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Analysis of Hypertension Risk Factors in the Lampung Province Region (2018 Riskesdas Data Analysis)

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Abstract: Hypertension is systolic blood pressure ≥ 140, and diastolic ≥ 90 mmHg (Unger et al., 2020). Indonesia showed an increase from the 2013 Riskesdas data (25.8%) and 2018 Riskesdas (34.11%). Lampung ranks 16th with the highest number of hypertension in Indonesia with a presentation reaching 29.94% (Kemenkes RI, 2019) and (Kementrian Kesehatan Republik Indonesia, 2018). This research aims to determine the risk factors for hypertension in the Lampung province community using 2018 Riskesdas data. Using secondary data with a quantitative research type and cross-sectional design. The research population was the total sample of the 2018 Riskesdas in Lampung Province, namely 22,345 individuals, and the sample excluding pregnant data and incomplete data resulted in a sample of 11,095 individuals. Data analysis used univariate, chi-square, and multiple logistic regression. Bivariate test results of gender, age, education, diabetes mellitus, salty consumption, smoking, physical activity, obesity p-value α<0.05 means there is a significant relationship between gender, age, education, diabetes mellitus, salty consumption, smoking, physical activity, obesity on the incidence of hypertension in Lampung Province. Obesity has a modifying effect on the relationship between age and the incidence of hypertension, in obese people aged ≥45 the risk of experiencing hypertension is 3,804 times higher than those aged <45 years after controlling for gender, education, history of diabetes mellitus, salt consumption, smoking, and physical activity.

Keywords: Hypertension; Risk factors; Riskesdas

Introduction

Hypertension is systolic blood pressure ≥ 140 and/or diastolic blood pressure ≥ 90 mmHg after repeated examinations (Unger et al., 2020). Hypertension is a non-communicable disease and is a disease that is one of the main causes of premature death in the world. The World Health Organization (WHO) estimates that currently, the global prevalence of hypertension is 22% of the world's total population, but only less than a fifth of people make efforts to prevent and control their blood pressure (Kemenkes RI, 2019).

Based on data from the World Health Organization (WHO) in 2019, hypertension is one of the main causes of premature death throughout the world with more than 1 billion people suffering, of which two-thirds of cases were found to be mostly caused by increased risk factors in this population. It is estimated that by 2025 there will be 1.5 billion people affected by hypertension and it is estimated that every year 9.4 million people die from hypertension and its complications (Ogbutor et al., 2019).

The highest prevalence of hypertension is in Africa at 27%, the second is in the Eastern Mediterranean at 26% and the third is in Southeast Asia at 23%. Meanwhile, in Indonesia, according to the 2018 Riskesdas, the prevalence rate of hypertension in the population >18 years old based on national measurements is 34.11%, while based on the results of the 2013 Riskesdas the hypertension prevalence rate is 25.8%. Nationally, hypertension cases show an increasing trend from the results of the 2013 Riskesdas data (25.8%) to the results of the 2018 Riskesdas data (34.11%) (Kemenkes RI, 2019) and (Kementrian Kesehatan Republik Indonesia, 2018). From the increase in the results of the Riskesdas survey, this has become one of the problems that wants to be researched and used as a problem in research.

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Currently, the pattern of diseases in Indonesia has experienced an epidemiological transition over the last two decades, namely initially from infectious diseases which were the main burden but now shifting to non-communicable diseases which are the main burden. In Indonesia, the main non-communicable diseases include hypertension, diabetes mellitus, cancer, and chronic obstructive disease (Kesehatan & Indonesia, 2011).

The prevalence of hypertension in Indonesia based on a doctor's diagnosis in residents aged ≥ 18 years is highest in North Sulawesi province (13.21%) and North Sulawesi province also occupies the first level (13.53%) in the prevalence of hypertension based on a doctor's diagnosis or taking antihypertensive medication in the population aged ≥ 18. Meanwhile, the highest prevalence in women was (36.85%) while in men (31.34%) (Kementrian Kesehatan Republik Indonesia, 2018).

Lampung Province ranks 16th with the highest number of hypertension sufferers in Indonesia with a presentation reaching 29.94% or 20,383 people aged ≥18 years.

