Pattern Analysis of Alteration of Systolic Blood Pressure and Diastolic Blood Pressure on Hypertension

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Abstract

Introduction: *High systolic blood pressure is a greater risk factor for brain, heart, kidney, and death compared to diastolic blood pressure. High diastolic pressure is a strong predictor of heart attack and stroke. The study was aimed to ascertain the pattern of alteration of systolic blood pressure and diastolic blood pressure hypertension.*

Methods: *The number of the participant was 102 people (≥17 yrs) who were outpatients with hypertension in the Department of Internal medicine-Bekasi District Hospital from September 1 to September 30, 2015. This study design was cross sectional. Blood pressure measurement was done twice within an interval of 5-10 minutes. Body Mass Index (BMI) was calculated as weight (kg) to height (m) squared by standard scale. Data was stored and analyzed with SPSS version 22 and EPISTAT version 3.3 on the relationship between systolic blood pressure and diastolic blood pressure according to demographic characteristics.*

Results: *People whose age is 36-55 yrs had the highest increase of systolic blood pressure and diastolic blood pressure (12.94% vs 9.71%; p=0.000). The group of female had a strongest variations relationship (r^2=0.65) between increasing systolic blood pressure and diastolic (9.87% vs 9.08%; p=0.000) compared to group of male (8.05% vs 8.78%; p=0.000). In the group of overweight patients, systolic and diastolic blood pressure were decreased when compared to the ideal BMI (9.09 mmHg vs 3.72 mmHg; p=0.000). However, in the obese group, there was an increase in systolic and diastolic blood pressure (6.54 mmHg vs 3.99 mmHg; p=0.001) compared with overweight groups. In the group of hereditary, systolic blood pressure decrease (1.73 mmHg) compared with non-hereditary, but in diastolic blood pressure both of them were similarly relative. AB blood type had the strongest variations relationship (r^2=0.73) between increasing systolic blood pressure (14.14%) that was higher than the diastolic blood pressure (14.14% vs 8.67%; p=0.019).*

Conclusion: *Variation in increasing systolic blood pressure is not always the same as and higher than the increasing diastolic blood pressure.*

Keywords: *pattern analysis of alteration, systolic blood pressure, diastolic blood pressure, hypertension*

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Analisis Pola Perubahan Tekanan Darah Sistolik dan Tekanan Darah Diastolik pada Hipertensi

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Abstrak

***Pendahuluan**: Tekanan darah sistolik yang tinggi merupakan faktor risiko yang besar terhadap otak, jantung, serta ginjal, dan kematian dibandingkan dengan tekanan darah diastolik. Tekanan diastolik yang tinggi adalah prediktor kuat terhadap serangan jantung dan **stroke**. Penelitian ini bertujuan untuk mengetahui pola perubahan tekanan darah sistolik dan perubahan tekanan darah diastolic hipertensi.*

***Metode**: Jumlah subjek penelitian 102 partisipan (≥17 thn) yang berobat jalan dengan hipertensi di bagian penyakit dalam RSUD Bekasi mulai 1 September sampai dengan 30 September 2015. Desain penelitian ini adalah **cross sectional**. Pengukuran tekanan darah dilakukan dua kali dengan interval waktu 5-10 menit. Indeks Massa Tubuh (IMT) dihitung sebagai berat badan (kg) terhadap tinggi (m) kuadrat dengan timbangan standar. Data disimpan dan dianalisis dengan SPSS versi 22 dan EPISTAT vertsi 3.3 terhadap hubungan antara tekanan darah sistolik dan tekanan darah diastolik menurut karakteristik demografi.*

