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THE USAGE OF STRUCTURAL EQUATION MODELING (SEM) METHOD IN HYPERTENSION OCCURRING AT ACHMAD MOCHTAR HOSPITAL BUKITTINGGI

***Abdi Iswahyudi Yasril[1], Wijayantono[2]**

[1]Faculty of Health, Universitas Fort De Kock Bukittinggi, 26117 Bukittinggi, West Sumatera, Indonesia
[2]Health Polytechnic Ministry of Health Padang, 25146 Padang, West Sumatera, Indonesia
***Corresponding Author:** Abdi Iswahyudi Yasril ; **Email:** iswahyudiabdi@fdk.ac.id

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ABSTRACT

Hypertension or high blood pressure has many factors, the Structural Equation Modeling (SEM) method is able to analyze the multivariable and find out the direct and indirect effects in a model of the relationship among variables. The purpose of this research to determine the use of structural equation modeling methods (SEM) to assess the factors affecting hypertension in Achmad Mochtar Bukittinggi Hospital. This research is an observational analytic study with a cross-sectional design study. The research sample is 151 respondents at Poli Interne Ahmad Mochtar Bukittinggi Hospital. Analysis was with the structural equation modeling (SEM) method with a CI 95%. The results showed that of the 5 latent variables only 3 had a direct effect on hypertension, namely blood fat (T-value = 5.806), lifestyle (T-value = 13.505) and disease history (T-value = 2.518).)> 1.96. Meanwhile, demographics (0.530) and obesity (0.163) do not directly affect hypertension but can indirectly affect them. It can be concluded that: Lifestyle is a dominant factor because it can directly and indirectly affect hypertension through obesity, blood fats and disease history. It is expected that the research will be able to determine the problem solving plan of hypertension, because it will be known the model of the factors that influence the incidence of hypertension so that planning can be directed at variables that have a more significant influence" either directly or indirectly.

Kata kunci:
hipertensi,
Penyakit Tidak Menular,
Struktural Equation Modeling (SEM)

ABSTRAK

Hipertensi atau tekanan darah tinggi memiliki banyak faktor, metode Structural Equation Modeling (SEM) dapat menganalisis multivariabel dan mengetahui pengaruh langsung dan pengaruh tidak langsung dalam sebuah model hubungan antar variabel. Tujuan penelitian ini mengetahui penggunaan metode struktural equation modeling (SEM) untuk mengkaji faktor yang mempengaruhi hipertensi di Rumah Sakit Achmad Mochtar Bukittinggi. Penelitian ini merupakan penelitian observational analitik dengan desain crossectional study. Sampel penelitian adalah 151 responden di Poli Interne RSAM. Analisis yang digunakan yaitu metode structural equation modeling (SEM) dengan CI 95%. Hasil penelitian menunjukkan dari 5 variabel laten hanya 3 yang berpengaruh langsung terhadap hipertensi yaitu lemak dalam darah (T-value = 5.806), pola hidup (T-value =13.505) dan riwayat penyakit (T-value = 2.518)>1.96. Sedangkan untuk demografi (0.530) dan obesitas (0.163) tidak mempengaruhi hipertensi secara langsung namun dapat berpengaruh secara tidak langsung. Simpulan: Pola hidup merupakan faktor dominan karena dapat mempengaruhi secara langsung, dan secara tidak langsung terhadap hipertensi melalui obesitas, lemak dalam darah dan riwayat penyakit. Penelitian ini diharapkan mampu menentukan perencanaan penyelesaian masalah penyakit hipertensi, karena akan diketahui model dari faktor yang mempengaruhi kejadian hipertensi sehingga perencanaan bisa diarahkan pada variabel yang memiliki pengaruh lebih signifikan baik itu secara langsung maupun tidak langsung.

INTRODUCTION

Non-Communicable Diseases (NCD) are a major problem in developed and developing countries. The number of deaths from NCDs continues to increase in every country. Deaths due to NCDs are common in middle and poor countries. As many as 70% of the world's population is estimated to die from PTM. It is estimated that NCD cases will

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increase by 2030 by 52 million people per year (1).

Hypertension is included in the category of Non-Communicable Diseases or *Penyakit Tidak Menular* (PTM). This disease has a high mortality rate because it can affect a person's quality of life. Hypertension occurs when blood pressure reaches >140 mmHg/90 mmHg (2). Based on the cause, hypertension can be divided into two groups, namely hypertension with 90% unknown cause (primary hypertension) and hypertension with known cause (secondary hypertension). Hypertension that lasts for a long time can cause coronary heart disease, kidney damage and stroke, and can get worse if there is no early detection and adequate treatment. For that, all parties are needed in controlling hypertension (3).