Thus, based on the explanation of the problem above, until now there has not been much research regarding risk factors related to hypertension in the Lampung Province area. So the author is interested in researching the prevalence and factors associated with hypertension in the Lampung Province region in 2018.

Method

This research uses secondary data from the 2018 Riskesdas data which has been submitted and approved by the BKPK Datin of the Ministry of Health to obtain data to be processed in this research. The 2018 Riskesdas was carried out in 34 provinces in Indonesia in 2018 and data was collected for Lampung Province, which has 15 districts or cities, with a quantitative research type and a cross-sectional design approach. Furthermore, the Riskesdas data used by researchers was analyzed from October 2022 to January 2023 at Malahayati University, Bandar Lampung. With the dependent variable being hypertension and the independent variables namely gender, age, education, history of diabetes mellitus, salt consumption, smoking, physical activity, and obesity. The population in this study was the total sample of the 2018 Riskesdas in Lampung Province, namely 22,345 individuals who were then selected for the research sample by including respondents aged ≥15 years and excluding respondents who were pregnant, aged <15 years and respondents who had incomplete data who then A total sampling sample was obtained of 11,095 respondents or individuals after filtering and cleaning the data and continuing with data coding. Then data analysis was carried out using univariate analysis to determine the frequency distribution of variables, bivariate analysis to determine the relationship between the dependent variable and the independent variable, and the final stage was carried out by multivariate analysis to determine the dominant factors that influence the occurrence of community hypertension in the Lampung province area and continued with interaction tests, and stratification test. The following are the stages or flow of the research.

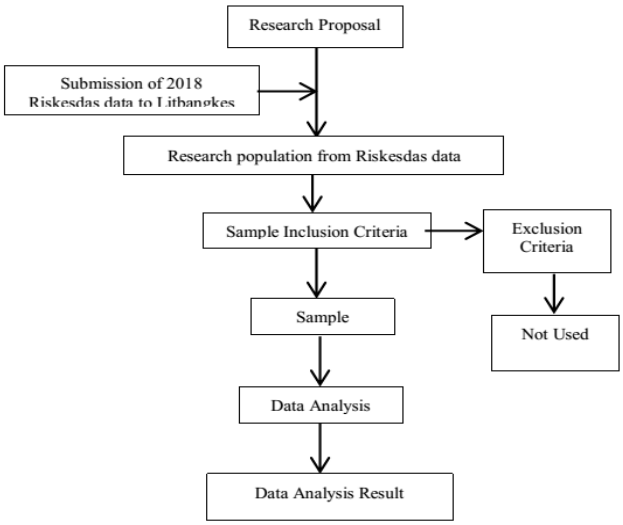

Figure 1. Research flow

Result and Discussion

The initial stage of data analysis is univariate analysis where this univariate analysis describes the characteristics of the variables to be studied. In this study, the distribution of the variables studied is displayed, namely hypertension, gender, age, education, history of DM, history of salty consumption, smoking habits, physical activity and obesity.

Based on Table 1, it is known that the sample size is 11,095, there are 1,743 individuals (15.7%) who suffer from hypertension and 9,352 individuals (84.3%) who do not suffer from hypertension. Regarding gender, there were 6,696 individuals (60.4%) female and 4,339 individuals (39.6%) male. For the age variable, there were 5,063 individuals (45.6%) who were ≥45 years old and 6,032 individuals (54.4%) who were <45 years old. For the education of 2,1147 individuals (19.4%) who did not attend school or did not complete elementary school, there were 5,428 individuals (48.9%) who had primary education, 2,605 individuals (23.5%) who had secondary education, and as many as 915 individuals (8, 2%) who are highly educated. For the history of diabetes mellitus variable, there were 285 individuals (2.6%) who had a history of diabetes mellitus and 10,810 (97%) who did not have a history of diabetes mellitus. The history of

salty food consumption was divided into 6 categories, namely > 1 time/day for 1,280 individuals (11.5%), 1 time/day for 1,699 individuals (15.3%), 3-6 times/week for 2,168 individuals (19, 5%), 1-2 times/week as many as 2,999 individuals (27%), <3 times/month as many as 1,810 individuals (16.3%), and never consume salt as many as 1,139 individuals (10.3%). For smoking habits, 3,705 individuals (33.4%) had smoking habits and 7,390 individuals (66.6%) had never smoked or did not have the habit of smoking. For physical activity, 1,599 individuals (14.4%) did not do any activity and 9,496 individuals (85.6%) had the habit of doing moderate or heavy physical activity. Furthermore, for the obesity variable, 2,347 individuals (21.2%) had a BMI ≥27, and 8,748 individuals (78.8%) had a BMI <27.

