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URL of this article: http://heanoti.com/index.php/hn/article/view/hn20301

The Topography and Physical Activity as Determinant Factor of Grade Hypertension in Patients with Primary Hypertension

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ABSTRACT

Primary hypertension is a causing factor of cardiovascular disease mortality. Patient with primary hypertension having high grade hypertension will cause various dangerous diseases if it is not performed further countermeasures. Consequently, it is necessary to prevent the increase of grade hypertension or blood pressure by analyzing grade hypertension risk factor. This study was quantitative research with cross sectional design method. The samples in this study were 346 respondents taken by consecutive sampling. Partial Least Square (PLS) with SmartPLS (v. 3.2.7) application software was used as to analyze the data. Results shows that there is a physical activity effect on grade hypertension, with the value of path coefficient by -0.564 of t statistic 16.48 (t statistic > t table significance by 1.96). Based on the result of the study, there is a topography effect on grade hypertension, with the value of path coefficient by 0.412 of t statistic 8.690 (t statistic > t table significance by 1.96). Physical activity affects grade hypertension. The better the physical activity, the better the way to prevent a blood pressure increase mainly systolic blood pressure. The high topography can lead to increase grade hypertension in the primary hypertension patient, therefore, lifestyle and topographic effect should also be considered for people with primary hypertension mainly for non-native people who have not experienced acclimatization.

Keywords: Primary hypertension, Topography, Physical activity, Grade hypertension

INTRODUCTION

Background

Hypertension, defined as systolic blood pressure ≤ 140 mmHg and / or diastolic pressure ≤ 90 mmHg, is one of the most common chronic diseases. Hypertension is a silent killer, the invisible endemic. Hypertension is a major risk factor for death in Indonesia: stroke (21% death) and ischemic heart disease (9% of all deaths)[(1)]. The most important consequence of hypertension is due to the atherosclerotic damage on the arteries, which can be well observed through a measuring instrument. Consequently, each form of hypertension eventually creates a vicious circle because of generated flow resistance. Damage on blood vessel eventually causes ischemia of various organs and tissues (myocardium, brain, kidney, mesenteric vessel, legs), renal ischemia that is accelerating the vicious circle. Damage on vascular walls along with hypertension for example, can cause cerebral hemorrhage (stroke) and in the large arteries (e.g. aorta) to aneurysm formation and eventually rupture. Therefore, life expectancy is reduced. American life insurance company, monitoring fate of 1 million people normal blood pressure, slightly, or slightly increased at age 45, finds that those who have a blood pressure around 132/85 mmHg nearly 80% are alive 20 years later, while those who are initially rising the blood pressure (about 162 / 100 mmHg) less than 50% can survive[(2)]. Hypertension is a very important public health challenge because its complication, including cardiovascular, cerebrovascular and renal diseases, are the main causes of morbidity and mortality. Reducing blood pressure in individuals with hypertension prevents or weakens these complications[(3)]. So, it takes effort to prevent the rise of grade hypertension or blood pressure by analyzing grade hypertension risk factor. One of the risk factors other than those that can be modified is physical activity, while the risk factor from the environment is topography.

Purpose

The purpose of this study was to analyze effects of physical activity and topography on grade hypertension in the primary hypertension patient.

METHODS

This research was analytic observational with cross sectional design. This research was conducted simultaneously in the working area of Kedungrejo Community Health Center (coastal topography), Mojopanggung Community Health Center (urban topography) and Licin Community Health Center (mountain topography). The collected data was 100 respondents from Kedungrejo Community Health Center, 100 respondents from Mojopanggung Community Health Center and 146 respondents from Licin Community Health Center, so the total samples were 346 respondents. The sampling method in the community health center used stratified random sampling, while sampling on the respondents used consecutive sampling. The data collection method for physical activity variable was interview, used questionnaire, topography used Measure Distance Map, Altimeter application and blood pressure used digital sphygmomanometer. Blood pressure level or Grade hypertension criteria have using by ESH/ESC(4). Multivariate data analysis used PLS with SmartPLS (v. 3.2.7) Professional application with License.

RESULTS

The research results on 346 respondents with primary hypertension in Kedungrejo Community Health Center (coastal topography), Mojopanggung Community Health Center (urban topography), and Licin Community Health Center (mountain topography) are as follows.