World data show as many as 77.9 million people in the United States are affected by hypertension. To date, hypertension is one of the most dangerous diseases in the PTM group, such as kidney failure, coronary heart disease, and stroke. Hypertension is the number 1 disease causing the most deaths in the world (4).

According to a study, people around the world are dying from cardiovascular disease as much as 17 million per year so that from these data, there are complications caused by hypertension of 9.4 million deaths worldwide every year. As many as 54% are caused by stroke and because of the heart by 47% with hypertension (5).

Hypertension is a silent killer; the symptoms vary from person to person. Factors that affect hypertension are genetics, gender, age, lifestyle such as alcohol consumption, smoking and lack of physical activity and obesity. The prevalence of hypertension in Indonesia is 25.8% and will continue to increase every year if people cannot maintain their health independently (6).

Hypertension in Indonesia in the last three years is still among the top 10 deadly diseases. The National Health Indicators Survey or *Survei Indikator Kesehatan Nasional* (SIRKESNAS) in 2016 stated that the incidence of hypertension increased to 32.4% from the last three years (1).

The results of several studies that affect risk factors for blood pressure in other countries and in Indonesia show that blood pressure is influenced by many factors. Based on the results of the study, it was explained that, with increasing age, a person will be at risk to develop hypertension; this is because at the older age the blood vessels naturally harden with age, so they lose elasticity in their body (7). The study also stated that obesity also affects high blood pressure (hypertension) (7). According to the *Journal of American Medicine* statistics, 37% of Americans over the age of 60 are obese and are associated with other health problems, namely hypertension, cholesterol, heart disease and stroke.

Other studies also state that diabetes is associated with the incidence of hypertension. It is proven that 55.7% of urban patients are at risk for diabetes and hypertension compared to rural patients (8).

West Sumatera in the last three years is still included in the top 5 for hypertension with a prevalence of 22.6%. As for the city of Bukittinggi, the prevalence is higher than the Province of West Sumatera and is still included in the top 10 cases of hypertension with a prevalence of 25.6% (9). Based on an initial survey conducted at the Bukttinggi City Health Office, data obtained that from 2016 to 2017 hypertension was always included in the list of 10 deadly diseases, here hypertension has been the number 2 disease in the last two years and is dangerous in Bukittinggi City.

The initial data were also taken from the medical records of the Achmad Mochtar Hospital (RSAM) Bukittinggi City. According to the results of medical records at the RSAM from 2016-2017, hypertension always occupies the top 10 at the RSAM. Hypertension has even increased. In 2016, inpatient hypertension was in third position and in 2017 it increased to first position. Initial data clearly prove that hypertension is still a very dangerous disease and threatens the lives of all people.

Hypertension can be influenced by many factors. Despite the number of signs and symptoms that accompany this hypertension, few let it and feel it because it is considered a normal thing. This gradual occurrence of hypertension is called a silent killer. Hypertension occurs after complications such as stroke, coronary heart disease, kidney failure, etc. (10).

There are many problems in the health sector in that there are relationships between phenomena that involve multivariable analysis. Generally, theories and models in the

world of health are formulated using constructs that are difficult to observe and directly measure, so that there are variables that are not directly measured and are marked with measurable variables. The pattern of the relationship between variables is that there is a direct influence and an indirect influence (10). Hypertension can be influenced by many factors so that if someone cannot maintain their health properly, they will potentially get hypertension. How to overcome the many factors that influence hypertension can be analyzed with the Structural Equation Modeling (SEM) method which allows researchers to analyze not only direct relationships but also indirect relationships in a causal relationship model between variables so that they can be added more accurately to factors that influence the incidence of hypertension.

In a study that compared path analysis and SEM it was found that, by using path analysis, many are not in accordance with the theoretical model but using SEM is more effective in influencing hypertension. It can be seen that of the seven variables analyzed, there are five that are included in the SEM model, namely a healthy lifestyle; fat and obesity can significantly affect blood pressure, then obesity can significantly affect fat and a healthy lifestyle significantly impacts on obesity (10).

The model is a summary of the theory that is often expressed in mathematical formulations. There are two types of models, namely the time series model and the causal model. The causal model assumes that the predicted factor shows a causal relationship with one or more independent variables so that this model is often used in decision-making. The most frequently used causal model is linear regression (10). Multiple linear regression analysis often causes problems because of the relationship between two or more regressor variables, which is often called multicollinearity. The use of variables that cannot be observed directly in linear regression causes errors in measurements that affect parameter estimates and the size of the variance. There are several ways to overcome this, one of which is to create a composite variable with path analysis and structural equation modeling (10).

