

Original Research Article

A STUDY OF 24 HOURS AMBULATORY BLOOD PRESSURE AMONG RESIDENT DOCTORS WORKING AT A TERTIARY CARE HOSPITAL IN NORTHERN INDIA

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ABSTRACT

Background: Ambulatory blood pressure monitoring (ABPM) provides the dynamic BP variations in relation to daily activities. Among physicians, BP elevations have been reported in clinical residents, compared to non-clinical residents. The aim and objective is to demonstrate that resident doctors of clinical courses are more prone to develop hypertension in comparison to those of non-clinical courses due to their more stringent duty schedule.

Materials and Methods: We conducted a descriptive cross-sectional study and recruited 159 healthy junior residents, 76 from clinical and 83 from non-clinical departments. Their office BP and ambulatory BP measurements were done following the ESH/ESC 2018 guidelines.

Results: Out of 159 residents, 93 were true normotensive, 24 were true hypertensive, 8 were white-coat hypertensive, 34 were masked hypertensive, 92 were dippers, 50 were non-dippers, 12 were reverse dippers and 5 were extreme dippers. The number of residents having true hypertension, white coat hypertension, masked hypertension, non-dipping, reverse dipping and extreme dipping were more in the clinical group as compared to those of non-clinical group.

Conclusion: Our study concludes that various modifiable risk factors like long working hours, inadequate sleep and work-related stress are significantly present in clinical residents as compared to non-clinical residents leading to more prevalence of non-dipper and reverse dipper in clinical group making them vulnerable for increased target organ involvement and increased cardiovascular morbidity and mortality. Hence there is an urgent need to improve and modify these work-related risk factors so that these young generation resident doctors can be prevented from falling into the high-risk category for developing hypertension and other cardiovascular comorbidities.

Keywords: Ambulatory blood pressure, dipper, non-dipper, resident doctors, reverse dipper.

INTRODUCTION

High blood pressure (BP) is currently the greatest threat to the global burden of disease. [1,2] The prevalence of hypertension is increasing rapidly in developing countries, where poor hypertension treatment and control contribute to a growing epidemic of cardiovascular disease. Half of this disease burden occurs in people with hypertension

(i.e. BP $\geq$ 140/90 mmHg); the other half occurs in people with lesser degrees of high BP (prehypertension). [3]

It is well known that BP and heart rate fluctuate over 24 hours. These fluctuations are due to complex internal physiological mechanisms, external stresses and own circadian rhythm attempting to synchronize day and night time BP. [4] Stress can cause hypertension through repetitive BP elevations and

through vasoconstricting hormones produced by nervous system.^[5]

Ambulatory blood pressure monitoring (ABPM) measures the mean level of BP over prolonged period of time and provides a person's "true" BP. ABPM takes the dynamic BP variations in relation to daily activities (i.e. to changes in physical activity and postures, to location e.g. home versus work, to psychological state and mood, waking versus sleep).^[6] Normally nocturnal BP falls between 10-20% of mean arterial pressure (MAP) and those individuals with nocturnal BP fall <10% are classified as non-dippers & have poorer cardiovascular outcomes.^[7] Shift work alters the diurnal variation of BP from a dipper to a non-dipper pattern, and increase the risk of hypertension among night shift workers.^[8]

Among physicians, BP elevations have been reported during particularly strenuous working conditions such as 24 hours or night shifts in the emergency room, compared to less strenuous periods. Recent studies suggest the prevalence of prehypertension and hypertension is high among medical students.^[9,10]

In this study, we included healthy junior residents from various departments of our institute to look for BP and dipping pattern by ABPM and to compare results between residents working in clinical and non-clinical departments.

MATERIALS AND METHODS

This descriptive cross-sectional study was carried out on 159 subjects in the Department of Medicine, King George Medical University, Lucknow, UP, a tertiary care hospital in Northern India. Ethical clearance was obtained from the Institutional ethical committee.