Table 1. Univariate Analysis

Research Variable	Frequency (n)	Precentage (%)
Hypertension		
Hypertension	1.743	15.7
Not Hypertension	9.352	84.3
Genre		
Female	6.696	60.4
Male	4.399	39.6
Age		
≥45 years old	5.063	4.6
<45 years old	6.032	54.4
Education		
No School	2.147	19.4
Basic	5.428	48.9
Elementary	2.605	23.5
High	915	8.2
History of Diabetes Melitus		
Diabetes mellitus	285	2.6
Not Diabetic Melitus	10.810	97.4
Salty Consumption		
>1 times/day	1.280	1.5
1 times/day	1.699	15.3
3-6 times/week	2.168	19.5
1-2 kali/week	2.999	27.0
<3 kali/month	1.810	16.3
Never	1.139	10.3
Smoking Habit		
Smoking	3.705	33.4
Not Smoking	7.390	66.6
Physical Activity		
No Physical Activity	1.599	14.4
Physical Activity	9.496	85.6
Obesity		
IMT ≥27	2.347	21.2
IMT <27	8.748	78.8
Total	11.095	100

In terms of age characteristics according to research results (Suryady Tjekyan & Palembang City Health), said that ages>40 years have a higher incidence of hypertension compared to those aged <40 years, which means that the older you get, the greater the risk of hypertension. The results of research (Arifin et al., 2016) show that the number of elderly people who experience hypertension is greater among female elderly people, namely 49 people compared to male elderly people. In research (Kautsar et al., 2015) of 71 total respondents, 49 (69%) respondents were obese and 22 (31%) respondents were overweight. The relationship between obesity (based on BMI) and blood pressure is that respondents who are obese are more likely to suffer from high blood pressure (hypertension) while respondents who are overweight are more likely to have normal blood pressure. In research conducted (Karim, 2018) from 40 respondents, 70% of respondents (28 people) with light physical activity, and 30% of respondents (12 people) with heavy physical activity. The results of the chi-square test showed that there was a relationship between physical activity and the degree of hypertension. Smoking habits in the study (Firmansyah & Rustam, 2017) of a total of 68 respondents, 41 respondents (60.3%) were smokers and 27 respondents (39.7%) were non-smokers, where the prevalence of smokers was greater than that of non-smokers.

Next, a bivariate chi-square test was carried out to determine the relationship between the independent variables (gender, age, education, history of DM, history of salt consumption, smoking habits, physical activity, and obesity) with the dependent variable (hypertension).

Based on Table 2, the results of bivariate analysis with the chi-square test. From the results of the bivariate analysis of the chi-square test, it can be stated that all independent variables (gender, age, education, history of DM, salty food, smoking, physical activity, and obesity) have a p-value <0.05 which can be said that All independent variables (gender, age, education, history of DM, salty foods, smoking, physical activity, and obesity) are related to the incidence of hypertension in the people of Lampung province based on 2018 Riskesdas data.

The results of the bivariate chi-square test for gender and hypertension have a p-value of 0.000 ($\alpha<0.05$), which means there is a relationship between gender and hypertension. This study concluded that women in Lampung province are more at risk of hypertension compared to men. Women go through menopause which can cause a decrease in the protective hormone estrogen and also the elasticity of blood vessels, thereby increasing the risk of hypertension. In this research, the OR value was also found to be 1.435, which means that women are 1.435 times more at risk of hypertension than men.

