



Path Analysis of Knowledge, Education Level, Income and Behavior to Hypertension Incidence in Semarang City

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Article Info	Abstract
Article History: Submitted 03 June 2025 Revised 15 December 2025 Accepted 10 February 2026 Keywords: Hypertension, Hypertension Knowledge, Lifestyle Behavior DOI: https://doi.org/10.15294/phpj.v10i1.26497	Globally 33% of the population aged 30-70 years will suffer from hypertension in 202. This study uses a quantitative approach with a <i>cross-sectional study design</i>. The research sample of 400 respondents used <i>the consecutive sampling technique</i>. Data collection was conducted using questionnaire instruments and medical record data. The samples taken were respondents aged >15 years who took blood pressure measurements at the Telogosari Kulon, Telogosari Wetan and Kedungmundu Health Centers. Data analysis using chi-square test and logistic regression with SPSS and path analysis using JASP. Most of the respondents in this study were female, elderly, and had high education levels, low knowledge, and bad behavior. The results of the study stated that statistically there was a direct influence of education level ($p\text{-value} = <0.001$), income ($p\text{-value} = <0.001$) and lifestyle behavior ($p\text{-value} = <0.001$) on the incidence of hypertension. Statistically, there is an indirect influence of knowledge ($p\text{-value} = <0.001$), education level ($p\text{-value} = 0.001$), income ($p\text{-value} = <0.001$) through lifestyle behaviors on the incidence of hypertension in Semarang City. Variables of knowledge about hypertension ($p\text{-value} = 0.772$) has no direct effect on the incidence of hypertension. Lifestyle behavior has the greatest effect (25%) in influencing the incidence of hypertension in Semarang City. The conclusion of this study is that there is a direct influence of education, income and lifestyle on the incidence of hypertension, and there is an indirect influence between knowledge, education level, and income through behavior on the incidence of hypertension in Semarang City. Suggestions for agencies and the community to increase preventive efforts, especially lifestyle behavior.

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INTRODUCTION

Hypertension is a condition when the pressure in the blood vessels is too high, so that the heart works harder to pump. Hypertension is one of the leading causes of death and disability worldwide. Globally, 38% of deaths caused by high blood pressure occur in adults under the age of 70. People with hypertension often do not feel symptom As 46% of people who suffer from hypertension do not realize they have hypertension (WHO, 2023a).

Hypertension affects 1 in 3 people in the world who appear asymptomatic or with the term "*the silent killer*". Hypertension is the leading cause of premature death worldwide and is mostly found in low- and middle-income countries. The African region has the highest prevalence of hypertension at 27%. Southeast Asia is in 3rd position with a prevalence of 25%. As many as 80% of deaths due to high blood pressure occur in developed and developing countries. Hypertension is one of the global targets of non-communicable diseases in reducing prevalence by 33% between 2010 and 2030

The 2018 Basic Health Research data states that the prevalence of hypertension in Indonesia has increased from 25.8% in 2013 to 34.1% in 2018. Central Java is the province with the 4th highest hypertension cases in Indonesia with a prevalence of 37.5% in 2018 and South Kalimantan is the first highest case with a hypertension prevalence of 44.1 (Riskesdas, 2018) . Hypertension in Semarang City shows that the number of cases tends to increase over the last 5 years from 161,283 to 290,910 cases with the prevalence of hypertension in 2022 of 24.8% of the population aged 15 years and above (Semarang City Health Office, 2022).

Semarang City as the Capital City of Central Java Province is an urban area with a coastal area of 5,039.17 Ha (0.02%) which has the second largest population in Central Java of 1,694,743 people (BPS Semarang City, 2024). The high number of residents in Semarang City cannot be separated from health problems including the problem of non-communicable diseases such as hypertension. Hypertension cases in Semarang City began to be found at the

age of ≥ 15 with the highest number of hypertension cases found in the Kedungmundu Health Center with 25,687 cases, the Tlogosari Wetan Health Center with 19,811 cases and the Tlogosari Kulon Health Center with 17,604 cases (Semarang City Health Office, 2022).

Knowledge is one of the risk factors that influences the incidence of hypertension. This is in line with previous research, which found that good knowledge is significantly associated with controlled blood pressure, the number of antihypertensive medications used, the frequency of hospitalizations, medication adherence, and healthy lifestyle behaviors (Paczkowska et al., 2021).

Education level is one of the sociodemographic factors that increases the risk of hypertension. Previous research also found that people with a primary education level were 1.56 times more likely to develop hypertension than those with a higher education level (Qin et al., 2022). People with higher education are more likely to acquire health knowledge about hypertension, which can lead to a healthier lifestyle (Qin et al., 2022).

Income is one of the sociodemographic factors that causes the risk of hypertension. This is supported by research findings that there is a relationship between low socioeconomic status and the incidence of hypertension (Kharisyanti and Farapti, 2017). This is in line with research in Nanjing, China, which found that low-income groups had a 1.35-fold risk of developing hypertension (Qin et al., 2022).

The 2018 Basic Health Research (Riskesdas) data indicates that risk factors for non-communicable diseases include low fruit and vegetable consumption, lack of physical activity, smoking, and alcohol consumption. Previous research found a link between smoking and hypertension, with the risk of hypertension being 3.1 times greater than that of non-smokers (Lusno et al., 2020).

Based on the high incidence of hypertension in Semarang City and the health impacts caused by hypertension, the researcher will conduct research on the analysis of knowledge paths, education levels, income, and behavior on the incidence of hypertension in

Semarang City.

METHOD

This research is a type of quantitative research with the design of Survey analytics using the *cross sectional*. This research was carried out by collecting data between exposure and disease at one time. Researchers choose *study cross sectional* or slice-by-latitudes to see the relationship between exposure and disease (Murti, 2018).

The population in this study is all people aged ≥ 15 years who live in Semarang City as many as 1,290,610 people (BPS Semarang City, 2024). The sampling technique in this study uses *consecutive sampling* by taking samples sequentially and considering the research criteria until the number of samples is met (Roflin and Pariyana 2022). Sampling was carried out in 3 Puskesmas areas in Semarang City with the highest number of hypertension cases, namely Kedungmundu Health Center with 25,687 cases, Tlogosari Wetan Health Center with 19,811 cases and Tlogosari Kulon Health Center with 17,604 cases (Semarang City Health Office, 2022).

