectional Study in Urban Varanasi.” *International journal of hypertension* .vol. 2017. https://doi.org/10.1155/2017/5491838
[3]. Alebiosu OC[1], Ogunsemi OO, Familoni OB *et al:* Quality of sleep among hypertensive patients in a semi-urban Nigerian community: a prospective study. 2009 Jan;121(1):166-72
[4]. David A. Calhoun and Susan M. Harding, Sleep and Hypertension, Chest. 2010 Aug; 138(2): 434–443
[5]. Laura Palagini, Rosa Maria Bruno, Angelo Gemignani e*t al*, Sleep Loss and Hypertension: A Systematic Review, Current Pharmaceutical Design. Volume 19 , Issue 13 , 2013
[6]. David A. Calhoun, Obstructive Sleep Apnea and Hypertension .Reports, June 2010, Volume 12, Issue 3, Pages 189–195
[7]. Jean-Louis Pepin, Anne-Laure Borel, Renaud Tamisier, Jean-Philippe Baguet, Patrick Levy, Yves Dauvilliers,Hypertension and sleep: Overview of a tight relationship,Sleep Medicine Reviews,Volume 18, Issue 6,2014,Pages 509-519.
[8]. Gangwisch JE, Feskanich D, Malaspina D, Shen S, Forman JP. Sleep Duration and Risk for Hypertension in Women: Results from the Nurses’ Health Study. *American Journal of Hypertension*. 2013; 26(7):903-911.
[9]. Buysse DJ[1], Reynolds CF 3rd, Monk TH, Berman SR, Kupfer DJ.The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. Psychiatry Res. 1989 May; 28(2):193-213.
[10]. H.K Chopra, C.Venkata S.Ram. Recent guidelines for hypertension, A Clarion call for BP control in India. Circulation Research.28 March 2019:124:984-986
[11]. Williams B, Mancia G, Spiering W, et al.; ESC Scientific Document Group. 2018 ESC/ESH guidelines for the management of arterial hypertension.Eur Heart J. 2018; 39:3021–3104.
[12]. Whelton PK, Carey RM, Aronow WS, et al.. 2017 ACC/AHA/AAPA/ABC/ACPM/AGS/APhA/ASH/AS PC/NMA/PCNA guideline for the prevention, detection, evaluation, and management of high blood pressure in adults: executive summary: a report of the American College of Cardiology/American Heart Association task force on clinical practice guidelines.J Am Coll Cardiol. 2018; 71:2199–2269.
[13]. A.FiorentiniR, ValenteA, PerciaccanteL, Tubani. Sleep's quality disorders in patients with hypertension and type 2 diabetes mellitus. International Journal of Cardiology. Volume, 8 January 2007, Pages E50-E52

[14]. Pooja Bansil MPH ,Elena V. Kuklina MD, PhD .Robert K. Merritt MA .Paula W. Yoon ScD, MPH. Associations between Sleep Disorders, Sleep Duration, Quality of Sleep, and Hypertension: Results From the National Health and Nutrition Examination Survey, 2005 to 2008.Journal of Clinical Hypertension. 14 July 2011. https://doi.org/10.1111/j.1751-7176.2011.00500.x
[15]. Gangwisch JE. Epidemiological evidence for the links between sleep, circadian rhythms and metabolism. Obes Rev 2009;10(Suppl 2):37–45.
[16]. Shamsuzzaman AS, Gersh BJ, Somers VK. Obstructive sleep apnea: implications for cardiac and vascular disease. JAMA. 2003; 290:1906–914.
[17]. Vgontzas, A. N., Liao, D., Bixler, E. O., Chrousos, G. P., & Vela-Bueno, A. (2009). Insomnia with objective short sleep duration is associated with a high risk for hypertension. *Sleep*, *32*(4), 491–497.
[18]. Ulfberg J, Nyström B, Carter N, Edling C. Prevalence of restless legs syndrome among men aged 18 to 64 years: An association with somatic disease and neuropsychiatric symptoms. Movement Disorders. 2001;16:1159–1163
[19]. Phillips B, Hening W, Britz P, Mannino D. Prevalence and Correlates of Restless Legs Syndrome*. Chest. 2006;129:76–80.
[20]. Batool-Anwar, S., Malhotra, A., Forman, J., Winkelman, J., Li, Y., & Gao, X. (2011). Restless legs syndrome and hypertension in middle-aged women. *Hypertension (Dallas, Tex. : 1979)*, *58*(5), 791–796.
[21]. Sabic, A., Sinanovic, O., Sabic, D., & Galic, G. (2016). Restless Legs Syndrome in Patients with Hypertension and Diabetes Mellitus. *Medical archives (Sarajevo, Bosnia and Herzegovina)*, *70*(2), 116–118. doi:10.5455/medarh.2016.70.116-118
[22]. Meghna P. Mansukhani, Naima Covassin, Virend K. Somers.Neurological Sleep Disorders and Blood Pressure, *Hypertension AHA*Journals ;3 Sep 2019;74:726–732.