Methodology: 159 healthy junior residents, 76 from the clinical departments and 83 from the non-clinical departments were recruited in this study. We took BP measurement of clinical residents who had night shift on the next working day. A predesigned and pretested semi-structured questionnaire was used which was filled in an interview-based session by study participants. Each eligible participant was instructed not to take any stimulant (e.g. tea or coffee) before office BP measurement for at least one hour. We noted weekly duty hours of residents as per the schedule and divided residents into two categories, first who were working ≤ 48 hours per week and second those who were working > 48 hours per week. We also noted the resident's average sleeping hours per week. Based on guidelines by the American Academy of Sleep Medicine (AASM) and Sleep Research Society (SRS) categorized them into two categories, first with sleeping hours ≥ 49 hours/week and second with < 49 hours/week.^[11]

BP Measurement: Office BP was measured using an aneroid sphygmomanometer using the standard protocol. The ABPM was done with the ABPM machine which was programmed to obtain BP every

30 minutes in a day and every hour at night. The participants were educated that the device would repeatedly inflate the cuff and measure BP at regular intervals for over 24 hours. The participants were advised to continue with their normal daily activities, and take all their routine medications. When the cuff started to inflate the participants were advised to keep the arm still and relaxed, stop moving and talking and breathe normally during day time. They were advised to avoid activities such as vigorous exercise. They were asked to maintain a brief diary to record the timing of activities, postures, sleep, medications if any, and symptoms (e.g. dizziness) that may be related to BP. We used ESH/ESC 2018 guidelines, to define hypertension, as office systolic BP (SBP) values > 140 mmHg and/or diastolic BP (DBP) values > 90 mmHg, ambulatory 24 hour mean SBP > 130 mmHg &/or DBP > 80 mmHg, day time mean SBP > 135 mmHg &/or DBP > 85 mmHg, night time mean SBP > 120 &/or DBP > 70 mmHg.^[12] Dipping pattern was also noted. those individuals with nocturnal BP fall $< 10\%$ are classified as non-dippers & have poorer cardiovascular outcomes.

Interpretation of results: Measurements obtained from ABP monitoring were interpreted by connecting the device with a computer. Based on the readings participants were classified as:-

1. True hypertensive, white coat hypertensive, masked hypertensive and true normotensive,
2. Dippers, non-dippers, reverse dippers and extreme dippers.

Results obtained in residents working in the clinical department were compared with the residents working in non-clinical departments. The statistical analysis was done using SPSS (Statistical Package for Social Sciences) Version 24.0.

RESULTS

The majority of participants were male (73%) with a mean age of 27.86 ± 3.01 years. 37% were overweight, 23% had a family history of hypertension and 11% had a history of either alcohol intake or smoking. All the clinical residents had duty hours > 48 hours/week and sleeping hours ≤ 49 hours/week while all the non-clinical residents had duty hours ≤ 48 hours/week and 75.9% had sleeping hours > 49 hours/week.

Systolic and diastolic BP pattern of study participants, its association with working hours and sleeping hours and dipping pattern is shown in table 1, 2, 3 and 4 respectively.

Out of 159 residents, 93 were true normotensive, 24 were true hypertensives, 8 were white-coat hypertensive and 34 were masked hypertensive. The number of residents having true hypertension, white coat hypertension and masked hypertension were more in clinical group as compared to non-clinical group.

Among study participants, 92 were dippers (including 29 clinical and 63 non-clinical residents),

50 were non-dippers (40 clinical and 10 non-clinical residents), 12 were reverse dippers (10 clinical and 2

non-clinical residents) and 5 were extreme dippers (3 clinical and 2 non-clinical residents).

Table 1: Systolic and Diastolic BP pattern of study participants (n=159)

SN	Variable	Clinical Residents (n=76)		Non-clinical Residents (n=83)		p-value
		Mean	SD	Mean	SD	
1.	Office SBP (mmHg)	124.66	13.79	124.89	11.35	0.907
2.	24 hours mean SBP (mmHg)	120.38	9.50	115.25	10.39	<0.001
3.	Day time mean SBP (mmHg)	121.49	11.33	121.14	13.22	0.862
4.	Night time mean SBP (mmHg)	112.95	11.04	106.35	9.73	<0.001
5.	Office DBP (mmHg)	77.76	8.47	76.29	6.82	0.039
6.	24 hours mean DBP (mmHg)	75.46	7.14	68.70	9.20	<0.001
7.	Day time mean DBP (mmHg)	77.51	7.58	69.67	9.49	<0.001
8.	Night time mean DBP (mmHg)	69.75	8.72	65.80	9.22	0.006