Outer Model Test

a. Convergence validity

Table 1. Convergence validity result

Construct	Indicator	Outer loading	Note
Topography	Topography surface	0.952	Significant
	Place elevation	0.927	Significant
	Seaside distance	0.995	Significant
Physical activity	Physical activity	1.000	Significant
Grade hypertension	Systolic pressure	0.952	Significant
	Diastolic pressure	0.719	Significant

Latent variable measurement model evaluation with reflective indicator analyzed by looking at the convergent validity in PLS can be seen from the outer loading amount of each indicator to the latent variable. Outer loading above 0.70 is strongly recommended, however, the loading factor of 0.50 - 0.60 can still be tolerated. Outer model or measurement model is an assessment of research variables validity and reliability(5). The measurement model computation in table 1 shows that, the three indicators, surface topography, altitude, seaside distance are valid in reflecting the topographic variable as proven by the estimated outer loading value of three variable indicators, of which the value is larger than 0.50 and t-value is larger than 1.96.

b. Discriminant validity

Table 2. Discriminant validity

	Physical activity	Grade hypertension	Topography
Topography surface	0.392	-0.073	0.949
Place elevation	0.379	-0.013	0.930
Seaside distance	0.413	-0.033	0.994
Physical activity	1.000	-0.485	0.412
Systolic blood pressure	-0.523	0.952	-0.064
Diastolic blood pressure	-0.212	0.719	0.025

The table shows that topographic construct correlation with its indicator is higher than topographic indicator correlation with other construct. It is seen that the grade hypertension construct correlation with its indicator is higher than grade hypertension indicator correlation with other construct.

c. Composite reliability

Table 3. Composite reliability

	Cronbach's Alpha	rho_A	Composite Reliability	AVE
Physical activity	1.000	1.000	1.000	1.000
Grade hypertension	0.641	0.949	0.829	0.712
Topography	0.955	0.958	0.971	0.918

Measuring construct reliability, that the generated AVE value by all constructs are above 0.5. The generated Cronbach's alpha by PLS is slightly under estimate so that it is recommended to use Composite Reliability. Rule of the thumb of alpha value or composite reliability must larger than 0.7 or 0.6 still can be tolerated[5]. It can be concluded that all Constructs in this study has composite reliability value larger than 0.6, therefore, all constructs in this study are reliable.

Inner Model

a. R^2 for endogen latent variable

Table 4. Structural model evaluation test

Structural model	R-square
Physical Activity	0.167
Grade hypertension	0.262

b. Path Coefficient Estimation

Table 5. T-Statistic value in the inner model effect of salt consumption on grade hypertension

	Original sample	Sample mean	Standard Deviation	T Statistic	T-Value
Physical Activity → Grade hypertension	-0.564	-0.565	0.034	16.488	0.000
Topography → Grade hypertension	0.412	0.412	0.047	8.690	0.000

Based on the information from table 5, there is an effect of physical activity on grade hypertension in the primary hypertension patient, there is also a topography effect on grade hypertension in the primary hypertension patient (t statistic > t table significance is 1.96).

DISCUSSION

The research results indicate that physical activity has a negative effect on grade hypertension which is more strongly reflected by systolic blood pressure. It means that good physical activity in patient with primary hypertension will cause grade hypertension decline. When the respondent has a good physical activity, it will lower the grade hypertension that is a systolic blood pressure decline. Results of the study figures out that physical activity affecting the stronger grade hypertension which is reflected by systolic blood pressure, it means that the better physical activity the better the way to decrease respondent grade hypertension suffering from primary hypertension. When the respondent has a good physical activity it will lower systolic blood pressure, and there is a decline in grade hypertension. Good physical activity will be able to prevent the increase in blood pressure by lowering psychological stress, therefore, it keeps lowering blood pressure mainly the systolic blood pressure or grade hypertension decline. Good physical activity can lower systolic blood pressure in primary hypertension patient, because physiologically good physical activity can decrease peripheral resistance, norepinephrine, plasma renin activity, vascular resistance and blood pressure.