SEM is a development of the Generalized Linear Model or commonly referred to as GLM with multiple linear regression included in its part. SEM is able to calculate or measure variables that are not directly observed. The model that is included in the SEM will be assumed to have a causal relationship between the latent variable and the observed as an indicator (11).

Structural Equation Modeling in the form of multivariate analysis has the ability to analyze models which characterize multivariable and tiered simultaneously (12). SEM has a strong theoretical basis so that requires a very complex test based on the theory. Latent variables on SEM are formed from indicators based on the reflective model so that causal relationships that occur between unobserved/latent variables can be measured as to their influence on the dependent variable (10).

The parameter of the SEM equation is the factor load of the latent variable on the indicator or observed variable. SEM is a multivariate analysis that has the ability and advantages to overcome multivariable tiered models simultaneously. SEM is based on solid theory. The latent variable in SEM is formed from indicators based on a reflexive model, namely the latent variable is a reflection of the indicator.

SEM has changed the traditional way of thinking into a structured one that is based on logical and fundamental thinking patterns. The advantage of SEM compared to path analysis using multiple linear regression is that it can be used to see forming indicators among variables and analyze the effect of a variable on other variables and get the accuracy of the model. The SEM equation model is an analytical technique that allows researchers to examine the relationship between variables and is able to provide a comprehensive picture and provide information about the causal relationship between the variables (10).

Variables that affect blood pressure are very complex, some of which are observed and unobserved. The variables in question include: demographics observed from age and genetics; fat in the blood is measured from cholesterol levels and LDL levels; obesity can be observed from weight, height and duration of exercise; smoking can be measured by the number of cigarettes smoked per day, age at starting smoking, and duration of smoking; Healthy lifestyle is measured by the frequency of fruit and vegetable

consumption, blood glucose, salt consumption, coffee consumption, amount of alcohol and sleep frequency.

The complexity of these variables will have a risk of multicollinearity between independent variables. So it can be concluded that the statistical test used to answer the various problems above is using SEM.

Various studies have been conducted to analyze the incidence of hypertension. The factors that influence this disease have been widely carried out and theoretically the cause and effect are clear. However, research that provides a model for all variables that affect hypertension has never been found, especially in the City of Bukittinggi.

The SEM method is used to overcome the many variables that cause hypertension and is very appropriate to use to bring up a new model so that latent variables will be obtained that affect the observed variables and can also produce the influence of the independent variables on the dependent variable, both directly and indirectly.

METHODS

Type of research: this is observational analytic research design with cross-sectional study. The population in this study was all hypertensive patients at the Internal Polyclinic as many as 584 persons with simple random sampling. So that obtained a sample of 151 respondents. This research was conducted from July to August 2018 at Bukittinggi City Hospital. Sources of data used are primary data using a questionnaire and secondary data from medical records. Data analysis was carried out using a computer program using the SEM method, namely the SMART-PLS application.

SEM is a development of the Generalized Linear Model or commonly referred to as GLM with multiple linear regression included in its part. GLM is a method to quantify the relationship between response variable (independent) and predictor variable (bound). The use of GLM can explain how is the change in the value of the response variable if there is a change in the predictor variables.

SEM is able to calculate or measure variables that are not directly observed. The model that is included in the SEM will be assumed to have a causal relationship between the latent variable and the observed as an indicator (11). SEM in the form of multivariate analysis has the ability to analyze a model which characterizes multivariable and tiered simultaneously (12). SEM has a strong theoretical basis, so that it requires a very complex test based on the theory. Latent variables on SEM are formed from an indicator' based on the reflective model so that causal relationships that occur between unobserved/latent variables can be measured as to their influence on the dependent variable (10). The stages of SEM testing are the measurement model specifications, structural specifications and path diagrams.

RESULT

Based on Figure 1, the results of the path coefficient analysis using the SEM method are obtained. The results obtained the factors that influence the incidence of hypertension either directly or indirectly, but before seeing the significant value of the independent variable on the dependent variable, the researcher must first look at the value of the observed variable, because in the observed variable there are still invalid values, which are below 0.5.

The value of the invalid observed variable will be eliminated first and then the data will be reprocessed using this SEM method, so that a significant value of the factors that influence the incidence of hypertension, either directly or indirectly, will be obtained.

The final stage of processing values that were previously insignificant can turn into significant, and vice versa. This is due to the observed variables which were eliminated previously. Therefore, the final result will be removed from the significant T-value and path coefficient values.

