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Body Mass Index and other Demographic Data in Relation to Daily Ambulatory Blood Pressure Parameters

Timur Orhanoğlu[1,a], Zeki Doğan[2,b]

[1] İstanbul Atlas Üniversitesi, Meslek Yüksekokulu, İstanbul, Türkiye, [2]İstanbul Atlas Üniversitesi, Kardiyoloji Anabilim Dalı, İstanbul, Türkiye.
**Corresponding author*

Research Article

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ABSTRACT

Objective: In patients with and without a diagnosis of hypertension, we sought to ascertain if body mass index (BMI) and other demographic information affected dipper/non-dipper and pulse pressure/pulse pressure index.
Method: Ambulatory blood pressure monitoring (ABPM) analysis of 56 patients with hypertension and 91 patients without hypertension were evaluated. We defined dipper as a drop in mean nocturnal blood pressure (BP) of >10% as compared with mean daytime values (non-dipper percentage <10%). The same calculations were made for the mean systolic and diastolic blood pressures. Pulse pressure (PP) and pulse pressure index were calculated using blood pressure measurements.
Results: Systolic dipper was observed in 35.7% of male patients and 25% of female patients in the hypertension group (group 1), and there was no statistically significant difference between them (p>0.05). Diastolic dipper was observed in 46.4% of male patients and 39.3% of female patients in the hypertension group, and there was no statistically significant difference between them (p>0.05). In examination cases (group 2), Although the incidence of systolic dipper and diastolic dipper in male subjects (46.5% and 60.5%, respectively) was higher than in female subjects (27.1% and 39.6%, respectively), this difference was close to significance, but not statistically significant (p>0.05). There was no statistically significant difference between the mean age and BMI of systolic dipper and non-dipper cases (p>0.05). Besides, the mean age of the diastolic non-dipper cases was statistically significantly higher than the diastolic dipper cases (p:0.048), and the mean BMI of the diastolic non-dipper cases was statistically significantly higher than the diastolic dipper cases (p:0.034).
Conclusion: It may be beneficial to include the mean pulse pressure/pulse pressure index in the evaluation of general, awake and asleep pulse pressure while evaluating the ABPM result.

Keywords: Ambulatory blood pressure monitoring, hypertension, pulse pressure index

Günlük Ambulatuvar Kan Basıncı Ritmi ile Demografik Veriler ve Vücut Kitle İndeksi Arasındaki İlişki

Süreç

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ÖZ

Amaç: Hipertansiyon tanısı olan ve olmayan hastalarda vücut kitle indeksi (VKİ) ve diğer demografik bilgilerin dipper/nondipper ve nabız basıncı/nabız basıncı indeksini etkileyip etkilemediğini belirlemeye çalıştık.
Yöntem: Hipertansiyonu olan 56 ve hipertansiyonu olmayan 91 hastanın ayaktan kan basıncı monitorizasyonu (AKBM) analizi değerlendirildi. Gece ölçülen ortalama kan basıncı değerinin gündüz ölçülen ortalama kan basıncı değerinden >%10 düşük olması dipper HT, <%10 düşük olası ise dipper olmayan HT olarak tanımlandı. Hesaplamalar sistolik ve diastolik tansiyon değerleri için ayrı ayrı yapıldı. Nabız basıncı (NB) ve nabız basıncı indeksi ölçülen kan basıncı değerlerinden hesaplandı.
Results: Sistolik dipper HT grubunda (grup 1) erkek hastaların %35.7' sinde kadın hastaların ise %25' inde gözlendi (p>0.05). Diastolik dipper HT grubunda (grup 1) erkek hastaların %46.4' ünde kadın hastaların ise %39.3' ünde gözlendi (p>0.05). HT olmayan grupta (grup 2) sistolik dipper (%46.5 ve %60.5) ve diastolic dipper oranları (%27.1 ve %39.6) erkek hastalarda kadın hastalara kıyasla daha yüksek olmasına ragmen istatiksel olarak anlamlı farklılık gölenmedi (p>0.05). Yaş ve BMI açısından sistolik dipper olanlar ve olmayanlar arasında istatiksel farklılık saptanmadı (p>0.05). Diastolik dipper olmayan hastalarda ise yaş ve BMI diastolic dipper olanlara kıyasla daha yüksekti (sırasıyla, p=0.048 ve p=0.034).
Sonuç: AKBM sonucunu değerlendirirken genel, uyanıklık ve uykuda nabız basıncının değerlendirilmesinde, ortalama nabız basıncı/nabız basıncı indeksinin dahil edilmesi faydalı olabilir.