In this study, the inclusion criteria were considered, namely people aged ≥ 15 years living in Semarang City who came to the Kedungmundu, Tlogosari Wetan and Tlogosari Kulon Health Centers, then conducted blood pressure checks to competent medical personnel during the study. The exclusion criterion in this study is people who are not willing to be respondents in the study. This study was conducted in September 2024-December 2024. The sample size in this study used a minimum sample calculation with the slovin formula and obtained a minimum sample of 400 respondents.

The independent variables in this study were knowledge about hypertension, education level, and income. The dependent variable in this study is the incidence of hypertension. The intervening variable in this study is lifestyle behavior. The data collection techniques in this study were obtained from the results of primary and secondary data sources and then processed into information. Primary data collection was carried out using questionnaire instruments and structured interviews with respondents using the

kobotoolbox website which has conducted blood pressure checks to professional and competent health workers at the Kedungmundu, Telogosari Wetan, and Telogosari Kulon Health Centers. The validity test in this study was carried out on 30 respondents who were selected according to the inclusion criteria carried out at the UPTD Perumnas Health Center, Rejang Lebong Regency, Bengkulu. This study uses the following data analysis techniques.

The research conducted on the age variable was then categorized into 2 categories, namely adults with an age of < 59 years and the elderly with an age of ≥ 60 years. The research on education level variables was then categorized into 2, namely low education in respondents who were not in school, elementary/equivalent and junior high/equivalent. while the higher education category is respondents with the last education of high school/equivalent and Academic/S1/S2/S3 universities. Revenue is categorized into 2, namely revenue $< \text{IDR } 671,936$ and $\geq \text{income IDR } 671,936$. The knowledge variables are categorized into 2, namely low knowledge if the score is < 10 and high knowledge if the score is ≥ 10 . The behavior variables are categorized into 2, namely bad behavior if the score is < 13 and good behavior with a score value of ≥ 13 .

Univariate analysis is carried out on each variable presented in the form of frequency distribution and percentage of each variable. The univariate analysis in this study aims to see the distribution of frequency and proportion in each of the variables studied, namely knowledge, education level, income, behavior and incidence of hypertension.

Bivariate analysis was carried out to obtain an answer whether there was a statistical relationship between variables. The statistical analysis used was the Chi-Square test using SPSS to find out the correlation between 2 variables and measure the risk factor (Odd Ratio).

Multivariate analysis was performed to see the influence of several independent variables on one or more bound variables. The analysis used in this study is linear regression analysis to determine the influence of two or more independent variables on bound variables. The statistical test analysis in this study uses the SPSS

program. Decision-making in this regression test can refer to the comparison of significant values with probability (0.05), if the significant value is < 0.05 , then the independent variable has an effect on the dependent variable

Path analysis is a further part of regression analysis. Regression analysis is commonly used to test whether there is a direct influence exerted by the independent variable on the bound variable. Meanwhile, path analysis not only tests the direct influence, but also explains the indirect influence exerted by the free variable through the intervening variable on the bound variable (Sugiyono and Susanto 2017).

RESULTS AND DISCUSSIONS

The image of the flow of the research

location shows the number of samples taken, namely 3 health centers out of 37 health centers with the highest hypertension cases in Semarang City based on Semarang City Health Profile data in 2023. The research location was carried out at the Kedungmundu, Tlogosari Wetan and Tlogosari Kulon Health Centers, then structured interviews were conducted on respondents aged >15 years who came and conducted blood pressure checks at the 3 health centers. Based on the selection of the sampling location, the number of samples was obtained at each health center, namely, Kedungmundu Health Center 133 samples, Tlogosari Wetan Health Center 133 samples and Tlogosari Kulon Health Center 144 samples. Sampling was stopped after the minimum sample target was met, which was 400 respondents.