Results of Analysis Using Structural Equation Modeling (SEM) Methods on Hypertension Incidence

The results of data analysis on the invalid observed variables have been eliminated so that only valid data appear from the values of the observed variables so that the magnitude of the effect and the value of the data significance level (T-value) are obtained. This matter can be seen in Table 1. Based on

Table 1 it obtained the results of the path coefficient and the significant level of factors that affect the incidence of hypertension. The data show that there are factors that influence hypertension and factors that do not have an influence on hypertension.

This can be seen in Figure 2 Part 1. Then after the results of the analysis are carried out, Figure 2 shows the T-value of the factors that influence the incidence of hypertension.

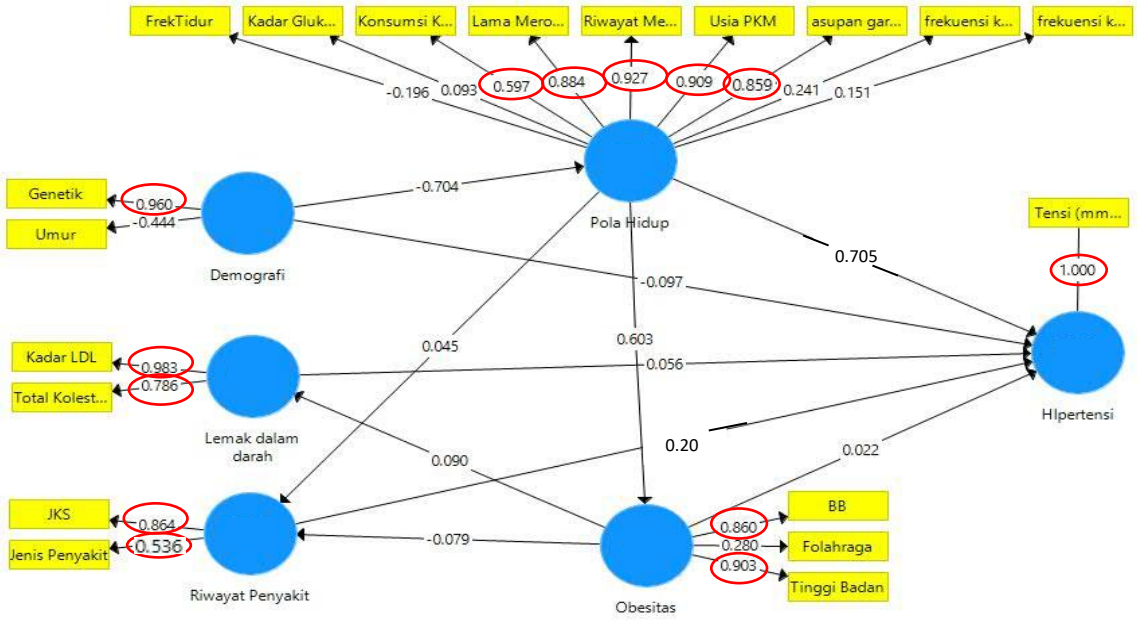

Figure 1. Results of Path Coefficient Analysis Using the SEM. Method

Table 1. Path Coefficient Results and Significance Levels of Factors Affecting the Incidence of Hypertension

Effect Between Variables	Path Coefficient (Beta)	T-Value	Test result
Demographics of hypertension	-0.097	0.530	Not significant
Lifestyle against hypertension	0.704	13,505	Significant
Fat in the blood against hypertension	0.473	5.806	Significant
History of hypertension	0.202	2.518	Significant

Demographics Against Hypertension

Based on Table 1 and Figure 2, the results of path analysis using the SEM method obtained a T value of 0.530 with a 95% confidence level (CI); value 0.530<1.96. This means that demographics have no influence on the incidence of hypertension.

Lifestyle Against Hypertension

Based on Table 1 and Figure 2, the statistical test results of path analysis using the SEM method obtained a T-value of 13,505 with a 95% confidence level; ;value 13,505>1.96. This shows that lifestyle has a significant effect on the incidence of hypertension.

Lifestyle has a great influence/coef value and pathway (β) of 0.704 with the incidence of hypertension. This means that if the lifestyle has increased in an unhealthy direction, it is estimated that hypertension can increase by 0.704.

Fat in the Blood against Hypertension

Table 1 and Figure 2 show the results of the statistical test of path analysis using the SEM method, which obtained a T-value of 5.806 with a 95%

confidence level; value 5.806>1.96. This shows that fat in the blood has an influence on the incidence of hypertension.