Table 2. Bivariate Analysis

Variable	Hypertension				P-Value	OR (95%)
	Hypertension		Not hypertension			
	n	%	n	%		
Genre						
Female	1.175	17.5	5.521	82.5	0.000	1.435(1.288-1.600)
Male	568	12.9	3.831	87.1		
Age						
≥45 years old	1.388	27.4	3.675	72.6	0.000	6.040(5.337-6.835)
<45 years old	355	5.9	5.677	94.1		
Education						
No School	564	26.3	1.583	73.7	0.000	0.39(0.318-0.492)
Basic	824	15.2	4.604	84.8	0.026	0.787(0.638-0.972)
Elementary	242	9.3	2.363	90.7	0.008	1.376(1.085-1.744)
High	113	12.3	802	87.7	0.000	1
History of DM						
DM	104	36.5	181	63.5	0.000	3.215 (2.512-4.115)
Not DM	1.639	15.2	9.171	84.8		
Salty Food						
>1 times/day	195	15.2	1.085	84.8	0.000	1.720 (1.402-2.111)
1 times/day	248	14.6	1.451	85.4	0.000	1.809 (1.493-2.192)
3-6/week	289	13.3	1.879	86.7	0.000	2.010 (1.672-2.418)
1-2/week	416	13.9	2.583	86.1	0.000	1.920 (1.920-2.279)
<3 times/month	326	18	1.484	82	0.000	1.408 (1.172-1.688)
Never	269	23.6	870	76.4	0.000	1
Smoking						
Yes	486	13.1	3.219	86.9	0.000	0.737 (0.658-0.825)
No	1.257	17	6.133	83		
Physical Activity						
No Activity	360	22.5	1.239	77.5	0.000	1.704 (1.496-1.942)
Activity	1.383	14.6	8.113	85.4		
Obesity						
IMT ≥27	539	23	1.808	77	0.000	1.868 (1.667-2.093)
IMT <27	1.204	13.8	7.544	85.2		

The results of this study are in line with Pramana (2016) in Widjaya et al. (2019), saying that the prevalence of hypertension in Indonesia is greater in women (8.6%) than men (5.8%). (Widjaya et al., 2019). In research by Kusumawaty (2016), it was concluded that gender is closely related to the occurrence of hypertension, where in middle age, hypertension is higher, especially in women when a woman experiences menopause. Menopause is associated with an increase in blood pressure. This occurs because menopausal women experience a decrease in the hormone estrogen, which protects blood vessels from damage (Kusumawaty, 2016).

In Falah's research, 2019, it was stated that gender influences the incidence of hypertension, where in the chi-square test the p-value was found to be 0.035. It is also stated that gender can influence blood pressure, where the results of Falah's research, 2019, found that women tend to experience hypertension more than men.

The relationship between age and the incidence of hypertension using the bivariate chi-square test obtained a p-value of 0.000 (α<0.05). In this study, it was concluded that those aged ≥45 years were more at risk of developing hypertension compared to those aged <45 years because increasing age can cause changes in the body's physiology, namely thickening of the uterine walls due to the buildup of collagen substances in the muscle layer so that the blood vessels narrow and become stiff at the age of 45 years. With a POR value of 6.040, it can be concluded that those aged ≥45 years are 6.040 times more at risk of hypertension than those aged <45 years.

In the results of research by female students and Susanto, 2020, it was stated that there was a significant relationship between age and the incidence of hypertension (Siwi & Susanto, 2020). The 2013 Riskesdas report also shows that the majority of elderly people tend to experience hypertension (Riskesdas, 2013).

In Widjaya, et al. (2019) research, with the title Research on the relationship between age and the incidence of hypertension in Kresek and Tegal Angus sub-districts, Tangerang district, it was stated that there was a relationship between age and the incidence of hypertension (Widjaya et al., 2019).

Changes in blood pressure from adolescence to adulthood, which mostly lead to hypertension, are due to increased blood pressure and impaired circulation in the blood vessels, where the structure of the blood vessel walls will harden and thicken with age (Guyton, 2011).

The relationship between education and hypertension in the bivariate test shows that people who do not go to school are 564 individuals (26.3%) with an OR value of 0.39 (0.318-0.492), meaning that people who are highly educated will prevent the incidence of hypertension 0.39 times compared to the general public. who don't go to school for basic education level, 824 individuals (15.2%) had an OR value of 0.787 (0.638-0.972), meaning that people with higher education would prevent the incidence of hypertension 0.787 times compared to people with basic education. For the secondary education level, there are 242 individuals (9.3%) with an OR value of 1.376 (1.085-1.744), meaning that secondary education are 1.376 times more at risk of developing hypertension than people with higher education. From the results of the chi-square test on education level, a p-value of 0.000 ($\alpha<0.05$) was obtained, which means that there is a statistically significant relationship between education level and the incidence of hypertension.