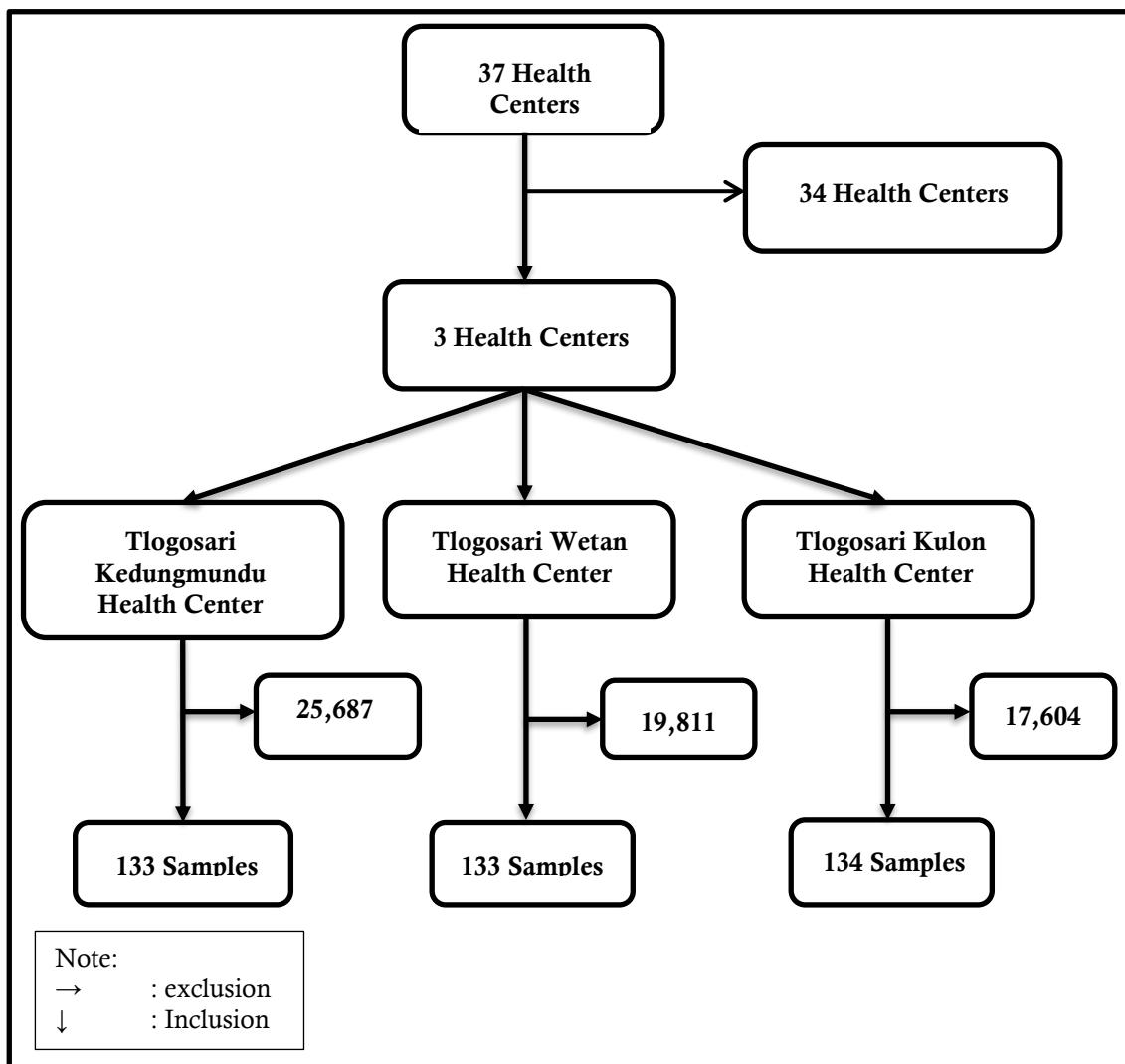


Figure 1. Population and Sample Chart

This study only reveals the factors that cause hypertension based on demographic factors, namely 3 independent variables which include knowledge, education level and income. So that the results can only be seen based on demographic factors. In the data collection process, there were respondents who did not fall into the inclusion criteria because they were not willing to become research respondents.

Table 1. Frequency of Respondent Characteristics

No	Vriabel	N	%
1	Incidence of Hypertension		
	Hypertension	183	45.8%
	No Hypertension	217	54.3%
2	Age		
	Early Adulthood	199	49.8%
	Advanced Adult	201	50.2%
3	Gender		
	Man	110	27.5%
	Woman	290	72.5%
4	Education level		
	Low	191	47.8%
	Tall	209	52.3%
5	Income		
	<IDR671.936	138	34.5%
	≥ IDR671.936	262	65.5%
6	Knowledge		
	Low	258	64.5%
	Tall	142	35.5%
7	Behaviour		
	Bad	233	58.3%
	Good	167	41.8%

Source: Primary data of the study (2025)

The results of the analysis in the table showed that the respondents who were not hypertensive, namely 217 (54.3%) people, were more than respondents who were hypertensive, namely 183 (45.8%) people, the respondents were elderly which was 201 (50.2%) more people compared to those who were of early adulthood, namely 199 (49.8%) people, respondents with female gender, which was 290 (72.5%) more people compared to male respondents, namely 110 (27.5%) people, respondents with higher education level as many as 209 (52.3%) more than respondents with low education level which is 191 (47.85) people, income respondents ≥IDR671,936 as many as 262 (65.5%) more people than respondents with income <IDR671,936 which is 138 (34.5%) people,

respondents with low knowledge as many as 258 (64.5%) people more than respondents with high knowledge which is 142 (35.5%) people, 233 (58.3%) respondents with bad behavior were more than respondents with good behavior 167 (41.8%) people.

The results of the bivariate analysis in table 2 show that all variables have a *p-value* of <0.05 which can be interpreted that the variables of knowledge ($p=0.000$), income ($p=0.000$) and education level variables ($p=0.000$) are related to lifestyle behavior. The test results on the knowledge variable showed that most of the respondents with bad behavior as many as 171 (66.3%) people had knowledge of low hypertension. The test results showed a PR value of 95% CI=1.518 (1.235-1.865). The results of the analysis on the income variable showed that most of the respondents who had bad lifestyle behaviors as many as 103 (74.6%) people had an income <IDR671,936. The test results showed a PR value of 95% CI = 1.504 (1.287-1.758). The results of the analysis on the education level variables showed that most of the respondents had a bad lifestyle as many as 137 (71.7%) people had a low level of education. The test results showed a PR value of 95% CI = 1.562 (1.315-1.855).

The results of the bivariate analysis in table 3 can be found that all variables have a *p value* of <0.05 which means that the variables of knowledge ($p=0.001$), income ($p=0.000$), education level ($p=0.000$), and behavior ($p=0.000$) are related to the incidence of hypertension in Semarang City. The results of the analysis showed that most of the respondents who experienced hypertension had knowledge of low hypertension, namely as many as 235 (52.3%) people. The test results showed a PR value of 95% CI = 1.548 (1.196-2.004). The results of the test on the income variable showed that most of the respondents who experienced hypertension as many as 96 (69.6%) people had an income of <IDR671,936). The test results showed a PR value of 95% CI=2.095 (1.708-2.569). The test results on the education level variables showed that most of the respondents who experienced hypertension were 117 (61.3%) people with low level of education. The results of the analysis showed a PR value of 95% CI=1,940 (1,542-

2,440). The results of the analysis on the behavioral variables showed that most of the respondents who experienced hypertension as many as 129 (55.4%) people had poor lifestyle behavior. The test results showed a PR value of 95% CI = 1.712 (1.336-2.194).

