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Ambulatory BP Monitoring: Self-Reported Sleep-Time Versus Prefixed Night-Time BP–Accuracy and Safety of Hypertension Diagnosis.

Dr. E. Dinesh Ragav[1], Dr. Sharada Sivaram K[2*], Dr. Aashish Arumugam[3], Dr.Magesh Vadivelu[4]

[1]Senior Resident, Department of Cardiology, MMCHRI, MAHER, Kanchipuram, Tamil Nadu
[2*]Professor & Head, Department of Cardiology, MMCHRI, MAHER, Kanchipuram, Tamil Nadu
[3]Associate Professor, Department of Cardiology, MMCHRI, MAHER, Kanchipuram, Tamil Nadu
[4]Associate Professor, Department of Cardiology, MMCHRI, MAHER, Kanchipuram, Tamil Nadu

Corresponding Author: Dr. Sharada Sivaram K[2*]
Professor & Head, Department of Cardiology, MMCHRI, MAHER, Kanchipuram, Tamil Nadu.
Address: MEENAKSHI MEDICAL COLLEGE HOSPITAL AND RESEARCH INSTITUTE (MMCHRI), Raasi Nagar, Karrapettai Post, Enathur, Meenakshi Nagar, Tamil Nadu 631552

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ABSTRACT:

Introduction: Ambulatory 24-hour BP monitoring (ABPM) is considered gold standard for evaluation of hypertension, an important risk factor for cardiovascular disease and death. While it gives many parameters of useful information, it is important to minimize data inaccuracies by defining daytime & night-time periods correctly.
Aim & Objectives: To determine whether defining diurnal periods by actual self-reported Sleep-Time versus a preset fixed-time produce different estimates of night-time ambulatory blood pressure, in postgraduate medical college student population of our Institute.
Methods & Materials: In this observational study, medical students doing their postgraduate course in our Institute were chosen for evaluation of their BP with a 24-hour ambulatory BP monitoring. When returning the monitor, participants reported actual sleep/wake times and this was compared with preset Night-Time (22:00-07:00 hours) for interpretation of the data.
Results: The study included 34 young PG doctors (18 males and 16 females), mean age 27.6 (range 23-32) years. The preset Night-Time SBP was 115 ±13 mmHg versus Sleep-Time SBP 111 ±13 mmHg. The mean difference was 4.5±4, ($p < 0.0001$ statistically significant). The preset Night-Time DBP was 71±10 mmHg versus Sleep-Time DBP 65±9 mmHg. The mean difference was 5±6 ($p< 0.0001$).
Conclusions: When evaluating hypertension ABPM, it is better to diligently use self-reported actual sleep period rather than preset Night-Time for accurate estimate of nocturnal blood pressure, so that potentially hazardous overtreatment can be prevented.

Keywords: Ambulatory Blood Pressure monitoring, Sleep-Time blood pressure, preset Night-Time blood pressure, Postgraduate medical students

1. Introduction/ Background:

Hypertension (HT) is well known important risk factor for cardiovascular disease, disability and death. Among young adults, (defined as ages 18–39), about 15% of women and 20% of men are diagnosed with hypertension. Prevalence may be expected to be Higher in more stressful profession, such as that of postgraduate medical student. According to Whelton et al.,(2017), Ambulatory 24-hour BP monitoring (ABPM) is recommended standard for evaluation of hypertension, an important risk factor for cardiovascular disease (CVD), disability and death. It is also a useful way to detect white coat hypertension, masked hypertension, and sustained hypertension.

Booth, et al. (2016) says, using ABPM, several parameters can be derived including mean Night-Time and Daytime ABP and BP non-dipping status (if <10% decline in nocturnal systolic & diastolic BP). Higher mean Night-Time ABP, daytime ABP and "non-dipper" status have been associated with increased risk for target-organ damage, CVD and all-cause mortality.

In a study by Delaney et al,. (2008), Postgraduate medical students have challenges due to lack of adequate sleep, academic/ work pressures, unhealthy food habits and lack of adequate time for physical exercise.

An American Heart Association Meeting Report dated 2019 mentions, if already they have higher non-modifiable cardiovascular risk factors, such as strong family history of HT/CVD, then it is expected to aggravate their own risk of developing the same.

Also, Rehman, et al,. (2011) and Patnaik et al,. (2015) states that lack of awareness regarding occurrence of hypertension is common in young adults, including medical students. Hence, it is imperative to have studies assessing important risk factor of hypertension in this at-risk population as per Namita et al,. (2017). There have been no studies of ABPM to study pattern of BP and prevalence of elevated BP in this young, stressed population.

