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Association of Circadian Variation of Blood Pressure with Obesity in Healthy young Adult Males

Jawahar Lal Agarwal[1], Sumit Garg[2], Gagan Singh[3]

Abstract

Blood pressure follows a circadian variation i.e. it falls at night during sleep (nocturnal dipping) and rises in the morning. Lack of nocturnal dipping predisposes to various cardiovascular diseases. Obesity is increasing day by day especially in younger age. It may be considered as a risk factor for various cardio metabolic diseases like hypertension, diabetes. The present study was designed to investigate the association of various obesity parameters with circadian variation of blood pressure as assessed by dipper state. 60 healthy young adults of age between 20 to 35 years were enrolled. Subjects with any H/o hypertension, cardiovascular, renal disorders were excluded. BMI was calculated. Waist circumference (WC) was measured in cms. Skinfold thickness was measured using Harpendent skinfold calipers and body fat percentage was calculated using Durnin-Womersley formula. 24 hours Ambulatory Blood Pressure was measured using Contec Ambulatory Blood Pressure Monitor (ABPM). ABPM was set to measure BP every 15 min during daytime and every 30-min in night time while sleeping. Subjects were divided into two groups according to their dipper profile, as defined: dippers (nocturnal decrease in systolic BP was ≥ 10% of daytime BP) and non-dippers (nocturnal decrease in systolic BP was <10% of daytime BP). The average BMI, waist circumference and body fat percentage were significantly more in non-dippers than dippers. Non-dippers even if normotensives are at more risk of cardiovascular complications. Hence, ABPM should be performed in obese individuals to know their dipper state and assess the risk of cardiovascular complications associated with non-dipping.

Keywords: BMI; Waist Circumference; Body Fat Percentage; Ambulatory Blood Pressure Monitoring; Non Dipper.

Introduction

Circadian rhythm may be defined as the intrinsic, regular fluctuation of a physiologic process. Like many other physiological processes in the body, BP also generally varies according to a circadian rhythm characterized by a reduction during sleep and an increase during wakefulness [1,2].

The decrease in BP during sleep is referred to as "nocturnal dipping" and is partly attributable to decrease in sympathetic output. Although arbitrary, a decrease of 10% to 20% in mean nocturnal BP (both systolic and diastolic) compared with mean daytime BP is considered normal. Conversely, an absence of nocturnal dipping, or non-dipping, is designated as a less than 10% decrease in nocturnal BP. Lack or diminished nocturnal dipping of BP is a strong, independent predictor of cardiovascular risk. The Ohasama study noted that on average, each 5% deficiency in the normal decline in nocturnal BP was associated with an approximately 20% greater risk in cardiovascular mortality [3]. Many diseases are associated with diminished or absence of nocturnal dipping, including most secondary causes of hypertension, chronic kidney disease, diabetes, older age, resistant hypertension, and obstructive sleep apnea (OSA) [4].

Obesity is increasing at an alarming rate in the modern world. Nowadays, due to sedentary lifestyle, the problem of obesity starts from a younger age. Epidemiological studies clearly demonstrate a correlation between body weight and blood pressure in obese populations. In the Framingham Study, 70% of the new cases of essential hypertension were related to excess body fat [5,6]. Obesity is also a risk factor of non-dipping state not only in hypertensives but also in normotensives. Study done by Kotsis et al showed that in subjects more than 40 years of age more than 70% of obese were non-dippers [2].

Author's Affiliations: [1]Professor & Head [2]Associate Professor [3]PG II year, Department of Physiology, Saraswathi Institute of Medical Sciences, Hapur, Uttar Pradesh 245304, India.

Corresponding Author: Sumit Garg, Associate Professor, Department of Physiology, Saraswathi Institute of Medical Sciences, Hapur, Uttar Pradesh 245304, India
E-mail: sumitgargdr@gmail.com

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Ambulatory blood pressure monitoring has gradually become a widely used clinical tool for diagnoses of hypertension. It is a simple and novel method to measure BP even at night when the subject is sleeping and can easily give information about the dipping state.

The present study was designed to investigate the effect of obesity on dipper state in young adult males.

Objectives

1. To compare BMI in dippers and non-dippers in healthy young adult males
2. To compare Waist Circumference in dippers and non-dippers in healthy young adult males
3. To compare body fat percentage in dippers and non-dippers in healthy young adult males

Subjects and Methods

Study Sample

The present study was conducted in the Department of Physiology of Saraswathi Institute of Medical Sciences, Hapur from the month March 2017 to July 2017. A convenient sample of 60 healthy young adult males who volunteered for the study were enrolled after taking written informed consent from all the subjects. Ethical clearance was obtained from Institutional Ethical Committee. Subjects with any H/o hypertension, cardiovascular, respiratory or renal disorders, smokers and alcoholics were excluded from the study.

The subjects were supposed to report to the Department of Physiology at 10.30 am. Their Weight, Height, WC and Skin fold thickness were measured and measurement of Ambulatory BP recording was started by 11 am. The subjects were supposed to tie the cuff of Ambulatory BP monitor for 24 hours even during their sleep. As disturbed sleep may not decrease the sympathetic activity in the body and hence may not result in decrease in BP during sleep. the subjects who complained of disturbed sleep at night were also excluded from the study.

Obesity Parameters

Body weight was measured in kg by a mechanical scale to the nearest kg. Height was measured to the nearest one cm using stadiometer. BMI (kg/m^2) was calculated using Quitelet's index i.e. weight in kgs divided by square of height in meters.

Waist circumference (WC) was measured midway between the lowest rib and the iliac crest using a non-stretchable measuring tape by average of three measurements nearest to 0.5 cm. Skinfold thickness was measured using Harpendent skinfold calipers at four sites viz triceps, biceps, subscapular and suprailiac region. Body fat percentage was calculated using Durnin-Womersley formula [7].