Table 2. Bivariate Results of Behavior-Related Variables in Semarang City

Variable	Lifestyle Behavior		Total	<i>p value</i>	PR(95% CI)
	Bad	Good			
Knowledge About Hypertension				<0.001	1.518 (1.235-1.865)
Low	171 (66.3%)	87 (33.7%)	258 (100%)		
Tall	62 (43.7%)	80 (56.3%)	142 (100%)		
Income				<0.001	1.504 (1.287-1.758)
<IDR671,936	103 (74.6%)	35 (25.4%)	138 (100%)		
≥IDR671,936	130 (49.6%)	132 (50.4%)	262 (100%)		
Education Level				<0.001	1.562 (1.315-1.855)
Low	137 (71.7%)	54 (28.3%)	191 (100%)		
Tall	96 (45.9%)	113 (54.1%)	209 (100%)		

Source: Primary data of the study (2025)

Table 3. Bivariate Results of Variables Related to the Incidence of Hypertension in Semarang City

Variable	Incidence of Hypertension		Total	<i>p value</i>	PR(95% CI)
	Hypertension	No Hypertension			
Knowledge About Hypertension				0.001	1.548 (1.196-2.004)
Low	135 (52.3%)	123 (47.7%)	258 (100%)		
Tall	48 (33.8%)	94 (66.2%)	142 (100%)		
Income				<0.001	2.095 (1.708-2.569)
<IDR671,936	96 (69.6%)	42 (30.4%)	138 (100%)		
≥IDR671,936	87 (33.2%)	175 (66.8%)	262 (100%)		
Education Level				<0.001	1.940 (1.542-2.440)
Low	117 (61.3%)	74 (38.7%)	191 (100%)		
Tall	66 (31.6%)	143 (68.4%)	209 (100%)		
Lifestyle Behavior				<0.001	1.712 (1.336-2.194)
Bad	129 (55.4%)	104 (44.6%)	233 (100%)		
Good	54 (32.3%)	113 (67.7%)	167 (100%)		

Source: Primary data of the study (2025)

The Relationship of Knowledge About Hypertension to Lifestyle Behaviors

Knowledge is one of the important factors that can affect a person's behavior. Unhealthy lifestyles such as lack of physical activity, smoking, excessive salt consumption and lack of fruit and vegetable intake can be caused by a lack of knowledge so that it can increase the risk of hypertension. A person's knowledge and attitude can significantly influence an individual's behavior (Zhang et al., 2025). The results of this study state that knowledge about hypertension is statistically related to lifestyle behaviors (*p value* = 0,000; PR 95% CI = 1.548. The results of this study found that most of the respondents with poor lifestyle behaviors as many as 171 (66.3%) people had low hypertension knowledge. The test

results in this study showed a PR value of 95% CI = 1.548 which means that a person who has knowledge of low hypertension is 1.5 times more likely to have poor lifestyle behavior. Previous research has shown consistent results that knowledge relates to hypertension prevention behaviors (*p-value*=0.028) It is known that most respondents with high knowledge show good hypertension prevention behaviors by 74.1% of people (Elsi Setiandari L.O, 2022). The results of previous research also found that hypertension knowledge is related to hypertension control efforts (*p-value*=0.001<0.05) (Isnaini & Hermawati, 2024).

The Relationship of Education Level to Lifestyle Behavior

In the process of taking education, it is

easier to get broader information and insights, so that it can determine the individual's way of thinking. The level of education plays a role in shaping a person's behavior, the higher the level of education, the better the healthy living behavior will be (Ariga, 2022). Previous research has shown consistent results that higher education is 5.6 times more likely to adopt better hypertension prevention practices (Chimberengwa & Naidoo, 2018). Another study found similar results that respondents with higher education levels were 1.5 times more likely to eat fruit and 1.8 times more likely to eat vegetables compared to respondents with lower education (Stea et al., 2020).

The results of this study show that education level is significantly related to lifestyle behavior with ($p=0.000 < 0.005$). Most of the respondents in this study who had poor lifestyle behaviors as many as 137 (71.7%) had a low level of education. The test results showed a PR value of 95% CI= 1,562 (1,315-1,855) which means that a person with a low level of education is 1.5 times more likely to have poor lifestyle behavior. Other studies also found similar results that there was a relationship between education level and fruit and vegetable consumption ($p=<0.001$) (Stea et al., 2020). Previous research is in line with the statement that low education levels are 4.7 times more likely to implement poor hypertension care behaviors than someone with higher education levels (Azmiardi et al., 2023).

The Relationship Between Income and Lifestyle Behavior

Income in this study is the monthly per capita income divided by the number of family members covered. Family income plays an important role in fulfilling a person's nutrition, including in fulfilling fruit and vegetable intake. A person with low socioeconomic status is more likely to adopt unhealthy lifestyle behaviors, such as smoking, excessive alcohol consumption, poor eating habits and lack of physical activity that can lead to the risk of developing diseases including hypertension (Li et al., 2024). Previous research has found the opposite that high-income people are 2.4 percent healthier than low-income individuals (Rakasiwi, 2021).

The results of this study state that statistically income is related to lifestyle

behaviors ($p\text{-value}=0.000$) with a PR of 95% CI= 1,504 (1,287-1,758). Most of the respondents in this study who had bad lifestyle behaviors as many as 103 (74.6%) people had an income of <Rp671,936. The results can be concluded that a person with an income of < Rp671,936 is 1.5 times more likely to have bad lifestyle behavior. Other studies have found consistent results that family income is related to fruit and vegetable consumption behaviors ($p\text{-value}= 0.023$) with a PR value = 3,441 (Luthviah et al., 2025).

The Relationship of Knowledge About Hypertension with the Incidence of Hypertension

Knowledge about hypertension plays an important role in shaping lifestyle behaviors as a risk factor for hypertension. The better the knowledge about hypertension will reduce the risk of hypertension by applying knowledge through disease prevention. This study found that statistically knowledge about hypertension is related to the incidence of hypertension in Semarang City ($P=0.001$) with a PR value (CI 95%)=1.548 (1.196-2.004). Most of the respondents in this study who suffered from hypertension as many as 135 (52.3%) people had knowledge of low hypertension. These results could mean that respondents with knowledge of low hypertension were 1.5 times more likely to experience the incidence of hypertension. Previous research has found consistent results that knowledge is related to the incidence of hypertension ($P=0.003$) (Rida Darotin & Madyaning Nastiti, 2022). The results of another study also found that knowledge was statistically related to the incidence of hypertension ($P=0.002$) with an OR value of 95% CI= 4,713 (1,821-12,198) (Wibowo et al., 2023). Another study found similarly that knowledge of physical activity as a risk factor for hypertension was associated with undiagnosed hypertension incidence ($p = <0.05$; OR 95% CI= 4.23 (2.23-8.00) (Gebrihet et al., 2017).