In research by Taiso et al. (2021), it was stated that the dominant community with low education experienced hypertension. This is related to individual knowledge influencing awareness of hypertension prevention behavior, in other words, the higher an individual's knowledge regarding the causes of hypertension, trigger factors, signs of symptoms, and normal and abnormal blood pressure, the individual will tend to avoid things that can trigger hypertension, such as smoking behavior, drinking coffee, and obesity. The high risk of developing hypertension in people with low education is possibly due to a person with low education's lack of knowledge regarding health and difficulty or slowness in receiving information (counseling) provided by officers so that it has an impact on healthy behavior/lifestyle (Dhirisma & Moerdhanti, 2022).

In Maulidina's research, 2019, it was stated that the chi-square test showed that there was a significant relationship between education and the incidence of hypertension with a p-value of 0.000 ($\alpha<0.05$) with the Prevalence Ratio (PR) calculation showing that respondents with low education had a 2.188 chance of experiencing hypertension, than respondents who have higher education. This occurs due to a lack of information or knowledge which gives rise to unhealthy behavior and lifestyle such as not knowing the dangers and preventing hypertension.

The relationship between history of DM and hypertension in a bivariate test concluded that there was a relationship between a history of diabetes mellitus and hypertension based on the results of the chi-square test p-value 0.000 ($\alpha<0.05$) where people with a history of diabetes mellitus would be more at risk of developing hypertension compared to people who has no history of hypertension. DM sufferers experience insulin resistance and hyperinsulinemia that can excessively increase peripheral resistance and vascular smooth muscle contractility to norepinephrine and angiotensin II, thereby increasing blood pressure. So people with a history of diabetes mellitus will have an increased risk of developing hypertension 3.215 times compared to those without a history of hypertension.

This research is in line with research from Artini et al. (2022) The incidence of diabetes mellitus was 63 people (66.3%), 32 people (33.7%) without diabetes mellitus with the chi-square test value obtained was $p=0.000$ ($p<0.05$), which means there is a relationship between diabetes mellitus and the incidence of hypertension at the Kedaton Inpatient Health Center, Bandar Lampung.

People who have a history of DM will tend to have high blood pressure. This is because people suffering from DM will experience insulin resistance and hyperinsulinemia that can excessively increase peripheral resistance and vascular smooth muscle contractility to norepinephrine and angiotensin II. Diabetes can trigger the appearance of plaque in large blood vessels (atherosclerosis). The impact of plaque is that blood flow will become narrowed, requiring higher pressure in the blood circulation process in the body.

The pathophysiology of DM with hypertension involves various organs and systems. Hypertension in DM people is the role of the dependent. Insulin resistance and hyperglycemia in DM can cause vascular inflammation and oxidative stress. Hyperinsulinemia as a result of insulin resistance, together with insulin resistance, will trigger activation of the sympathetic nervous system resulting in Na+ and water retention. This is the most important factor in the development of hypertension. Insulin resistance and hyperinsulinemia can increase the response to norepinephrine and AT II so that peripheral vascular resistance and smooth muscle contractility will increase and trigger physiological feedback through the RAA system which ends in an increase in blood pressure.

The relationship between salty consumption and hypertension is that salty consumption is divided into 6 categories, where salty consumption and hypertension are highest in people who never consume salt, namely 269 individuals (23.6%) followed by people who consume salty <3 times/month as many as 326