Fat in the blood has a large effect/coef. The path (β) is 0.473 with the incidence of hypertension. This means that if there is an increase in fat in the blood, it is estimated that there will be an incidence of hypertension of 0.473.

History of Disease Against Hypertension

Table 1 and Figure 2 show the results of the statistical test of path analysis using the SEM method, which obtained a T-value of 2.518 with a 95% confidence level; value 2.518>1.96. This means that the history of the disease significantly affects the incidence of hypertension.

The history of the disease has an influence value / coefficient. pathway (β) of 0.202 to the incidence of hypertension. This means that, if the history of the disease has increased, it is estimated that hypertension can increase by 0.202.

Obesity to Hypertension

Based on Table 1 and Figure 2, the results of path analysis using the SEM method showed that the T-value was 0.163 with a 95% confidence level; value 0.163<1.96. This means that obesity has no significant effect on the incidence of hypertension.

After obtaining the overall result diagram in accordance with Figure 2, then the path analysis results are made that have a significance level only on the dependent variable, so that paths are formed between variables. This can be seen in Figure 3 and Figure 4.

Path Analysis with Significance Level Value (T-Value) and Large Influence (β)

Based on Figure 3, a path analysis was formed using the SEM method. Then, in Figure 4, the influence/path coefficient of each significant variable is obtained. Table 2 shows the conclusion of the significance level and path coefficient using SEM.

Based on the results of path analysis using the SEM method, it was found that demography did not directly affect the incidence of hypertension, but the results obtained that demography indirectly influenced the incidence of hypertension through lifestyle, obesity and blood fat. Then demographics also indirectly influence the incidence of hypertension through lifestyle and history of disease with a total influence of -1.261.

Based on the results of path analysis using the SEM method, it was found that lifestyle had a significant direct effect on the incidence of hypertension. However, lifestyle besides directly influencing the incidence of hypertension, also indirectly influences the incidence of hypertension through obesity and fat in the blood. Lifestyle also indirectly influences the incidence of hypertension through a history of hypertension with a total effect of 0.903.

Table 2. The Results of the Level of Significance and the Magnitude of the Effect/Path Coefficient using the Structural Equation Modeling (SEM) Method on the Factors Affecting the Incidence of Hypertension

Variable	Path Coefficient	T-value	Correlation (r)
Demographics (X1) -> Lifestyle (X2)	–0.704	8.866	–0.716
Fat in Blood (X3) -> Hypertension (Y)	0.473	5.806	0.692
Obesity (X5) -> Fat in Blood	0.544	7.186	0.703
Lifestyle (X2) -> Hypertension (Y)	0.704	13,505	0.888
Lifestyle (X2) -> Obesity (X5)	0.600	8,525	0.544
Lifestyle (X2) -> Disease History (X4)	0.225	2,903	0.632
History of Disease (X4) -> Hypertension (Y)	0.202	2.518	0.641

The results of path analysis using the SEM method found that blood fat has a direct influence on the incidence of hypertension with a total effect of 0.473. Based on the

history of disease, the results of path analysis using the SEM method were found to have a significant direct effect on the incidence of hypertension with a large effect (β) of 0.202.

As for obesity, the results of path analysis using the SEM method showed that obesity had no direct effect on the incidence of hypertension, but the results obtained that obesity indirectly affected the incidence of hypertension through the blood fat pathway with a large effect (β) of 0.257.

In accordance with the results and interpretations above, the total structural equation Y is formed: Pyx1 X1 + Pyx2 X2 + Pyx3 X3 + Pyx4 X4 + Pyx5 X5 + Pyε: -1,261X1 + 0.903X2 + 0.473X3 + 0.202X4 + 0.257 X5 + 0.488ε; 0.512.

Based on the overall results, it can be seen that the ability of hypertension to explain the variance of each variable is 51.2% and there is a value of 48.8% explained by other factors. After being researched and based on theory, other factors that are intended to influence hypertension are coconut milk consumption, ethnicity, alcohol and waist circumference. In accordance with the research at RSAM with interviews, the researchers received information that there were other variables as hidden influences/other factors in this study, namely coconut milk consumption and waist circumference. The results of the path analysis showed that the most dominant factor influencing hypertension, both directly and indirectly in RSAM, was lifestyle.

Structural Equation Y : Pyx1 X1 + Pyx2 X2 + Pyx3 X3 + Pyx4 X4 + Pyx5 X5 + Pyε ; $Rsquare$ = -0.097X1 + 0.704X2 + 0.473X3 + 0.202X4 + 0.022 X5 + 0.488ε; 0.512.