***Hasil**: Peningkatan tekanan darah sistolik dan tekanan darah diastolik tertinggi berada pada kelompok umur 36-55 (12.94% vs 9.71%; p=0.000). Kelompok perempuan memiliki hubungan variasi terkuat (r^2=0.65) antara peningkatan tekanan darah sistolik dan diastolik (9.87% vs 9.08%; p=0.000) dibandingkan dengan kelompok laki-laki (8.05% vs 8.78%; p=0.000). Pada kelompok **overweight** tekanan darah sistolik dan diastolik menurun dibandingkan dengan kelompok BMI yang ideal (9.09 mmHg vs 3.72 mmHg; p=0.000). Namun, pada kelompok obesitas tekanan darah sistolik dan diastolik meningkat (6.54 mmHg vs 3.99 mmHg; p=0.001) dibandingkan dengan kelompok **overweight**. Pada kelompok hereditas, tekanan darah sistolik menurun (1.73 mmHg) dibandingkan dengan non-hereditas, tetapi tekanan darah diastolik keduanya relatif sama. Golongan darah AB memiliki hubungan variasi terkuat (r^2=0.73) antara peningkatan tekanan darah sistolik yang lebih tinggi dari tekanan darah diastolik (14.14% vs 8.67%; p=0.019).*

***Kesimpulan**: Variasi kenaikan tekanan darah sistolik tidak selalu sama dengan dan lebih tinggi dari kenaikan tekanan darah diastolik.*

***Kata kunci**: pola perubahan, tekanan darah sistolik, tekanan darah diastolik, hipertensi*

Introduction

In Indonesia, the prevalence of hypertension based on the Basic Health Research (Riskesdas) of the Department of Health in 2013 was about 25.8%. According to Kidney Disease Death Rate by Country, the death rate of hypertension in Indonesia was 27.8 per 100.000 people. The mortality rate is ranked 84th out of 192 countries.[1,2] In Asia, hypertension and stroke mostly occur in young adults. Other complications of hypertension is heart disease. Approximately 70% of stroke is caused by hypertension and 50% of heart disease is caused by hypertension as well. Thirty one percent up to fifty nine percent of acute myocardial infarction is preceded by hypertension. There are several factors that can lead to myocardial infarction, but hypertension is an important risk factor. The impact of hypertension is influenced by two factors, namely systolic blood pressure and diastolic blood pressure.[3,4]

High systolic blood pressure (SBP) is now known to be a greater risk factor than diastolic blood pressure (DBP) for brain, heart, kidney, and circulatory complications and for death, particularly in middle-aged and elderly adults. High diastolic pressure is a strong predictor of heart attack and stroke in young adults.[5] It is well recognized that SBP is the most relevant component of blood pressure (BP) for the prognosis of patients suffering from arterial hypertension, especially when they are older than 60 years.

However, SBP has traditionally been underplayed as a risk factor for two main reasons: 1) it was believed that the

maintained pressure in diastole reflected the hypertension-derived cardiovascular risk better than the peaks of pressure reached at systole; and 2) the elevation in systolic arterial pressure with age that appears in Western populations constitutes a necessary mechanism of adaptation to arterial stiffness that guarantees blood flow to vital organs. Even at the present time, poor recognition of elevated SBP as a cardiovascular risk factor exists, in particular when it occurs with a DBP of <90 mmHg.[6,7]

From previous study, there was a note that Isolated Diastolic Hypertension (IDH) had a high prevalence among younger age groups, especially in developing countries. Although IDH carries a low risk of cardiovascular mortality, it is associated with an increased cardiovascular risk. In the elderly, a DBP reduction below 70 mmHg should be avoided, because it is associated with increased mortality.[8-11] The study was aimed to ascertain the pattern of alteration of systolic blood pressure and diastolic blood pressure on hypertension.

Methods

The study involved 102 participants (≥17 yrs) who were treated in the Departement of Internal medicine in Bekasi District Hospital and were suffering from stage I and stage II of hypertension. The period of the study was from September 1 to September 30, 2015. This study design was cross sectional. Study tools being used are questionnaires and physical examinations. The questionnaires include data of age, gender, BMI, heredity and blood type. The physical examination includes blood pressure measurement (mmHg) using the digital sphygmomanometer, height, and body weight.

The first blood pressure measurement was done after the participants rested for 5 minutes with a lying position. After the first measurement, the participant took a rest for five to ten minutes and then the paramedic performed the second blood pressure measurement. If there was a difference of more than 10 mmHg between the first and second blood pressure, then the third blood pressure should be conducted. If the difference between the first and second blood pressure was less than 10 mmHg, the blood pressure that was recorded was the average value of both the first and the second measurement. Body Mass Index (BMI) was calculated as weight (kg) to height (mtr) squared by standard scale. Blood type was recorded from ID card (KTP).