The Relationship of Education Level to the Incidence of Hypertension

Education level is an aspect in individual sociodemographic factors that are related in shaping a person's behavior. In the process of pursuing education, it allows individuals to obtain information and knowledge that can

determine a person's behavior. Behaviors including lifestyle are very closely related to mortality including hypertension, so education level plays a role in shaping lifestyle behaviors that are risk factors for hypertension. According to WHO, education is one of the determinants of health, where low education levels are related to poor health and more stress. Individuals with higher education are 3% more likely to have healthier health status than individuals with low education (Rakasiwi, 2021). Other findings also stated that individuals who did not have formal education were 18 times more likely to develop hypertension (Naidu et al., 2019)

The results of the analysis in this study state that education level is statistically related to the incidence of hypertension in Semarang City ($P=0.000$) with a PR value of 95% CI= 1,940 (1,542-2,440). Most of the respondents in this study who suffered from hypertension as many as 117 (61.3%) people were respondents with low level of education. The results can be concluded that respondents with low education level are at risk of experiencing hypertension 1.9 times. Previous studies have found consistent results that a person with a basic level of education is 1.56 times more likely to develop hypertension (OR CI 95% = 1.56 (1.43-1.70)) (Qin et al., 2022). Previous research has found consistent results that education is statistically related to the incidence of hypertension ($p = 0.002$) and OR value 95% CI=16.11 (2.07-25.47) (Herlinah, Erma Gustina, 2024). Previous research results have also obtained similar results that education is related to hypertension ($p<0.020$) (Roy et al., 2024)

The Relationship of Income and the Incidence of Hypertension

Income is closely related to fulfilling nutritional intake as a healthier immune system. Income plays a role as a factor in fulfilling fruit and vegetable consumption behavior. Consumption of vegetables and fruits is one of the factors that can be modified as a cause of hypertension. Efforts through income factors play a role as an indicator of socio-economic status in the formation of a better degree of health. Individuals with high incomes are 2.44 times more likely to have healthier health status (Rakasiwi, 2021). Previous studies have shown

that low-income individuals are 16 times more likely to develop hypertension than high-income individuals (Naidu et al., 2019)

The results of this study state that statistically income is related to with the incidence of hypertension in Semarang City ($P=0.000$) with PR (CI 95%) = 2.095 (1.708-2.569). Most of the respondents in this study who experienced an incidence of hypertension as many as 96 (69.6%) people had an income of <Rp671,936. The results can be concluded that a person with an income of < Rp671,936 is at risk of experiencing hypertension 2 times. Another study found consistent results that low-income groups were 1.35 times more likely to develop hypertension (OR CI 95%= 1.35(1.19-1.52)) (Qin et al., 2022). Previous research has shown consistent results that income is statistically related to hypertension prevalence ($p=0.016$) (Roy et al., 2024). Consistent with similar research that low income in women is associated with systolic blood pressure ($p=0.010$) (Salvador et al., 2019).

The Relationship of Lifestyle Behavior with the Incidence of Hypertension

Behavior is an important factor that is closely related to non-communicable diseases such as hypertension. Hissing style behavior is one of the factors that can be modified in the risk factors for hypertension. Lifestyles such as lack of physical activity, smoking behavior, excessive salt intake and lack of fruit and vegetable intake have been shown to be closely related to the incidence of hypertension. Lack of physical activity puts you at 24 times greater risk of developing hypertension compared to high physical activity (Aripin et al., 2018). Previous research also stated that lack of physical activity has a 26 times greater risk of experiencing hypertension, as well as salt consumption behavior, where excessive salt intake is 2.3 times the risk of experiencing hypertension (Herawati et al., 2020).

This study found that there is a statistically significant relationship between lifestyle behavior and the incidence of hypertension ($p\text{-value}=0.000$) with a PR value (CI 95%) = 1.712 (1.336-2.194). Most of the respondents in this study who experienced hypertension as many as 129 (55.4%) people had poor lifestyle behaviors. These results can be interpreted that respondents with poor

lifestyle behaviors are 1.7 times more likely to experience hypertension. Previous research has also found results that exercise habits are associated with the incidence of hypertension ($p\text{-value}=0.021$) (Rida Darotin & Madyaning Nastiti, 2022). The results of another study found that smoking (OR 95% CI = 0.29 (0.09–0.961)), fruit

and vegetable consumption (OR 95% CI = 1.32 (1.01–1.74)) is significantly associated with hypertension (Rajkumar & Romate, 2020). Previous research has also found results that salt intake ($p = 0,000$; PR= 2,38) and physical activity ($p = 0,000$; PR= 26,00) statistically related to the incidence of hypertension (Herawati et al., 2020).

Table 4. Results of Multivariate Analysis of the Effect of Income and Education Level and Knowledge of Behavior

Variabel	B	S.E	Forest	<i>p value</i>	PR	CI 95%
Income	0.801	0.244	10.802	0.001	2.228	1.382
Education Level	0.765	0.227	11.347	0.001	2.149	1.377
Knowledge	0.610	0.228	7.132	0.008	1.840	1.176
Constant	-0.652	0.191	11.703	0.001	0.521	

Source: Primary data of the study (2025)

Table 5. Multivariate Analysis of the Influence of Income, Education, and Behavior on the Incidence of Hypertension in Semarang City

Variabel	B	S.E	Forest	<i>p value</i>	PR	CI 95%
Income	1.221	0.238	26.233	0.000	3.391	2.125 5.410
Education Level	0.868	0.227	14.645	0.000	2.381	1.527 3.731
Lifestyle Behavior	0.543	0.232	5.491	0.019	1.721	1.093 2.709
Constant	-1.340	0.202	44.099	0.000	0.262	

Source: Primary data of the study (2025)

The results of the bivariate test in table 2 and table 3 show that all variables can show a relationship with a p value of <0.05 . Multivariate test using regression test, to determine the influence of independent variables on dependent variables. The results of the multivariate test in table 4 showed that the variables of income, education level, and knowledge had an effect on lifestyle behavior with a p value of <0.05 . The income variable is the most dominant variable affecting lifestyle behavior with a p value of 0.001 and the highest PR value of 2,228.