individuals (18%) with an OR value of 1,408 (1,172-1,688), which means that people who consume salt <3 times/month have a risk of developing hypertension 1,408 times compared to those who never consume salt. People who consumed salt >1 time/day were 195 individuals (15.2%) with an OR value of 1,720 (1,402-2,111), which means that consuming salt >1 time/day had a 1,720 times risk of developing hypertension compared to those who never consumed salt. There were 248 individuals (14.6%) who consumed salt once per day with an OR value of 1,809 (1,493-2,192), which means that consuming salt once per day had a 1,809 times greater risk of hypertension compared to those who did not consume salt. There were 416 individuals (13.9%) consuming salty 1-2 times/week with an OR value of 1,920 (1,920-2,279), which means that consuming salty food, consuming salty food 1-2 times/week had a 1,920 times risk of hypertension compared to those who did not. salty consumption. 289 individuals (13.3%) consumed salt 3-6 times/week with an OR value of 2,010 (1,672-2,418). From the results of the OR value, it can be said that the habit of consuming salty food 3-6 times/week has a 2x higher risk of developing hypertension compared to those who never consume salty food. From the results of the chi-square test, a p-value of 0.000 (α<0.05) was obtained, which means that there is a statistically significant relationship between salt consumption habits and hypertension. The World Health Organization (WHO) recommends a salt consumption pattern that can reduce the risk of hypertension. The World Health Organization (WHO) recommends limiting consumption of table salt to 6 grams a day (2400 mg sodium). Excessive sodium intake, especially in the form of sodium chloride, can cause disturbances in body fluid balance, thereby causing hypertension. This can happen because the effect of salt intake on the emergence of hypertension occurs through increasing plasma volume, cardiac output, and blood pressure. Salt causes a buildup of fluid in the body because it attracts fluid outside the cells so that it does not come out, thereby increasing blood volume and pressure (Elvivin et al., 2016). The recommended sodium level is no more than 100 mmol (around 2.4 grams of sodium or 6 grams of salt) per day. Excessive sodium consumption causes the sodium concentration in the extracellular fluid to increase. To normalize it, intracellular fluid is pulled out, so that the volume of extracellular fluid increases. The increase in extracellular fluid volume causes an increase in blood volume, which has an impact on the emergence of hypertension (Shapo et al., 2003).

Relationship between smoking and hypertension. From the results of the chi-square test between smoking habits and hypertension, a p-value of 0.000 (α<0.05) was obtained, which means there is a statistically significant relationship between smoking habits and hypertension. So the hypothesis can be accepted, which means there is a significant relationship between smoking habits and hypertension in the Lampung province area based on 2018 Riskesdas data. However, this is inversely proportional to the OR value between smoking and the incidence of hypertension which is OR 0.737 (α<1) which means smoking is a protective factor or can be interpreted as smoking not being a risk for the incidence of hypertension.

Heavy smoking can be associated with an increased incidence of malignant hypertension and the risk of renal artery stenosis leading to atherosclerosis. In a prospective cohort study by Dr. Thomas S Bowman from Brigmans and Women's Hospital, Massachusetts on 28,236 subjects who initially had no history of hypertension, 51% of subjects did not smoke, 36% were new smokers, 5% of subjects smoked 1-14 cigarettes per day and 8% of subjects smoked more than 15 cigarettes per day. Subjects continued to be studied for a median time of 9.8 years. This study concluded that the incidence of hypertension was highest in the group of subjects with a habit of smoking more than 15 cigarettes per day (Bowman et al., 2007). However, this research shows that there is a relationship between smoking and hypertension with a p-value of 0.000 (α<0.05) but it is not the only risk factor for hypertension, this can happen because even though people smoke, they have a good lifestyle and have Regular good activity (exercise) means that people who smoke are less likely to develop hypertension. The Ministry of Health (2001) states that intense exercise or physical activity will reduce blood pressure by 16/11 mmHg.

So it can be concluded that the results of the chi-square test with a p-value of 0.000 are inversely proportional to the risk with an OR of 0.737 (α<1) which can occur because some of the samples are female, there are no other variables regarding smoking such as type of cigarette, duration of smoking. So the need for in-depth studies is necessary for future authors to be able to analyze smoking factors.

The relationship between physical activity and hypertension obtained a p-value of 0.000 (α<0.05), which means that there is a statistically significant relationship between physical activity and hypertension. So the hypothesis can be accepted, which means there is a significant relationship between physical activity and hypertension in the Lampung province area based on 2018 Riskesdas data. In this study respondents who did not do physical activity, whether heavy or moderate, had a higher risk of hypertension in Lampung province. With an OR value of 1.704, it can be concluded that respondents who do not do physical activity will be

1.704 times more likely to develop hypertension than those who do physical activity.

This research is in line with research Istiqamah et al. (2021) which states that there is a significant relationship between the level of physical activity and hypertension p-value 0.000 with a very strong correlation (0.764) and there is a difference in the level of physical activity between the normotensive group and the hypertensive group p-value 0.000.