All data were collected and stored in the software SPSS version 22. The data analysis used SPSS version 22 and EPISTAT version 3.3. When data entry was taken, the paramedic did what was called as washing data. Then, univariate analysis was performed to describe the demographic characteristics of the respondent. Bivariate analysis was conducted to analyze the relationship between systolic blood pressure and diastolic blood pressure according to demographic characteristics.

Results

Table 1 shows distribution of participants by demographic characteristics. It was known that the average age of respondents was 57.80 years (SD=11.42) and an average BMI of respondents was 26.65 kg (SD=3.59). Out of total participants, 67.65% aged more than 56 yrs. Age group of 17-35 was only 5.88%. The number of male while and female was the same. Most participants had a BMI overweight (53.92%). The participants who had the hereditary factors of hypertension were 92.16%. The majority of participants had B blood type was 59.80%, while there was only a few participants who had the AB blood type (5%).

Tabel 1. Distribution of Participants by Demographic Characteristics

Variables	n	%	Mean (SD)
Age (yrs)			57.80 (11.42)
17-35	6	5.88	
36-55	27	26.47	
≥56	69	67.65	
Gender			
Female	51	50	
Male	51	50	
BMI			26.65 (3.59)
18.5-24.9	24	23.53	
25-29.9	55	53.92	
≥30	23	22.55	
Heredity			
Negative	8	7.84	
Positive	94	92.16	
Blood type			
A	7	6.86	
AB	5	4.90	
B	61	59.80	
O	29	28.43	

Table 2 illustrates the relationship between systolic blood pressure and diastolic blood pressure in hypertensive patients according to demographic characteristics. Overall, there was a positive correlation between systolic blood pressure and diastolic blood pressure.

In the three sub variables of age, only in the sub variables of 36-55 yrs and ≥56 yrs that there were correlations between the increase in systolic blood pressure and the increase in diastolic blood pressure while in the sub variable of 17-35 yrs there was no correlation between systolic and diastolic blood pressure (p=0.211). The group of ≥56 yrs, had a strongest variations relationship (r^2=0.61) between increasing systolic blood pressure (7.66%) but lower than the diastolic (8.36%). The highest of increasing systolic blood pressure and diastolic blood pressure were in the group of 36-55 yrs (12.94% vs 9.71%). However, with increasing age from the group of 36-55 yrs to the group of ≥56 yrs, the systolic and diastolic blood pressure decreased (7.39 mmHg vs 1.22 mmHg).

Tabel 2. The Relationship Between Systolic Blood Pressure and Diastolic Blood Pressure by Demographic Characteristics

Variable	SBP Mean (SD)	DBP Mean (SD)	r^2	p value
Age (yrs)				
17-35	147.67 (6.282)	93.67 (2.422)	0.36	0.211
36-55	158.11 (17.747)	98.74 (9.646)	0.60	0.000
≥56	150.72 (12.966)	97.52 (5.782)	0.61	0.000
Gender				
Female	153.82 (15.189)	98.18 (6.333)	0.65	0.000
Male	151.27 (13.491)	97.90 (7.684)	0.60	0.000
BMI				
18.5-24.9	158.50 (20.636)	100.46 (10.599)	0.68	0.000
25-29.9	149.41 (9.319)	96.74 (4.834)	0.58	0.000
≥30	155.95 (15.622)	100.73 (5.582)	0.39	0.001
Heredity				
Negative	154.25 (16.051)	97.38 (6.823)	0.63	0.019
Positive	152.52 (14.418)	98.12 (6.862)	0.62	0.000
Blood type				
A	170.00 (31.086)	106.71 (15.521)	0.70	0.067
AB	159.80 (15.238)	97.80 (5.891)	0.73	0.019
B	151.33 (11.780)	98.08 (5.463)	0.44	0.000
O	151.07 (11.566)	97.07 (5.424)	0.67	0.000

SBP= systolic blood pressure; DBP= Diastolic blood pressure; SD= standart deviation; r^2= coefficient determination

The group of female had a very strong variation relationship (r^2=0.65) between increasing systolic blood pressure (9.87%) and diastolic (9.08%) and also was higher compared to the group of male (8.05%; 8.78%).