The results of the multivariate test in table 5 show that the variables of income, education level and lifestyle behavior were obtained with a p value of <0.05 , which means that it affects the incidence of hypertension in Semarang City. The knowledge variable showed a p value of >0.05 , so it was concluded that the knowledge variable had no effect on the incidence of hypertension in Semarang City. The test results showed that the most dominant income variable had an effect on the incidence of hypertension with a p value of 0.000 and the highest PR value of 3.391.

This study determined the regression

equation based on the results of multivariate analysis as follows:

y (lifestyle behavior) = $-0.652 + 0.801$ (low income) + 0.765 (low education level) + 0.610 (low knowledge)

y (incidence of hypertension) = $-1,340 +$ (low income) + (low education level) + (poor lifestyle behavior)

Based on the equation, the value of the constant and the value of the coefficient (a) are located in column B of the table. Independent variables including low income, low education level and low knowledge were given a code of 1 for those at risk while those who were not at risk were given a code of 0. Furthermore, the value of the constant is added to the value of the variable that is at risk to obtain the result of the regression equation (y).

Based on the probability results in table 6, it is known that the lower the level of education, income and knowledge, the higher the possibility of bad lifestyle behavior. Based on the probability results in table 7, it is known that the lower the level of education, income and knowledge, the higher the possibility of hypertension.

Table 6. Behavioral Probability Results in Respondents

Respond	Level Education	Income	Knowledge	Probability Behavior (%)
A	Low	Low	Low	85%
B	Low	Low	Tall	82%
C	Tall	Low	Low	71%
D	Low	Tall	Low	68%
E	Tall	Low	Tall	54%
F	Low	Tall	Tall	53%
G	Tall	Tall	Low	49%
H	Tall	Tall	Tall	34%

Source: Primary data of the study (2025)

Table 7. Results of Probability of Hypertension Incidence in Respondents

Respond	Income	Education Level	Behaviour	Probability of Hypertension Incidence (%)
A	Low	Low	Bad	78%
B	Low	Low	Good	69%
C	Tall	Low	Bad	60%
D	Low	Tall	Bad	52%
E	Tall	Low	Good	47%
F	Low	Tall	Good	38%
G	Tall	Tall	Bad	31%
H	Tall	Tall	Good	21%

Source: Primary data of the study (2025)

Table 8. Analysis of Knowledge Paths, Education Levels, Income and Behavior on the Incidence of Hypertension in Semarang City

No	Variable	p	PR	95% CI	
				Lower	Upper
1	Knowledge → incidence of hypertension	0.772	0.014	-0.083	0.112
2	Education level → incidence of hypertension	< 0.001	0.159	0.065	0.254
3	Income → incidence of hypertension	< 0.001	0.231	0.132	0.329
4	Lifestyle behavior → the incidence of hypertension	< 0.001	0.250	0.154	0.345
5	Knowledge → lifestyle behavior	< 0.001	0.214	0.116	0.311
6	Education level → lifestyle behavior	0.001	0.159	0.064	0.255
7	Income → lifestyle behavior	0.240	< 0.001	0.142	0.338

Source: Primary data of the study (2025)

The analysis results showed that the direct effect of knowledge about hypertension was not statistically significant on the incidence of hypertension ($p=0.772>0.05$). The direct effect of education level was statistically significant on the incidence of hypertension ($p=<0.001$) with an effect of 16% (CI=6.5-25.4%). The direct effect of income was statistically significant on the incidence of hypertension ($p=<0.001$) with an effect of 23.1% (CI=13.2-32.9%). The direct effect of lifestyle behavior was statistically significant on the incidence of hypertension ($p=<0.001$) with an effect of 25% (CI=15.4-34.5%). The direct effect of knowledge about hypertension was statistically significant on lifestyle behavior ($p=<0.001$) with an effect of 21.4% (CI=11.6-31.1%). The direct effect of education level on

lifestyle behavior was statistically significant ($p=0.001<0.05$) with an effect size of 15.9% (CI=6.4-25.5%). The direct effect of income was also statistically significant on the incidence of hypertension ($p=<0.001$) with an effect size of 24% (CI=14.2-33.8%).

Table 9. Value of R squared

No	Variable	R2
1	Incidence of Hypertension	0.218
2	Lifestyle behavior	0.178

Source: Primary data of the study (2025)

Path model analysis found that the variables knowledge, education level, and income had a 21.8% influence on hypertension incidence and a 17.8% influence on lifestyle behavior.

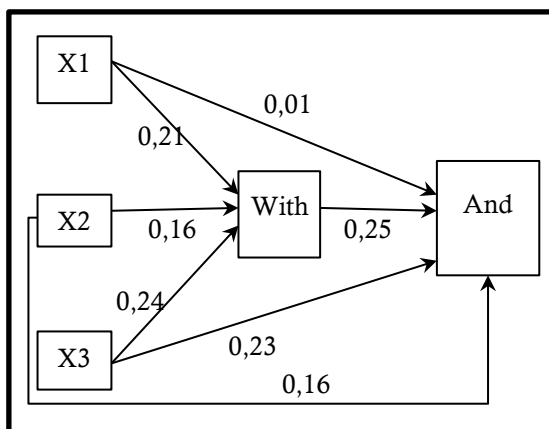


Figure 2. Path Analysis Diagram

Direct Effect of Knowledge About Hypertension on Hypertension Incidence

The results of the pathway analysis test in this study showed that there was no direct influence between knowledge about hypertension and the incidence of hypertension ($p=0.772$). There was no direct effect of knowledge about hypertension on the incidence of hypertension in this study due to the effect of knowledge about hypertension is only 0.014. This is because the knowledge variable is not strong enough to affect the incidence of hypertension. In addition, there are other factors that have a greater effect such as income, education and lifestyle behaviors that affect the incidence of hypertension. Lack of strong knowledge in influencing the incidence of hypertension can be due to the need for concrete action in the prevention of hypertension.