Anahtar sözcükler: Ambulatuvar kan basıncı kaydı, hipertansiyon, nabız basıncı indeksi

[a] *orhanoglu@gmail.com* *https://orcid.org/0000-0002-8797-7580* | [b] *drzeki@yahoo.com* *https://orcid.org/0000-0002-5620-7268*

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Introduction

Hypertension is a public health problem of increasing importance worldwide due to its high prevalence [1]. Although hypertension is a cause of serious mortality and morbidity, It is a disease that is frequently asymptomatic and ranks first among the preventable causes of death in the world [2]. According to the data of 2005, while 26.4% of the world population has hypertension, it is expected that in 2025, 29.2% of the population will have hypertension [3]. While hypertension is the cause of one out of every four deaths in our country, it causes the death of 7.6 million people and disability in 90 million people in the world every year [4]. Hypertension is one of the most important health problems in the world and one of the leading complaints among the reasons for consulting a doctor, and its frequency in the general population increases with age [5]. In addition, it is thought that the prevalence of hypertension will increase as the average age of the population increases and life expectancy increases [6]. Hypertension studies in Turkey, the 4-year incidence rate was found to be 21.3%, its prevalence increases with age, and it is significantly higher in women than men in the 40-79 age group. While 40% of patients with hypertension in Turkey are aware that they are hypertensive, the awareness rate is 70% in the United States [7]. While the treatment rate of hypertensive patients in Turkey was 31%, this rate was 59% in the USA. Also, in Turkey, the control rate was found to be 8% in all hypertensive patients, whereas the control rate of blood pressure in all hypertensive patients in the USA is 34% [8].

It is known that the prevalence of obesity is higher in hypertensive patients compared to the healthy population. However, it is suggested that body fat distribution is as important as body weight in the development of obesity and hypertension-related mortality and morbidity. For this reason, it has been recommended to measure body mass index in addition to body weight in the evaluation of patients with hypertension [6].

Diagnosis of hypertension should be based on multiple blood pressure measurements, since blood pressure can differ when measured in different environments, situations, and times according to the diet content consumed, measurement methods, time of day, and season [9]. Blood pressure is inherently variable, and ambulatory measurements of blood pressure predict clinical outcomes better than conventional, clinic-based measurements. Ambulatory monitoring can help identify “white-coat” hypertension, as well as patients whose blood pressure does not decrease the normal amount during the night. Ambulatory blood-pressure monitoring is practical, can lead to a reduction in health care costs, and can provide improved estimates of true blood pressures to guide decisions about treatment [10]. Ambulatory blood pressure monitoring (ABPM) can easily detect the circadian blood pressure (BP) pattern: systolic (SBP) and diastolic BP (DBP) show a nocturnal fall of at least 10% in normal subjects [11]. Patients whose blood pressure does not decrease during sleep compared with daytime have been defined as non-dippers [12]. A number of studies have demonstrated that individuals with essential hypertension and a non-dipper BP pattern show an increased frequency of target organ damage [13,14]. In this study, we aimed to determine whether body mass index (BMI) and other demographic data had an effect on dipper/non dipper and pulse pressure/pulse pressure index in patients with and without hypertension diagnosis.

Materials and Methods

We conducted the study on a cohort who had been referred to the internal medicine and cardiology outpatient clinic for ABPM between June 2017 and March 2018. ABPM analysis of 56 patients with hypertension and 91 patients without hypertension was evaluated. Clinical information was obtained by a thorough standardized review of the written and electronic medical records. Patients were defined as having a history of hypertension if this diagnosis was listed in their medical history (generally based on office measurements), or if they were prescribed antihypertensive medications (whether they were taking them at the time of the BP monitoring). We defined dipper as a drop in mean nocturnal BP of >10% as compared with mean daytime values (non-dipper percentage <10%). For both the mean systolic and diastolic blood pressures, identical computations were performed (9). Body mass index (BMI) was calculated as (weight in kilograms)/ (height in meters)2. Exclusion criteria included secondary hypertension, thyroid dysfunction, renal dysfunction or those on dialysis, chronic liver disease, blood pressure not under control, proteinuria, congestive heart failure, sleep disorders, night shift workers, gout attack history, allopurinol users due to hyperuricemia.