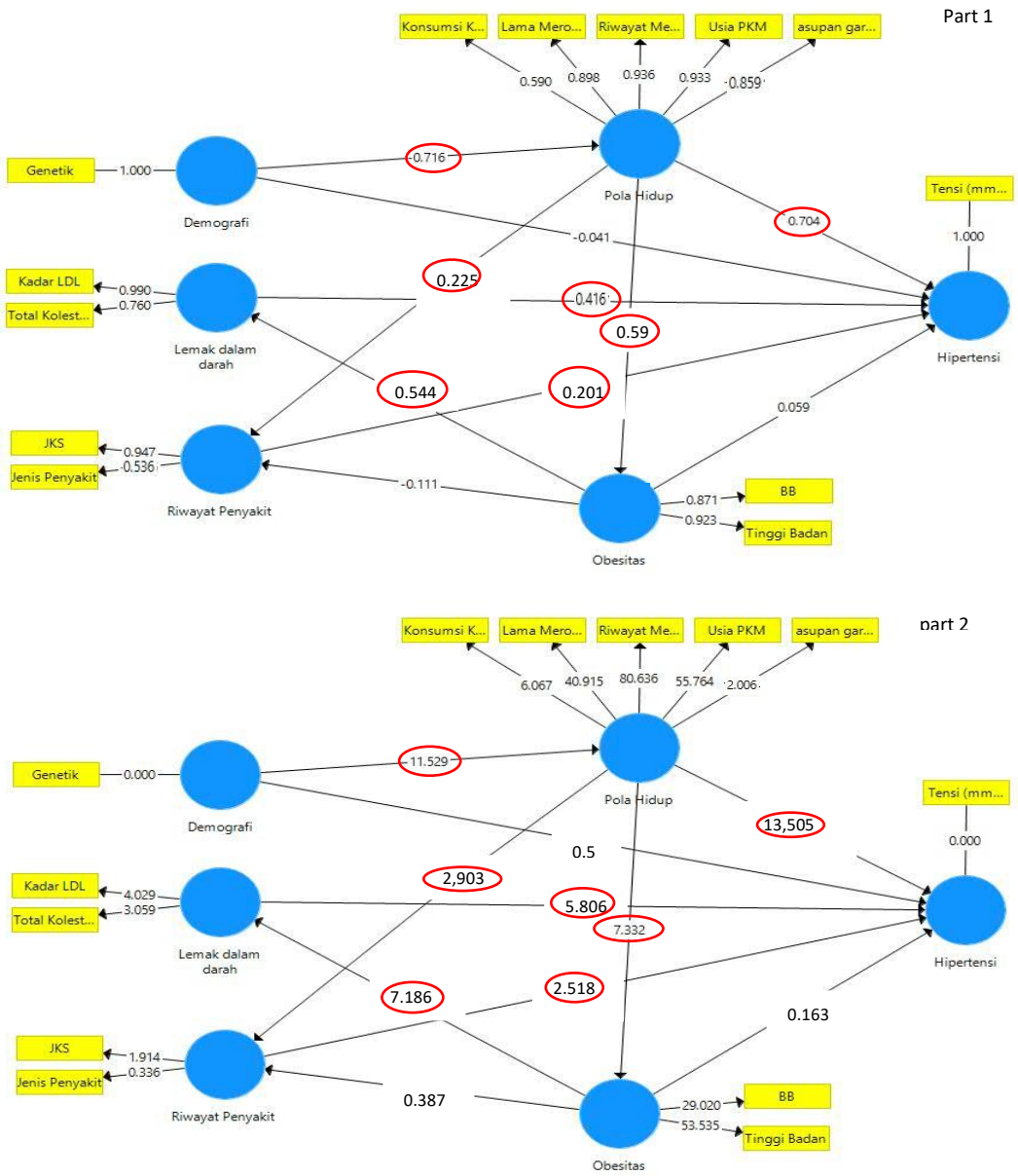

Figure 2. Path Coefficient Value (Part 1) and Significance Level Value (T-Value) (Part 2) on Factors Affecting the Incidence of Hypertension