Ambulatory BP Monitoring

Subjects were allowed to sit quietly for 15 min prior to assessment of BP; three consecutive measurements were made 5 min apart, and baseline BP was determined as the mean of the three readings. 24 hours Ambulatory Blood Pressure was measured using Contec Ambulatory Blood Pressure Monitor. The cuff of the BP apparatus was tied on the non-dominant arm. Subjects were enquired about daily morning wake up time and night bed time. AMBP was set to measure BP every 15 min during daytime and every 30-min in night time while sleeping. All the subjects were instructed to perform their normal daily routine but refrain from heavy physical activity. Subjects were divided into two groups according to their dipper profile, as defined: dippers (nocturnal decrease in systolic BP was ≥10% of daytime BP) and non-dippers (nocturnal decrease in systolic BP was <10% of daytime BP).

Statistical Analysis

The data thus obtained was arranged by groups and analysed using standard descriptive statistics and the association between obesity parameters and Dipper state was analysed by independent t test. SPSS version 20 software was used to perform all the statistical analysis.

Results

The mean age of the subjects was 27.76±6.46 years. There were 9 subjects who complained of disturbed sleep at night, so, they were excluded from the study. So overall 51 subjects were included in the study. Out of the 51 subjects left, 17 subjects were non – dippers i.e. their BP decreased less than 10% of the average day systolic BP. The mean value of all the obesity parameters which are considered in the study i.e. BMI, WC and Body Fat% were significantly more in non-dipper subjects as compared to dippers as shown in table 1 suggesting that obesity may be a contributing factor for non-dipper state.

Table 1: Comparison of BMI, Waist Circumference and Body Fat % in dipper & non-dipper

Obesity Parameter	Mean ± Standard deviation		P value
	Dipper (n= 34)	Non Dipper (n = 17)	
BMI (kg/m²)	24.55±3.87	29.81±3.96	0.001
WC (cm)	84.68±10.95	97.18±13.14	0.009
Fat percentage (%)	12.96±2.71	17.43±1.74	<0.01

Discussion

The present study was a retrospective study which intended to investigate the association of dipper state with obesity parameters.

Many studies have shown that an increased risk of developing hypertension in overweight & obese. Kumanyika et al have shown body mass index to be even more strongly related than race to blood pressure and that its effect is similar across surveys in the United State and within sex and racial groups [8]. Mean systolic and diastolic BP levels were higher among subjects with elevated BMI was the result of another study [9].

WC reflects abdominal fat, which contains higher amounts of visceral fat. Visceral fat is made by liver, turned into cholesterol, and released into the bloodstream where it forms plaque on the artery walls, resulting in high blood pressure and cardiovascular disease [10].

Studies have shown that BF% had a strong association with the prevalence of dyslipidemia. As dyslipidemia has been reported to precede the appearance of blood pressure elevation, so increased BF% can be a good indicator of elevation in blood pressure [11,12].

Our study showed that all the obesity parameters like BMI, WC and Fat % were significantly increased in non-dippers. So, we interpret that obesity can result in non-dipping of blood pressure during sleep. There can be multiple factors responsible for this. Obesity may play an important role in impaired nocturnal BP drop include Sympathetic nervous system (SNS) activation which is suggested as most crucial, altered kidney functions, obesity-driven hormones elevation, endothelial dysfunction and vascular structural changes [13,14].

Several studies provide evidence of SNS activation in obese patients and those with high-caloric intake. High muscle SNS activity were detected by microneurographic methods in obese. Plasma norepinephrine concentration and rise of norepinephrine turnover in peripheral tissues correlated positively with level of caloric intake [13,15,16].

Obesity may lead to increased renin-angiotensin-aldosterone system (RAAS) activity, hyperinsulinaemia, impaired baroreceptor sensitivity and increased free fatty acids circulation and adipokines level. These factors are considered as those which result in increased sympathetic activity [15,17]. Animal models with high fat and carbohydrate intake developed significant rise in BP due to intensified peripheral alpha-1- and beta-adrenergic receptors sensitivity [18]. Corresponding results were reported in human studies, where BP of obese patients after one month of alpha- and beta-adrenergic receptors pharmacological blockade was noticeably more reduced than BP of lean ones [19].

Leptin is considered as a mediator of SNS activation. Its amount of secretion from adipose tissue stays in direct proportion with adipose tissue mass [20,21]. After passing blood-brain barrier leptin binds to hypothalamus and brainstem, where it suppresses hunger drive and stimulates SNS [13,22]. Also leptin levels in blood are higher between midnight & early morning. So, this may be another important reason of sympathetic overdrive during sleep and hence non-dipping state in obese [23].

Thus, our study has shown that obese even if normotensives may be non-dippers. Studies have shown that non-dipping state may result in increased risk of cardiovascular morbidities and mortality. Several cross-sectional studies have revealed that cardiac hypertrophy, silent cerebral infarction and microalbuminuria in normotensive or hypertensive populations were more common in non-dippers than dippers [24,25]. Furthermore, certain prospective studies have shown that each 5% attenuation in the nocturnal BP decline conferred a 20% increase in the risk of cardiovascular mortality in the normotensive or hypertensive population [26].

Conclusion

Our study revealed that obese young adult subjects even if normotensives were more likely to become non-dippers. Non-dippers have a great risk of cardiovascular complications. Ambulatory Blood pressure monitoring should be done in obese

individuals to assess their dipping status and hence diagnose the risk of cardiovascular complications associated with non-dipping early.

Key Messages

As young obese individuals even if normotensive were non-dippers, Ambulatory Blood pressure monitoring should be done in obese individuals to assess their dipping status and hence diagnose the risk of cardiovascular complications associated with non-dipping early.

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