Statistical analyses

All values are given as mean±SD. The Statistical Package for Social Sciences software (SPSS 17, Chicago, IL, USA) was used for analysis. Unpaired Student’s t-test was used for group comparison. The Chi-square test and Continuity (Yates) Correction were used to compare qualitative data. Pearson correlation analysis was used to examine the relationships between parameters. A p-value < 0.05 was considered significant.

Results

The study was conducted on a total of 147 subjects, 71 (48.3%) men and 76 (51.7%) women, whose ages ranged from 20 to 79. Average age is 53.6±12.4 years. BMI values range from 20.7 kg/m2 to 48.1 kg/m2, with an average of 30.1±4.9 kg/m2. 56 of the cases (38.1%) had hypertension that had previously been diagnosed and these were classified as group 1, whereas 91 (61.9%) of the patients had not yet received a hypertension diagnosis when they underwent an examination and these were classified as group 2. In all patients, 50 (34%) were systolic dippers and 97 (66%) non-dipper. Diastolic dippers made up 69 (46.9%) of the cases, whereas diastolic non-dippers made up 78 (53.1%).

Table 1. Evaluation of the groups in terms of age, BMI and gender

	Group 1	Group 2	p
Age (mean±SD)	58,3±11,4	50,9±12,2	0,001*
BKI (mean±SD)	29,6±4,5	30,4±5,3	0,392
Gender n(%)			
Male	28 (%50)	43 (%47,3)	0,746
Female	28 (%50)	48 (%52,7)	

Group 1: Patients having an established HT diagnosis, Group 2: Examining those who have not yet received an HT diagnosis
Student's t-test was used for age and BMI, and Chi-square test was used for gender. *p<0.05

The average age of the patients in group 1 was statistically substantially older than that of group 2 patients (p:0.001). In terms of average body mass index and gender distribution, there was no statistically significant difference between the groups (p>0.05).

Table 2. Evaluation of systolic, diastolic and pulse pressure parameters between groups

	Group 1	Group 2	p
	Mean±SD	Mean±SD	
Overall Average Systolic	130,5±13,6	129,9±15,4	0,836
Overall Average Diastolic	75,6±9,6	76,8±11,2	0,534
Overall Pulse Pressure	54,9±10,5	53,2±9,3	0,320
Overall Pulse Pressure index	0,4±0,1	0,4±0,1	0,260
Overall Average Heart Rate	71,3±11	73,9±9,1	0,128
Awake Systolic	132,6±13,5	132,7±15,9	0,955
Awake Diastolic	77,4±9,8	79±11,8	0,391
Awake Pulse Pressure	55,1±10,5	53,6±9,5	0,382
Awake Pulse Pressure index	0,4±0,1	0,4±0,1	0,247
Awake Heart Rate	73,5±11,3	76,6±9,9	0,086
Sleep Systolic	124,1±15,8	122,6±15,7	0,571
Sleep Diastolic	70,3±10,3	70,8±10,3	0,778
Sleep Pulse Pressure	53,8±11,3	51,8±9,6	0,252
Sleep Pulse Pressure index	0,4±0,1	0,4±0	0,257
Sleep Heart Rate	64,7±10,5	66,5±8,3	0,250

Student t test

There was no statistically significant difference between the groups in terms of overall mean systolic pressure, diastolic pressure, pulse pressure, pulse pressure index, and mean heart rate averages (p>0.05). Additionally, there was no statistically significant difference between the groups in terms of awake systolic pressure, diastolic pressure, pulse pressure, pulse pressure index, and mean heart rate (p>0.05). Finally, there was no statistically significant difference between the groups in terms of sleep systolic pressure, diastolic pressure, pulse pressure, pulse pressure index, and mean heart rate (p>0.05).

Table 3. Evaluation of the groups in terms of systolic and diastolic dippers

	Group 1	Group 2	p
	n (%)	n (%)	
Systolic			
Dipper	17 (%30,4)	33 (%36,3)	0,463
Nondipper	39 (%69,6)	58 (%63,7)	
Diastolic			
Dipper	24 (%42,9)	45 (%49,5)	0,437
Nondipper	32 (%57,1)	46 (%50,5)	

Chi-square test

Systolic dipper was observed in 30.4% of Group 1 cases and 36.3% of Group 2 cases, and there was no statistically significant difference between them (p>0.05). Besides that, Diastolic dipper was observed in 42.9% of Group 1 and 49.5% of Group 2, and there was no statistically significant difference between them (p>0.05).