2. Methodology:

In this observational study, medical students doing their postgraduate course in our Institute will be chosen for evaluation of their BP with a 24- hour ABPM. It is a cross-sectional study, and the study participants will be Postgraduate medical students of 3 admission year batches.

Study participants were explained about the purpose of the study and assured privacy and confidentiality of the information provided by them, to obtain their informed consent.

Their baseline demographics, height, weight, body mass index was documented. Also, questionnaire detailing information about tobacco use, alcohol consumption, exercise habits, and past medical history was taken. A baseline12-lead ECG was done and all of them underwent 24-hour ABPM.

Body mass index (BMI) was calculated as weight in kilograms divided by the square of standing height in meters. Participants were classified as overweight if BMI was between 25-29.9 kg, while obesity was defined as BMI greater than 29.9 kg (Booth et al, 2016).

Ambulatory BP monitoring (ABPM): (GE Ambulatory Blood Pressure recorder TONOPART V1) yields many readings over a continuous period. Patient wore the device that was about size of a portable radio and was attached to a belt or strap worn on their waist. A BP cuff that is attached to the device was worn around their upper arm, which inflates at certain intervals throughout the day and night. After 24 hours, device and BP cuff were removed and returned to hospital. A computer analyzed the readings and generated results.

Readings were set to be taken every 30 minutes during the day and every hour at night and heart rate was measured at the same time. These multiple readings were averaged over the 24-

hour period. Changes in BP and heart rate, the BP distribution pattern and other statistics were system-generated.
The ambulatory blood pressure monitoring (ABPM) classification of BP values:
Normal values are defined as a daytime SBP/DBP of ≤130/80 mm Hg, a Night-Time SBP/DBP of 110/65 mm Hg, and a 24-hour SBP/DBP of 125/75 mm Hg (Booth et al, 2016).
Values above daytime SBP/DBP of 135/85 mm Hg, a Night-Time SBP/DBP of 120/70 mm Hg, and a 24-hour SBP/DBP of 130/80 mm Hg correspond to Stage II hypertension (clinic BP ≥140/90mm Hg) (Booth et al, 2016).

Inclusion criteria:
1. Postgraduate medical student of our Institute.
2. Willing to give informed consent.
3. Age between 18-39 years.

Exclusion Criteria:
1. Previous history of having high blood pressure
2. Students with renal or renovascular disease, polycystic kidney, pheochromocytoma, Cushing syndrome, acromegaly, hypothyroidism, and hyperparathyroidism
3. History of intake of drugs, such as steroids, oral contraceptive pills, known to be associated with secondary hypertension.

3. Results:

- The study included 34 young PG doctors (18 males and 16 females), mean age 27.6 (range 23-32) years.
- The preset Night-Time SBP was 115.03 ±13.13 mmHg versus Sleep-Time SBP 110.56 ±13.02 mmHg. The mean difference was 4.47±4.40, t value 6.092, with p value 0.0001 (statistically significant). (Table 1) (Figure 1)
- The preset Night-Time DBP was 70.50±9.63 mmHg versus Sleep-Time DBP 65.42±8.98 mmHg. The mean difference was 5.08±5.94, t value 5.131, with p value 0.0001 (statistically significant). (Table 2) (Figure 2)

4. Discussion:

ABPM is currently the gold standard for correct diagnosis of hypertension. But care should be taken to have accurate record of actual time in sleep to arrive at correct diagnosis (Palatini et al 2012). Using preset versus actual self-reported –Night-Time approaches to define the true sleeping time on ABPM may lead to different estimates of ABP. This can result in over diagnosis of Nocturnal systolic and diastolic HT with possible over-treatment which may be unsafe for individual patients as demonstrated similar to Booth et al,. (2016).

Similarly, in a study of adolescents with Type 1 diabetes, Delaney et al,. (2008) demonstrated that by using the actual reported Sleep-Time, the mean ± SE fall in nocturnal systolic blood pressure was 11.6 ± 4.7%. When the mean systolic nocturnal dip was measured using the preset Sleep-Time, the mean fall in Night-Time systolic blood pressure was only 8.8 ± 4.9%. Two-thirds (64%) of patients had a normal nocturnal decline in systolic blood pressure (14.9 ± 3.1% mmHg), whereas 36% had an abnormal dip (5.7±2.8% mmHg). Repeat ABPM performed in 22 of the 35 non-dippers revealed that only 36% had abnormal systolic dipping confirmed on the repeat ABPM. Hence the use of actual reported Sleep-Time is required to accurately determine the nocturnal dip in systolic blood pressure. Repeating ABPM in non-dippers is essential to confirm this abnormality (Delaney et al,. 2008).