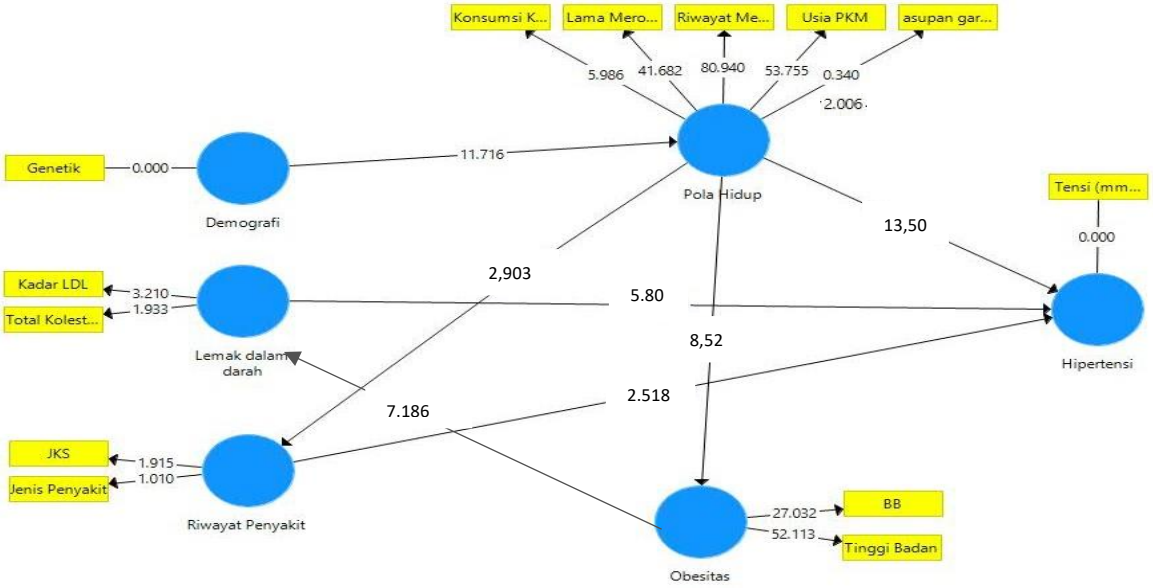

Figure 3. Level of Significance (T-Value) of Factors Affecting the Incidence of Hypertension using the SEM Method

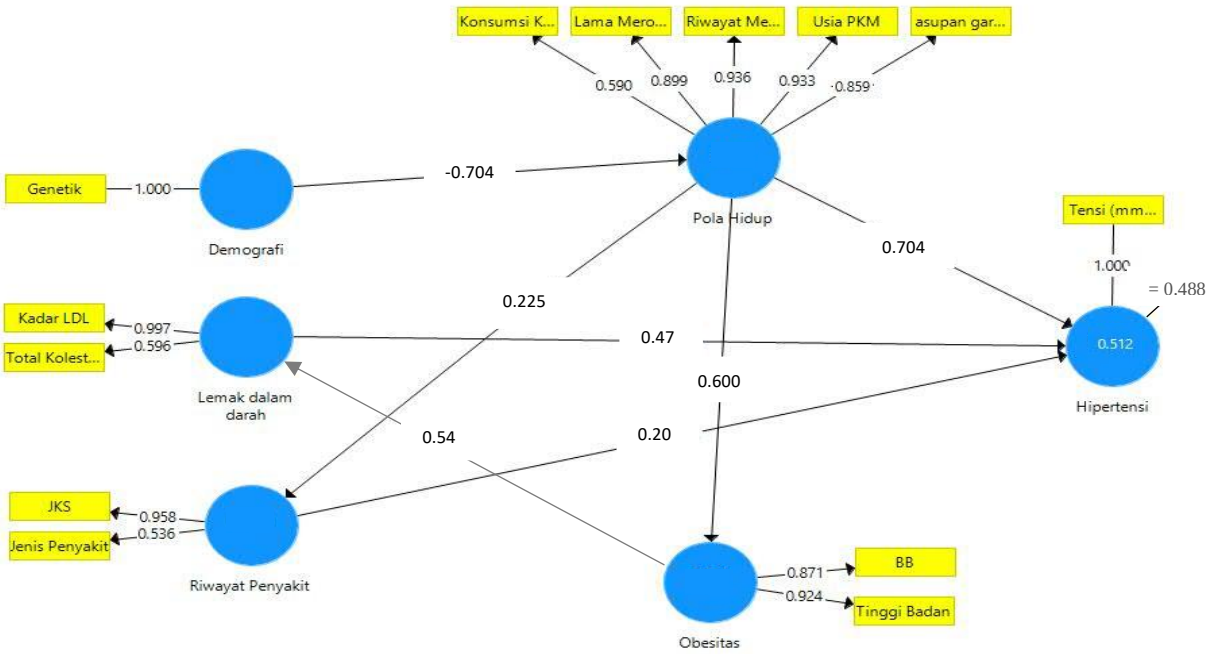

Figure 4. The Influence / Path Coefficient of Factors Affecting Events Hypertension Using the SEM Method

DISCUSSION

Use of Structural Equation Modeling (SEM) Methods

Based on the results obtained in the model, 20 variables were observed which resulted in the value of the latent/independent variable which could theoretically affect hypertension. After validating the observed variables, the results obtained from 20 variables, only 13 observed variables were valid, so that invalid variables were eliminated from the research model. After that, the valid observed variables were reprocessed in the research model so as to produce new values for the latent variables which can then affect hypertension.