Table 4. Evaluation of general, awake, and sleep pulse pressure indices in groups, separately, according to gender

	Male	Female	p
	Mean±SD	Mean±SD	
Group 1			
Overall Pulse Pressure index	0,41±0,06	0,43±0,05	0,256
Awake Pulse Pressure index	0,41±0,06	0,42±0,05	0,201
Sleep Pulse Pressure index	0,42±0,07	0,44±0,05	0,326
Group 2			
Overall Pulse Pressure index	0,4±0,05	0,41±0,06	0,343
Awake Pulse Pressure index	0,4±0,05	0,41±0,06	0,486
Sleep Pulse Pressure index	0,42±0,05	0,43±0,05	0,529

Student t test

There was no statistically significant difference between the general, awake and sleep pulse pressure indices of male and female subjects in both groups (p>0.05).

Table 5. Evaluation of systolic and diastolic dipper in both groups separately according to gender

	Male	Female	p
	n (%)	n (%)	
Group 1			
Systolic Dipper	10 (%35,7)	7 (%25)	0,561
Systolic Non-dipper	18 (%64,3)	21 (%75)	
Diastolic Dipper	13 (%46,4)	11 (%39,3)	0,787
Diastolic Non-dipper	15 (%53,6)	17 (%60,7)	
Group 2			
Systolic Dipper	20 (%46,5)	13 (%27,1)	0,088
Systolic Non-dipper	23 (%53,5)	35 (%72,9)	
Diastolic Dipper	26 (%60,5)	19 (%39,6)	0,075
Diastolic Non-dipper	17 (%39,5)	29 (%60,4)	

Yates continuity correction

In Group 1, systolic dipper was seen in 35.7% of male cases and 25% of female cases, while diastolic dipper was observed in 46.4% of male cases and 39.3% of female cases. There was no statistically significant difference between them (p>0.05).

In Group 2, male individuals had a greater incidence of systolic dipper (46.5%) than female subjects (27.1%), and male subjects had a higher incidence of diastolic dipper (60.5%) than female subjects (39.6%). Although these differences were almost statistically significant, they were not (p>0.05).

Table 6. Correlation of age and BMI with pulse pressure index overall, awake, and asleep, separately in both groups

			Age	BMI
Group 1	Overall Pulse Pressure index	r	0,507	-0,179
		p	0,000*	0,194
	Awake Pulse Pressure index	r	0,504	-0,160
		p	0,000*	0,248
	Sleep Pulse Pressure index	r	0,466	-0,149
		p	0,001*	0,281
Group 2	Overall Pulse Pressure index	r	0,398	-0,106
		p	0,000*	0,333
	Awake Pulse Pressure index	r	0,394	-0,124
		p	0,000*	0,249
	Sleep Pulse Pressure index	r	0,358	-0,021
		p	0,001*	0,849

Pearson Correlation analysis **p<0.05*

In Group 1, There is a statistically significant, positive 50.7%, 50.4%, 46.6% correlation between age and the overall, awake and sleep pulse pressure index (p:0.000), (p:0.000) and (p:001) respectively. There was no statistically significant correlation between body mass index and general, awake and sleep pulse pressure indices (p>0.05).

In Group 2, There is a statistically significant, positive 39.8%, 39.4%, 35.8% correlation between age and the overall, awake and sleep pulse pressure index (p:0.000), (p:0.000) and (p:001) respectively. There was no statistically significant correlation between body mass index and general, awake and sleep pulse pressure indices (p>0.05).

Table 7. Age and BMI are evaluated separately for the systolic and diastolic dipping in both groups

	Age	BMI
	Mean±SD	**Mean±SD**
Group 1		
Systolic Dipper	54,1±11,8	28,7±4,6
Systolic Non-dipper	60,0±10,9	30,1±4,4
p	0,093	0,303
Diastolic Dipper	54,8±11,9	28,2±3,7
Diastolic Non-dipper	61,1±10,3	30,8±4,8
p	0,048*	0,034*
Group 2		
Systolic Dipper	48,7±10,6	30,9±5,1
Systolic Non-dipper	52,1±12,9	30,0±5,4
p	0,200	0,445
Diastolic Dipper	48,8±11,1	31,2±5,0
Diastolic Non-dipper	52,9±12,9	29,6±5,4
p	0,104	0,157

Student t test

In Group 1, There was no statistically significant difference between the mean age and BMI of systolic dipper and non-dipper cases (p>0.05). The mean age of diastolic non-dipper cases was statistically significantly higher than diastolic dipper cases (p:0.048). Then, mean BMI of diastolic non-dipper cases was statistically significantly higher than diastolic dipper cases (p:0.034; p<0.05).