When the blood pressure rises, one way to lower it is by increasing physical activity level. Physical activity can protect the body from hypertension and can be used to reduce formed hypertension. In patient with severe hypertension, there are anti-hypertension medications available to lower blood pressure but sometimes it gives unwanted side effects. Diuretic side effects include electrolyte imbalance, inability to handle glucose normally, and blood cholesterol level increase. Medication side effect that is affecting total peripheral resistance includes blood triglyceride level increase, lower HDL cholesterol level (good cholesterol form), weight gain, sexual dysfunction, and depression. The evidence in the literature suggests that moderate aerobic exercise performed for 15 to 60 minutes three times a week is beneficial in most cases of mild to moderate hypertension, therefore, it is good that the aerobic exercise program is regularly performed along with other therapeutic measures to optimize blood pressure decline(6). Based on the information in this study, physical activity in primary hypertension respondents should be increased as an effort to prevent the increase of systolic blood pressure to avoid and reduce the risk of organ complication. In addition, good physical activity is a non-pharmacological effort to complete pharmacological efforts with the type of anti-hypertension medication that have been established by health worker at community health center in the respective working area of respondents. Good and routine physical activity will train the heart muscle and peripheral resistance to prevent blood pressure increase, and also it can stimulate the endorphin hormones release that is causing euphoria effect and muscle relaxation so blood pressure will increase(7). The potential benefit of physical activity in the hypertension prevention and treatment have been recognized very well, but regular physical activity is difficult and sometimes impossible to implement in actual life(1). Physical activity increase, 30-45 minutes per day is important as an effort to control and manage blood pressure or grade hypertension. Results of the study indicates that stronger topography is reflected by the distance to the sea and type of topography positively affects grade hypertension more strongly, reflected by systolic blood pressure. It means that high topography will cause grade hypertension increase. Results of hypothesis test show that topography has positive effect on grade hypertension. The rationality in this study is that a high topography can cause a systolic blood pressure increase.

Results of the study indicate that the further the distance from the sea and located in mountain topography will increase systolic blood pressure. Licin, which is mountain area, is an area with lower oxygen level than area with low topography either in the urban Mojopanggung community health center or in coastal Kedungrejo community health center, then in Licin community health center with high topography may cause blood pressure increase or grade hypertension will increase. It still has a relationship between logical concept and it will be accepted if there is an evidence or physiological mechanism that is underlying the occurrence of grade hypertension increase or blood pressure. Certainly, it is no longer using epidemiological approach, but it must lead to a deeper approach at least from a review of the pathophysiology or organ generalization mechanism. The height effect on the body. The atmospheric pressure is progressively reduced as the altitude increases. At 18,000 feet above sea level, atmospheric pressure is only 380 mm Hg half of its value at sea level. In addition, because the proportion of O_2 and N_2 in the air remains the same, the inspired PO_2 at this altitude is 21% of 380 mm Hg or 80 mm Hg, with the Po_2 alveolus being lower at 45 mm Hg. At any height above 10,000 feet, the arterial Po_2 descends to the bulk portion of the O_2-Hb curve, below the base region safe range. As a result, the% saturation of Hb in arterial blood decreases sharply with the height increase(3).

A person who lives on high place for a few days, weeks, or years, becomes increasingly acclimatized to the low Po_2, so the harmful effect on the body is decreasing, and it is allowing the person to work harder without experiencing hypoxic effect or to get on the higher spot. The main principles in acclimatization are the substantial increase in pulmonary ventilation, the red blood cells multiply, the lung diffusion capacity increases, the tissue vascularization increases and the cell's ability to use oxygen increases even with low Po_2. The lungs ventilation increases, if Po_2 is suddenly lower, the chemoreceptor stimulation due to hypoxia will increase the maximum alveolar vent about 65 percent above normal. This is an immediate compensation on the rise to the high place, and with this alone one can rise several thousand feet higher than without ventilation increase. If the person then lives in a very high place for several days, it will gradually be five times above normal (400 percent above normal)(3). A sudden increase of pulmonary ventilation by 65 percent by the time we rise to the high place will remove large amounts of carbon dioxide, so that Pco_2 will decrease and increase the pH of body fluid. All of these changes will inhibit the respiratory center, therefore, it counteracts the low Po_2 effect to stimulate the peripheral respiratory chemoreceptor in the carotid body and the aortic body. However, these inhibitory effects slowly disappear within two to five days, so the respiratory center can now respond maximally to the chemoreceptor stimulus as a result of hypoxia, and ventilation increases by five times normal. The cause of this blockage loss is mainly due to the decrease in bicarbonate ion level in cerebrospinal fluid and brain tissue. These changes will decrease the fluid pH surrounding the sensitizing neurons in the respiratory center, thereby increasing the activity of respiratory center(3).