DBP = diastolic blood pressure, SBP = systolic blood pressure

Table 2: Association of systolic and diastolic BP pattern with working and sleeping hours per week

SN	Variable	Working hours (per week)					Sleeping hours (per week)				
		≤ 48 hours		> 48 hours		p-value	≥ 49 hours		<49 hours		P-value
		Mean	SD	Mean	SD		Mean	SD	Mean	SD	
1.	Office SBP (mmHg)	124.89	11.35	124.66	13.79	0.907	127.81	10.10	124.32	12.83	0.236
2.	24 hours mean SBP (mmHg)	115.25	10.39	120.38	9.50	<0.001	115.47	9.58	118.82	10.46	0.052
3.	Day time mean SBP (mmHg)	121.14	13.23	121.49	11.33	0.862	127.16	11.08	120.05	8.38	0.079
4.	Night time mean SBP (mmHg)	106.35	9.73	112.95	11.04	<0.001	106.71	9.62	111.33	11.28	0.008
5.	Office DBP (mmHg)	80.29	6.82	77.76	8.47	0.039	81.52	6.48	78.71	7.86	0.121
6.	24 hours mean DBP (mmHg)	68.70	9.20	75.46	7.14	<0.01	68.30	8.39	73.75	8.66	<0.01
7.	Day time mean DBP (mmHg)	69.67	9.49	77.51	7.58	<0.001	70.05	8.38	73.93	9.53	0.079
8.	Night time mean DBP (mmHg)	65.80	9.22	69.75	8.72	0.006	65.17	8.71	69.33	9.14	

clinical residents, 24 h mean ABP, night time mean BP was significantly higher in residents of clinical group ($p < 0.001$). However, on comparing office BP and day time mean BP no significant difference was found. On comparing diastolic BP, office, 24 hours mean, day time as well as night time mean diastolic BP was found to be significantly raised among residents of clinical group ($p = 0.039$, < 0.001 , < 0.001 and 0.006 respectively). More prevalence of hypertension among clinical group could be due to effect of stressful environment in clinical settings, long working hours and lesser sleeping hours of residents of clinical group compared to non-clinical group.

The overall prevalence of white coat hypertension (WCH) in the general population is 10-15%.^[22] In our study we found that 5% of total residents were white coat hypertensives. Two third of these were from clinical group while one third were from non-clinical group. Treatment decisions based on office BP alone might result in substantial overdiagnosis. The long-term outcome of WCH is not clear but most studies agree that patient of WCH has a higher possibility of progression to sustained hypertension.

21.4% of the total residents were found to have masked hypertension by ABPM in our study, the majority were from clinical group. These masked hypertensive residents would have been missed if ambulatory monitoring had not been done. Moo-Yong Rhee et al in their study found 16.22% of total 496 participants had masked hypertension. In their study the estimated prevalence of masked hypertension was 17.5%, 20.58%, 24.34%, and 13.29% in the age categories of 30s, 40s, 50s, and 60s, respectively.^[23] So screening and periodic monitoring of resident doctors for hypertension should be incorporated at the time of entrance and during their residency period.

Many studies suggest that raised BP and increased risk of cardiovascular disease is associated with long working hours. Residents of clinical department don't have fixed working hours. They have emergency duties, night time duties and shift work. They work in a stressful environment during their emergency duties. 24 hours mean systolic and diastolic BP of the clinical residents were 115.25 ± 10.39 and 68.70 ± 9.20 which were higher as compared to non-clinical group. Similarly, day time mean and night time mean systolic and diastolic BP of clinical residents were found to be higher than that of non-clinical residents. A statistically significant difference ($p < 0.05$) was found between long working hours and both systolic and diastolic BP pattern. Kivimaki et al found that working long hours was associated with an increase in risk of incident coronary artery disease and incident stroke.^[24] Similar results were found by Fadel et al and Lee et al.^[25,26] The resident doctors who have long working hours are prone to develop hypertension and other cardiovascular comorbidities, so working hours of residents should be optimised.