In Group 2, There was no statistically significant difference between the mean age and BMI of systolic dipper and non-dipper cases (p>0.05). Similarly, there was no statistically significant difference between the mean age and BMI of diastolic dipper and non-dipper cases (p>0.05)

Discussion

Blood pressure exhibits a diurnal rhythm. Blood pressure considerably reduces at bedtime and quickly increases when you wake up in the morning due to decreased nocturnal sympathetic activity and increased vagal tone [15]. Verdecchia et al [11]. reported that the frequency of non-dipper hypertension among patients with hypertension is between 10-40%. In this study, systolic non-dipper was observed in 69.6% of the cases in the hypertension group and in 63.7% of the cases in the control group, and there was no statistically significant difference between them. In addition, 57.1% of the cases in the hypertension group and 50.5% of the cases in the examination group had diastolic non-dippers, and there was no statistically significant difference between them.

In many studies in the literature, no significant difference was found between dipper hypertension and non-dipper hypertension patients in terms of mean age and gender [10-12]. In our study, systolic dipper was observed in 35.7% of male patients and 25% of female patients in the hypertension group (group 1), and there was no statistically significant difference between them (p>0.05). Diastolic dipper was observed in 46.4% of male patients and 39.3% of female patients in the hypertension group, and there was no statistically significant difference between them (p>0.05). In examination cases (group 2), Although the incidence of systolic dipper and diastolic dipper in male subjects (46.5% and 60.5%, respectively) was higher than in female subjects (27.1% and 39.6%, respectively), this difference was close to significance, but not statistically significant (p>0.05).

It is known that obesity causes hypertension. Moreover, studies have shown that obesity is an independent risk factor for the development of hypertension and the incidence of hypertension is three times higher in obese patients [16,17]. In the majority of research comparing dipper HT and non-dipper HT with BMI in hypertension patients, no difference in BMI between the two groups was discovered [18]. In addition, in an animal experiment by Antic et al., they showed that rabbits who became obese after fatty diet, developed hypertension and the daily rhythm of blood pressure was disrupted [19]. Again, Afşar et al. showed that insulin resistance is an independent risk factor in the development of non-dipper hypertension [20]. In our study, there was no statistically significant difference between the mean age and BMI of systolic dipper and non-dipper cases (p>0.05). Besides, The mean age of the diastolic non-dipper cases was statistically significantly higher than the diastolic dipper cases (p:0.048), and the mean BMI of the diastolic non-dipper cases was statistically significantly higher than the diastolic dipper cases (p:0.034).

Similar to heart rate, pulse pressure (PP), defined as the difference between systolic and diastolic blood pressures, (PP=SBP-DBP), has been accepted as another usable variable, and many studies have been conducted on it and it has been accepted as a cardiovascular risk marker in the general population [21]. Again, similar to the pulse pressure, it was stated that the pulse pressure index (PPI: PP/SBP) is an indicator of cardiovascular risk in hypertensive patients [22]. Pulse pressure and pulse pressure index are parameters associated with vascular flexibility and increase with age. In the study of Kodama et al.; stated that pulse pressure is the most important cardiovascular risk indicator among the mean arterial pressure, systolic blood pressure and diastolic blood pressure values in diabetic patients [23]. Additionally, in our study, a favorable and statistically significant correlation between age and pulse pressure index was discovered in the participants of both groups (Table 6).

Limitation

The main limitation of our study was that it was conducted with a relatively small number of patients. Due to the careful selection of patients, statistically sufficient numbers were taken as the basis.

Conclusion

Daily ambulatory blood pressure measurements are important in the diagnosis and treatment of hypertensive patients. While evaluating the outcome in daily Ambulatory Blood Pressure Follow-ups, it may be useful to consider the overall, awake and sleep averages and dipper/non-dipper status, as well as other parameters. Studies in the literature have reported that pulse pressure and pulse pressure index are related to vascular flexibility and increase with aging. Similarly, it has been reported that increased pulse pressure is associated with an increased risk of cardiovascular events, and the pulse pressure index is associated with increased left ventricular pressure in patients with chronic renal failure (21-23). Considering all these and the findings obtained in this study, it may be beneficial to include the mean pulse pressure/pulse pressure index in the evaluation of general, awake and asleep pulse pressure while evaluating the ABPM result.

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