Model *precedes-proceeds* by Green & kreuter (in Sood and Riley, 2023) explains that knowledge is included in the *Precedes* Meanwhile, in determining health status, there needs to be a phase *Continue* which emphasizes real actions in the formation of health behaviors. Previous research has shown consistent results that knowledge of hypertension has no statistically significant effect on blood pressure levels ($p = 0.068$) (Kilic et al., 2016). Another study found different results that statistically knowledge had an effect on undiagnosed hypertension ($p = 0.002$), This is likely because a person with good knowledge of hypertension is more likely to have a health checkup (Gelassa et al., 2022). Previous studies have similarly found that knowledge about lack of physical activity as a risk factor for hypertension has an effect on hypertension ($p =$

<0.05 ; $AOR=3.57 (1.69, 7.69)$), This shows that a lack of knowledge results in a person being more likely to adopt a sedentary lifestyle which leads to hypertension (Gebrihet et al., 2017).

Direct Influence of Education Level on Hypertension Incidence

Education level is included in the behavioral factor as the most important factor that affects health status. The level of education is a learning process in the level of education taken by a person. People with higher education have a greater chance of gaining health knowledge about hypertension so that they can have a healthier lifestyle (Qin et al., 2022). According to WHO, education is one of the determinants of health, where low education levels are related to poor health and more stress. Individuals with higher education are 3% more likely to have healthier health status than individuals with low education (Rakasiwi, 2021). A person who completes higher education tends to know more about hypertension and have a better understanding of blood pressure health and lead to healthier lifestyle practices (Li et al., 2024).

The results of the path analysis test in this study stated that statistically there is a direct influence of education level on the incidence of hypertension in the city of Semarang ($p = <0.001$) with an effect of 16% ($CI=6.5-25.4\%$). These results are in line with previous research which stated that statistically there is a direct influence between education levels on the incidence of hypertension ($P-value= <0,01$) (Li et al., 2024). Previous research has found similar results that education level has a statistically significant effect on the prevalence of hypertension ($p = 0.0013$) (Wang et al., 2019). The results of another study state that education level has a statistically significant effect on hypertension ($p=<0.001$) (Ismail et al., 2023). Consistent with previous research showing that education level has a statistically significant effect on the prevalence of hypertension ($p=<0.001$) (Kumar & Misra, 2021)

Direct Effect of Income on Hypertension Incidence

Income is one of the social factors associated with mortality and morbidity that can determine an individual's life level. Prevention efforts through income factors play a role as an indicator of socio-economic status in the

formation of a better degree of health. Individuals with high incomes are 2.44 times more likely to have healthier health status (Rakasiwi, 2021). Previous research has also stated that low-income people are 2.15 times more likely to develop stage 2 hypertension than those with high income (Naidu et al., 2019).

The results of the pathway analysis test in this study are known that statistically there is a direct influence of income on the incidence of hypertension in Semarang City ($p = <0.001$) with an effect of 23% (CI=13.2-32.9%). These results are in line with previous research with the results that there is an influence on income and hypertension incidence (Li et al., 2024). Consistent with previous research that found results that socioeconomic status has a direct effect on hypertension ($p=0.001$) (Xiao et al., 2021). Previous research has also found similar results that there is a direct influence of income on health status ($p = <0.001$) with an effect of 15.6% (Huang et al., 2021).

Direct Influence of Lifestyle Behavior on Hypertension Incidence

Behavior is one of the second most important factors that can affect the degree of health. An unhealthy lifestyle can affect the occurrence of a disease, including hypertension. Lifestyle such as lack of physical activity, smoking behavior, excessive salt consumption, lack of intake of vegetables and fruits are risk factors for hypertension. Lifestyle behaviors such as sitting too much or sitting still can increase the risk of diseases such as hypertension, heart disease and diabetes. Regular physical activity is a major factor as a prevention of non-communicable diseases (NCDs) (WHO, 2020). Previous research stated that smoking status has a 16.68 times greater chance of developing hypertension, a person who lacks physical activity has a 2.2 times greater chance of suffering from hypertension, a person who lacks fruit and vegetable intake has a 4.9 times greater chance of developing hypertension (Casmuti & Fibriana, 2023). Previous research has shown that active smokers are 1.7 times more likely and no physical activity to have a 6.4 times higher risk of developing a hypertensive crisis (Yagoub et al., 2022). The results of another study stated that individuals who did not consume fruits were at a

1.2 times higher risk of developing hypertension (Ismail et al., 2023). Consistent with other studies that show that low fruit consumption is 3.1 times, vegetable consumption is 2.1 times and smoking behavior is 2.8 times higher risk of hypertension (Roy et al., 2024).

The results of the analysis test in this study found that statistically there is a direct influence of lifestyle behavior on the incidence of hypertension in Semarang City ($p=<0.001$) with an effect of 25% (CI=15.4-34.5%). These results are in line with previous research that found that there is a direct influence of lifestyle factors such as low physical activity, lack of vegetable and fruit intake, smoking and alcohol consumption on the incidence of hypertension ($p = 0<0.05$) (Hou & Yang, 2024). Previous research has also shown results that smoking status ($p = 0.002$) and physical activity ($p = 0.035$) Affects the incidence of hypertension crisis (Yagoub et al., 2022). Previous studies have found that health behaviors such as smoking, physical exercise, sleep duration and physical examination have a direct effect on health status ($p = 0.007$) with an effect of 4.1% (Huang et al., 2021).

The Indirect Influence of Knowledge About Hypertension on Lifestyle Behavior on The Incidence of Hypertension

Good knowledge of hypertension is an important factor in lowering the risk of hypertension with an understanding of hypertension. Knowledge of hypertension is necessary in the formation of behaviors about modifiable risk factors for hypertension such as lifestyle. Unhealthy lifestyles such as lack of physical activity, smoking, excessive salt consumption and lack of fruit and vegetable intake can be caused by a lack of knowledge so that it can increase the risk of hypertension. A person's knowledge and attitude can significantly influence an individual's behavior (Zhang et al., 2025). The results of the multivariate test in this study found that statistically knowledge about hypertension affects lifestyle behavior ($p=0.008$) with a PR CI of 95% = 1,840 (1,176-2,879), so it can be interpreted that individuals who have knowledge of low hypertension are 1.8 times more likely to have poor lifestyle behavior. Previous research has found consistent results that a person with good knowledge of

hypertension is 10 times more likely to have good hypertension self-care behaviors compared to those with low knowledge (Azmiardi et al., 2023). Previous studies have shown that lack of knowledge about risk factors for hypertension is 3.57 times more likely to develop hypertension (Gebrihet et al., 2017).