Sleep deprivation has a great effect on cardiovascular regulation through the autonomic nervous system. Cohort studies reported increased incidence of cardiovascular diseases (CVD) in short sleepers.^[27] In our study, out of 159 total residents, 60.4% had fewer sleeping hours. All the residents of clinical group had sleeping hours < 49 hours/week. The mean sleeping hour of clinical residents (40 ± 3.70) was lesser compared to residents of non-clinical department (51.48 ± 3.70). We found that 24 hour mean systolic BP ($p = 0.05$) and night time mean systolic BP ($p = 0.008$) was significantly higher in residents with sleeping hours < 49 hours/week when compared to residents who had sleeping hours > 49 hours/week. However, the difference in office systolic BP and day time mean systolic BP of both the groups were not statistically significant. Similarly, 24 hours mean diastolic BP ($p < 0.01$) and night time mean diastolic BP ($p = 0.005$) was statistically significantly higher in residents with sleeping hours < 49 hours/week when compared to residents who had sleeping hours > 49 hours/week. However, the difference in office diastolic BP and day time mean diastolic BP was not statistically significant. Ru-Qing Liu et al evaluated the association between sleep quality, as determined by the Pittsburgh sleep quality index (PSQI), and hypertension and concluded that the global PSQI score and its components (short sleep duration, poor sleep quality, prolonged sleep latency and sleep disturbance) were associated with high BP.^[28] Poor sleep quality and stressful status are closely associated with higher activation of sympathetic nervous system, and independent predictors of non-dipping hypertension.^[29]

In our study, 57.9% residents had normal dipping pattern of BP while 31.4% residents had non-dipping pattern of BP. Non-dipping pattern was more prevalent in clinical group. Mean of dipping in BP was statistically significantly lower (falling into non dipper or reverse dipper range) in residents in clinical group ($p < 0.001$) when compared to residents in non-clinical group. This dipping pattern in BP was found to be statistically significant in subjects with long working hours ($p < 0.001$) as well as with inadequate sleeping hours ($p = 0.05$). Huan Yang et al found in his study that repeated inadequate sleeping blunts sleep associated BP dipping.^[30] These non-dipper participants may be at increased risk of hypertension due to repetitive blunting of sleep associated BP dipping, and resultant increase in mean circadian BP. We found in our study that prevalence of raised BP is more among clinical residents and this might be due to their long working hours, less sleeping hours and work-related stress in clinical settings. Presence of these risk factors among clinical residents make them vulnerable for development of hypertension and other cardiovascular comorbidities. So, these risk factors should be reviewed and modified to prevent progression. Working hours of the resident doctor should be rescheduled to allow proper rest. A long duty at a stretch should be discouraged. Proper

measures need to be taken to improve sleep time and sleep quality of resident doctors. The number of resident doctors should be raised to overcome poor doctor: population ratio. Teaching programme to overcome the work-related stress should be introduced. Screening programme to diagnose at risk young doctors should be developed to identify those at risk so that early intervention and other measures can be taken to prevent development of cardiovascular comorbidities. Periodic monitoring of the resident doctors should be done for raised BP.

Whether these residents will develop hypertension in future and whether they should be treated? Whether abnormal dipping pattern will lead to cardiovascular complications? Further follow up and research with larger sample size is required to answer these questions.

The strength of this study can be attributed to the BP measured with validated automatic device.

The main limitations of our study are, our study was a single centre study, this is a cross-sectional study and long term follow up of the participants was not done which might affect our results and this study was done in tertiary care referral hospital with average bed occupancy of more than 100% and it may not correlate with other institutions.

CONCLUSION

Our study concludes that various modifiable risk factors like long working hours, inadequate sleep and work-related stress are significantly present in residents which make them prone to develop hypertension and other cardiovascular comorbidities. Also, the prevalence of non-dippers and reverse dippers was found to be higher in clinical residents compared to non-clinical residents making them vulnerable for increased target organ involvement and increased cardiovascular morbidity and mortality. Hence there is an urgent need to improve and modify these work-related risk factors so that these young generation resident doctors could be prevented from falling into the high-risk category for developing hypertension and other cardiovascular comorbidities.

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