The results of the study obtained a model of factors that influence the incidence of hypertension; from five independent variables, three variables proved to have a significant effect on hypertension, namely

lifestyle, blood fat and disease history, two variables were not significant, namely demographics and obesity so that they could only have an indirect effect. through the paths in the model.

SEM has changed the traditional way of thinking into a structured one that is based on logical and fundamental thinking patterns (13)(14). The advantage of SEM compared to classical path analysis using multiple linear regression is that it can be used to analyze an indicator on a variable, and can obtain confirmation of the accuracy of the model and analyze the effect of a variable with other variables (15).

The variables that affect hypertension are very complex, some of which are observed and unobserved. The variables in question include demographics observed from age and genetics; fat in the blood is measured from cholesterol levels and LDL levels; obesity can be observed from weight, height and duration of exercise; smoking can be measured by the number of cigarettes smoked per day, age at starting smoking, and duration of smoking; healthy lifestyle is measured by the frequency of fruit and vegetable consumption, blood glucose, salt consumption, coffee consumption, amount of alcohol and sleep frequency.

The factors that influence this disease are theoretically clear cause and effect. In accordance with research which states that by using the SEM method of seven hypotheses, five hypotheses are proven to be significant and two hypotheses are not significant (10). According to the results of the study, researchers stated that many respondents had blood pressure >160 mmHg. In general, hypertension is a common disease. Factors causing hypertension can be divided into two groups, which cannot be controlled such as gender, age and family history. Then the controllable factors are such as smoking behavior, lack of physical activity, obesity and consumption patterns of saturated fat foods (16).

Hypertension that cannot be controlled and left unchecked for too long will accelerate the occurrence of atherosclerosis. Hypertension is a risk factor for diastolic dysfunction and can lead to complications of heart, cerebral, kidney, and stroke which results in weakness of vital organ functions, causing paralysis and even death (17).

Based on the model obtained for this study, it is assumed that SEM is a very complex method to test, resulting in an influence on the model of the incidence of hypertension. Based on the existing model, the research results obtained that lifestyle is the most dominant factor in influencing hypertension. This is evidenced that lifestyle influences directly and indirectly. Therefore, according to the resulting model, it can help officers or other health workers to provide information related to the incidence of hypertension. Based on the model produced, the researcher is able to explain and assume that in people with hypertension the most important thing to control and maintain is a lifestyle, because lifestyle is something that can be controlled.

After conducting research on excessive salt consumption, smoking activity is a trigger for respondents to get hypertension and there are other indicators that cause hypertension, namely excessive consumption of coconut milk, especially Minang people who really like coconut milk. Therefore, it is hoped that further researchers will add coconut milk as a variable to study on hypertension.

A healthy lifestyle is very important, especially for people with hypertension; according to the model produced, lifestyle is a risk factor that greatly affects hypertension because lifestyle can affect directly and indirectly; therefore, by implementing a healthy lifestyle, such as maintaining a healthy diet, not smoking, consumption of fruit, vegetables and not drinking alcoholic beverages, according to the respondent's model it will avoid obesity and can reduce fat levels in the body so that fat accumulation can be minimized and disease history can be controlled properly. If we have managed to maintain a healthy lifestyle with regular exercise, we will have an ideal and healthy body so that in old age we can enjoy a healthy life and avoid hypertension and all kinds of diseases.

CONCLUSIONS AND SUGGESTIONS

Conclusion

Lifestyle is the most dominant factor because apart from being able to have a direct effect with a large effect value of 0.704 or 70.4%, lifestyle can also indirectly affect

hypertension through obesity, fat in the blood (0.600 x 0.544 x 0.473 = 0.154) and a history of disease (0.045) with a large influence of 0.154 + 0.045 = 0.199, so that the total overall pattern of life on hypertension becomes 0.903 (90.3%).

Suggestion

This article is expected to be able to determine the planning of solving the problem of hypertension, because it is known that the model of the factors that influence the incidence of hypertension so that planning can be directed at variables that have a more significant influence, either directly or indirectly.

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