Regarding the variable of BMI, the group of ideal BMI (18.5-24.9) had a very strong variation relationship (r^2=0.68) between increasing systolic blood pressure (13.21%), but higher than the diastolic blood pressure (11.62%). In the group of overweight, systolic and diastolic blood pressure were decreased when compared to the ideal BMI group (9.09 mmHg; 3.72 mmHg). However, in obese group there was an increase in systolic and diastolic blood pressure (6.54 mmHg; 3.99 mmHg) compared with overweight groups. Of the four BMI sub variables, systolic blood pressure is highest in ideal BMI group and the diastolic blood pressure is highest in ideal BMI and obese groups.

Non-hereditary group had a very strong variation relationship (r^2=0.63) between increasing systolic blood pressure (10.18%), higher than the diastolic blood pressure (8.20%). In the group of hereditary, systolic blood pressure decreased (1.73 mmHg) compared to non-hereditary; but, in diastolic blood pressure both of them were relatively similar.

Amongst four blood types, AB blood type had the strongest variation relationship (r^2=0.73) between increasing systolic blood pressure (14.14%) higher than the diastolic blood pressure (8.67%). Of the four sub variables blood types, even though the A blood type had the highest systolic and diastolic blood pressure, it was not significant (p=0.067). The lowest systolic blood pressure was in B and O blood type while AB and O had the lowest diastolic blood pressure.

Discussion

The study results showed that there was an increase in systolic and diastolic blood pressure in the age group of above 55 years. It is associated with increased arterial stiffness due to endothelial dysfunction, vascular remodeling, and a change in the extracellular matrix. There is a decrease in elastin fibers and an increase in the collagen fibers in the arterial wall.[12,13]

These determinants of increased arterial stiffness seem to be influenced by genetic factors that is not related to other classical cardiovascular risk factors. The most important influence seems to be on the structural and functional properties of the large arteries. It has been previously demonstrated that genetic factors directly influence the structure of the arterial wall or act indirectly through age, blood pressure, smoking, cholesterol levels, and glycemia. The final result is an increase in arterial stiffness.[14]

At the age of 56 years or more, systolic and diastolic blood pressure decreased but the systolic blood pressure was more noticeable. This situation is considered as a mechanism of the body to adjust to the condition of arterial stiffness. There was a linear rise in SBP from age 30 through 84 years and concurrent increases in DBP and mean arterial pressure (MAP). After age 50 to 60 years, DBP declined, pulse pressure (PP) rose steeply, and MAP reached an asymptote.[15]

Male has a higher risk of hypertension in young adulthood than women. But in the old age, women are more at risk for hypertension. It occurs due to reduced hormone levels of estrogen. Women who have not experienced menopause are protected by estrogen hormone that plays a role in increasing the levels of HDL (High Density Lipoprotein). High levels of HDL are protective factors in preventing atherosclerosis. Therefore the low estrogen hormone will cause decreased levels of HDL (High Density Lipoprotein) and result in an increase in blood pressure.[16,17]

From the group of BMI, it is known that the highest systolic blood pressure was at sub variable ideal BMI. While the highest diastolic blood pressure was at sub variable ideal BMI and Obese. Increased blood pressure with BMI approach is associated with the intake of fat source. Systolic blood pressure was related to the frequency source of fat intake, total fat intake. Diastolic blood pressure is related to the frequency source of fat intake, total fat intake, intake of polyunsaturated fatty acids.[18] But this study didn't measure the sources of fat intake.

In this study, 92.16% of hypertensive patients have hypertension hereditary. Even though the systolic blood pressure in non-heredity group was higher but the maximum value was lower than heredity group (191 mmHg vs 222 mmHg).

Of the blood type, blood type A has a highest systolic blood pressure and diastolic blood pressure but not signifi-

cant. For diastolic blood pressure, blood type B, AB and O are relatively similar. It was allegedly associated with the transporter gene whereas in this study were not explored.

Conclusion

Overall, special attention of systolic blood pressure should be given to woman aged 36-55 yrs with ideal weight and does not have a family history of hypertension and have A blood type. Attention of diastolic blood pressure should be given to woman aged 36-55 yrs with ideal weight and obese and have a family history of hypertension and have A blood type.

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