The red blood cells and hemoglobin increase occurs during acclimatization. Hypoxia is a major stimulus that is causing red blood cells production increase, usually in full acclimatization to low oxygen, the hematocrit may increase from a normal value ranging from 40 to 45 to an average of 60, and this corresponds to an increase in hemoglobin level from the normal value of 15 gm/dl. In addition to the process, blood volume also increases, often increases by 20 to 30 percent, resulting in an increase in the total circulating hemoglobin to 50 percent or more. Hemoglobin and blood volume increase occurs slowly, with little effect until after two weeks, reaching half the capacity in a month or more, and reaching full capacity after a few months. Diffusion capacity increase after acclimation. We recall that normal diffusion capacity for oxygen when through a pulmonary membrane is approximately 21 ml/mm Hg/min, and this diffusion capacity can increase threefold during exercise. Similar diffusion capacity increase also occurs on the high place. Parts of this increase may be due to lung volume, which results in the expanding surface of the alveolar membrane. The last part to support is an increase in pulmonary artery pressure, this force will push the blood to pass through more alveolar capillaries than under normal circumstances, especially the upper portion of inside lung that usually has a bad perfusion(3).

Circulatory system on acclimatization is through the process of increasing capillarity. Immediately after reaching a high place, cardiac output is often increased by 30 percent, but then drops back to normal along with an increase in blood hematocrit, so the amount of oxygen transported to the tissue is approximately normal-unless it is too high to cause severe hypoxia. Another circulation adaptation is an increase in the number and size of capillaries in tissues called capillary enhancement. This is mainly occurring to the animals born and bred in high place, and the effect is less obvious if the animal is new in high place after the old age. The capillarity increase will be highly visible in active tissues exposed to chronic hypoxia. For example, the capillary density in right ventricular muscle increases by a percent due to hypoxia and severe workload, caused by pulmonary hypertension at elevation (hypertension caused by vessel suppression arising from low alveolar oxygen levels)(3).

Many inhabitants live in Andes and Himalaya above the 13,000-foot altitude, a single cluster of people living in the Andes of Peru is 17,500 feet height and works at 19,000 feet. Many of the inhabitants are born at that height and lived there all their lives. In all acclimatization effect, this population is superior to the low-lying population with the best acclimatization, even though the inhabitants of the lower place have been acclimatized for 10 years or more. The process of acclimatization on that population has started since infancy, especially the size of their chest that is very large. Meanwhile the size of their body is slightly smaller, so the ventilation capacity ratio to mass body becomes large. In addition, the right-part heart is larger than the heart of people who are in a low place, that large size heart produces high pressure in the pulmonary artery so that it can push blood through the widened lung capillaries(3).

Increase in grade hypertension is not only due to risk factors such as salt intake, poor physical activity but topography can also cause an increase in blood pressure, so that the increase in blood pressure can also be due to the influence of environment and the body's physiological process adaptability to the environment where it occupies. Good physical activity is required in attempting to lower systolic blood pressure for hypertension patient, thereby reducing the adverse effects of adverse disease complication, and also to be concerned about effects of topography on grade hypertension, especially for primary hypertension patients who are not native to the mountain, due to traveling or being on mountain, will cause an increase in blood pressure as a response to body adaptation to the environment.

CONCLUSION

Based on the research results, physical activity has an effect on grade hypertension decrease, especially systolic blood pressure in patients with primary hypertension, therefore, it needs health education about physical activity benefits for primary hypertension patients at Kedungrejo community health center (coastal topography), Mojopanggung (urban topography) and Licin (mountains topography), especially respondents in community health center with coastal topography, in which almost all respondents have less physical activity. There is a topographic effect on grade hypertension, the higher the topography, it can cause grade hypertension increase in primary hypertension patient. So, it should be noted also about the environmental effect for patients with primary hypertension especially for non-native people who have not suffered acclimatization.

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