The results of this research path analysis test obtained the results that statistically there is an indirect influence of knowledge about hypertension through lifestyle behavior on the incidence of hypertension in Semarang City ($p < 0.01$) with an effect of 5.3% (CI=2.2-8.5%). Previous research has found that there is a direct influence of knowledge on practices related to hypertension management ($p = 0.006$) (Zhang et al., 2025). Previous research findings have found that knowledge has a statistically significant effect on hypertension prevention practices ($p = < 0.001$) (Icyimpaye & Ogendi, 2024). Analysis in previous studies found that there is an influence of knowledge on the incidence of hypertension ($p = 0.009$) (Herlinah, Erma Gustina, 2024).

The Indirect Influence of Education Level on Lifestyle Behavior on The Incidence of Hypertension

Education level is one of the important factors in influencing various aspects including health aspects. Individuals with higher levels of education tend to be more knowledgeable about hypertension and have a better understanding of blood pressure health, leading to the adoption of a healthier lifestyle (Li et al., 2024). Lifestyle is an important aspect in influencing health status. The analysis in this study obtained the results that statistically the level of education affects lifestyle behavior ($p < 0.001$) with a PR CI of 95% = 2,149 (1,527-3,731), So it can be interpreted that a low level of education is 2.1 times more likely to have bad lifestyle behaviors. This means that the lower the education allows a person to adopt worse lifestyle behaviors. Previous research has shown consistent results that the higher the education the more likely they are to adopt better hypertension prevention practices (Chimberengwa & Naidoo, 2018). Previous studies have also found similar results that a person with a higher level of education is 6 times more likely to perform good hypertension care behaviors than people with a low level of

education (Azmiardi et al., 2023).

The results of this research path analysis test obtained the results that statistically there is an indirect influence of education level through lifestyle behavior on the incidence of hypertension in Semarang City ($p = 0.006$) with an effect of 4% (CI=1.1-6.8%). Previous research has found consistent results that there is an effect of education on hypertension through salt intake ($p < 0.001$) kitchen as a mediating variable with an effect of 1.93% (Li et al., 2024). Previous research has also found similar results that there is an indirect influence between education on health status through health behaviors ($p = 0.010$) (Huang et al., 2021).

The Indirect Influence of Income and Lifestyle Behavior on The Incidence of Hypertension

Income is considered a social factor that affects health status. Income is often associated with social status which is one of the important factors that affect various aspects. A person with low socioeconomic status is more likely to adopt unhealthy lifestyle behaviors, such as smoking, excessive alcohol consumption, poor eating habits and lack of physical activity that can lead to the risk of developing diseases including hypertension (Li et al., 2024). Previous studies have shown that a person with a high income is 2.8 times more likely to have better hypertension care behaviors than an individual with a low income (Azmiardi et al., 2023).

The results of this research path analysis test found that statistically there is an indirect influence of income through lifestyle behavior on the incidence of hypertension in Semarang City ($p < 0.001$) with an effect of 6% (CI=2.6%-9.3%). Previous research has found consistent results that there is an indirect effect of income on hypertension through table salt intake ($p < 0.001$) with an effect of 3.45% (Li et al., 2024). Previous results also show that there is an indirect influence of socioeconomic status through *body fat distribution* against hypertension ($p = 0.009$) (Xiao et al., 2021). Other studies have also found similar results that socioeconomic status has an indirect influence on systolic blood pressure ($p < 0.01$) with an effect of 17% (Dawson et al., 2022). Other studies have also found similar results that there is an indirect influence of income on health status through

health behaviors ($p = 0.013$) (Huang et al., 2021).

CONCLUSION

Based on the results of the research regarding the analyst of the knowledge path, education level, income and behavior towards the incidence of hypertension in Semarang City, it can be concluded as follows: The results of the descriptive analysis showed that most of the respondents were female (72.5%), elderly adults (50.2%), higher education level (52.3%) and respondents with income $\geq$ Rp671,936 (65.5%). The results of the bivariate analysis showed that there was a relationship between knowledge, education level, income and lifestyle behavior in the city of Semarang with $p\text{-value} = < 0.05$. There was no direct effect of knowledge about hypertension on the incidence of hypertension in Semarang City with a $p\text{-value} = 0.772$. There is a direct influence of the level of education on the incidence of hypertension in Semarang City with a $p\text{-value} = < 0.001$. There is a direct influence between income on the incidence of hypertension in Semarang City with a $p\text{-value} = < 0.001$. There is an indirect influence between knowledge through lifestyle behavior on the incidence of hypertension in Semarang City with a $p\text{-value} = < 0.001$. There is an indirect influence between education levels through lifestyle behaviors on the incidence of hypertension in Semarang City with a $p\text{-value} = 0.006$. There is an indirect influence between income level through lifestyle behavior on the incidence of hypertension in Semarang City with a $p\text{-value} = < 0.001$.

Based on the results of research that has been carried out at the Tlogosari Kulon, Tlogosari Wetan and Kedungmundu Health Centers, the suggestions that can be given by researchers are as follows: For institutions, especially the Tlogosari Kulon, Tlogosari Wetan and Kedungmundu Health Centers. For agencies, it can be used as a source of information and consideration, especially in promotive and preventive efforts related to hypertension in the hope that the community will further improve better lifestyle behaviors as a prevention of hypertension, especially for those at risk. For the community, especially in the coverage of the Tlogosari Kulon, Tlogosari Wetan and

Kedungmundu Health Centers. For the community, it can be used as a source of information and insight to increase knowledge about hypertension and to further improve good lifestyle behaviors such as physical activity, not smoking, limiting salt intake, and sufficient intake of fruits and vegetables as a prevention of hypertension. For researchers, especially in the field of public health. For researchers, it can be used as a reference in future research. Further research is expected to reveal other factors related to hypertension by examining more variables.

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