In a community study of 330 adults with ABPM and actigraphy, Booth, J.N., Muntner, P et al. (2016), showed mean differences (95% CI) in Night-Time systolic ABP for self-report versus fixed-time was −0.53 (−6.61, +5.56) mmHg, self-report versus actigraphy was 0.91 (−3.61, +5.43) mmHg and fixed-time versus actigraphy was 1.43 (−5.59, +8.46) mmHg (Booth et al,. 2016). The authors concluded that their data supports using self-reported sleep-time to define diurnal periods during ABPM.

Similar to the abovementioned studies, our study also demonstrated that the error of overestimation of ABPM SBP and DBP was significantly higher when preset Night-Time data is used compared to that of self-reported Sleep-Time. Both systolic and diastolic BP were higher with machine-set Nighttime (of 10PM to 7AM) and if this report was not edited for actual sleep time, could have led to significant over-estimation of the readings. This would have not only diagnostic errors but also could have concerning negative psychological impact in the subjects and possible needless initiation of pharmacological interventions by the unaware-clinicians.

The study limitation is that, being a sub-study of a bigger study were only part of data has been used for interpretation. Hence, a larger study population would have been better for interpreting further significant data.

FIGURES

Figure 1. Sleep-Time Systolic BP (SBP) versus Night-Time SBP analysis ANALYSIS

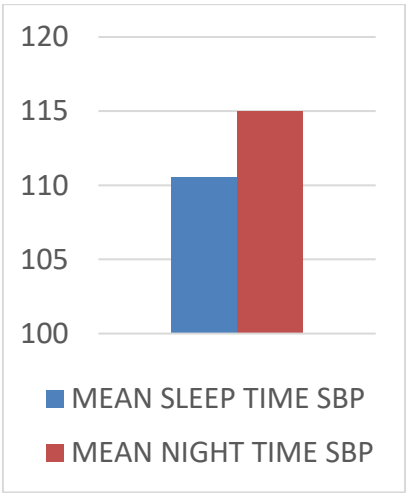
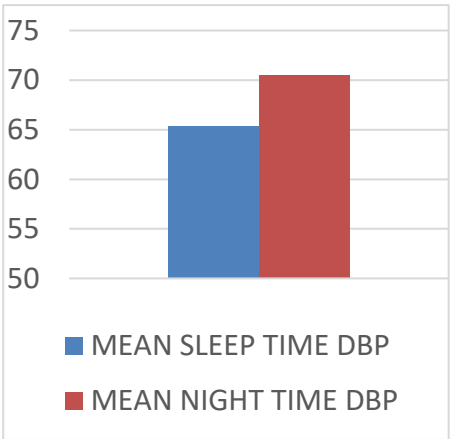


Figure 2. Sleep-Time Diastolic BP (DBP) versus Night-Time DBP analysis



Legends/Captions for figures:

Figure 1. Sleep-Time Systolic BP (SBP) versus Night-Time SBP analysis

Figure 2. Sleep-Time Diastolic BP (DBP) versus Night-Time DBP analysis

TABLES

Table 1. Night-Time Systolic BP (SBP) versus Sleep-Time SBP

Variables	**Mean ± SD**	**Mean difference**	**Standard deviation**	**Paired t-Value (P-Value)**
Night-Time SBP	115.03 ±13.127	4.472±4.404		6.092 (.0001)
Sleep-Time SBP	110.56 ±13.015			

Interpretation: the mean differences for the Night-Time and Sleep-Time are 4.472±4.404, t value 6.092, with p-value 0.0001 which is statistically significant.

Table 2. Night-Time Diastolic BP (DBP) versus Sleep-Time DBP

Variables	**Mean±SD**	**Mean difference**	**Standard deviation**	**Paired t-Value (P-Value)**
Night-Time DBP	70.50±9.629	5.083±5.944		5.131 (.0001)
Sleep-Time DBP	65.42±8.977			

Interpretation: the mean differences for the Night-Time and Sleep-Time are 5.083±5.944, t value 5.131, with p-value 0.0001 which was statistically significant.

5. Conclusions:

Using pre-set Night-Time data on ABPM should be interpreted with caution as this method results in a significant overestimation of both systolic and diastolic BPs, which is mostly due to inclusion of waking hours in the preset night-time period. Diligent practice of using self-reported actual sleep period will minimize this data error and potentially obviate medication harm in concern with newer technological assessment of a common yet serious cardiovascular disease risk factor of hypertension.

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Conflict of Interest:
No conflict of interest.

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