Exercise is often associated with the management of non-communicable diseases because isotonic and regular exercise can reduce peripheral resistance which will lower blood pressure (for hypertension) and train the heart muscle so that it becomes accustomed to the heart having to do harder work due to certain conditions. Lack of physical activity increases the risk of high blood pressure because it increases the risk of becoming obese. Inactive people tend to have a faster heartbeat and their heart muscle has to work harder with each contraction, the harder and more often the heart has to pump, the greater the force pushing against the arteries according to Cortase, 2008 (Nuraini, 2015).

Physical activity can provide many health benefits, one of which is reducing the risk of hypertension and lowering blood pressure, keeping blood pressure stable within normal limits, improving heart blood flow, and improving heart and endothelial function. Apart from that, physical activity can also improve a person's psychology by reducing stress, anxiety, and depression (Welis et al., 2013).

Table 3. Multivariate Modeling

Variable	P-Value	OR	CI 95%	
			Lowest	Highest
Genre	0.011	1.249	1.055	1.486
Age	0.000	5.486	4.803	6.266
Education				
No School	0.000	0.620	0.489	0.787
Basic	0.010	0.744	0.593	0.932
Elementary	0.550	1.080	0.840	1.389
High	0.000			
History of Diabetes mellitus	0.000	1.769	1.360	2.301
Salty Consumption				
>1 time/day	0.002	1.415	1.135	1.765
1 time/day	0.000	1.558	1.267	1.916
3-6 times/week	0.000	1.715	1.407	2.092
1-2 times/week	0.000	1.702	1.415	2.049
<3 time/month	0.014	1.279	1.051	1.557
Never	0.000			
Smoking	0.006	0.780	0.655	0.930
Physical Activity	0.000	1.478	1.282	1.705
Obesity	0.000	1.961	1.728	2.225

The relationship between obesity and hypertension is shown through a p-value of 0.000 (α<0.05) and obesity (BMI ≥27) is a factor in the occurrence of hypertension. This is because obesity in people increases the occurrence of insulin resistance and impaired blood vessel endothelial function which causes vasoconstriction and sodium reabsorption in the kidneys which causes an increase in blood pressure leading to hypertension. From the OR results, it can also be concluded that a BMI ≥27 (obesity) can increase the risk 1.868 times of developing hypertension compared to people who have a BMI <27 (normal or pre-obesity).

Next, a multivariate analysis test was carried out, then selected based on the chi-square p-value which was α<0.25, so it could be included in the multivariate modeling. Based on the results of the bivariate test, all independent variables have a p-value of α<0.25, so all variables are included in the multivariate modeling.

In the multivariate test, there was a p-value α>0.05 so a confounding test was carried out.

Table 4. Confidence Test

Variable	OR Crude	OR Adjusted	% Change (Delta OR)
Genre	1.249	1.350	8.086
Age	5.486	6.158	12.249
Education			
No School	0.620		
Basic	0.744		
Elementary	1.080		
High			
History of DM	1.769	1.688	-4.579
Salty Consumption			
>1 times/day	1.415	1.377	-2.686
1 times/day	1.558	1.521	-2.375
3-6 times/week	1.715	1.680	-2.041
1-2 times/week	1.702	1.688	-0.823
<3 times/month	1.279	1.288	0.704
Never			
Smoking	0.780	0.800	
Physical Activity	1.478	1.451	-1.827
Obesity	1.961	1.880	-4.131

After carrying out the confounding test by removing the education variable, there was a change in the OR of >10% in the age variable so the education variable was included again in the multivariate model. After that, an interaction test was carried out.

Table 5 is the result of the interaction test, where the interaction test carried out was on the variable age and obesity 0.000 (α<0.05), which means there is an interaction between the variable age and obesity in the incidence of hypertension. So the results of this interaction test are the final modeling results of this research. What was also found was that obesity had a modifying effect on the relationship between age and the incidence of hypertension, in obese people aged ≥45 the risk of experiencing hypertension was 3,804 times higher than in those aged <45 years after controlling for

gender, education, history of diabetes mellitus, salty consumption, smoking, physical activity.

Table 5. Interaction Test and Final Multivariate Modeling

Variable	P-value	OR
Genre	0.008	1.258
Age	0.000	3.804
Education		
No School	0.000	0.640
Basic	0.015	0.756
Elementary	0.513	1.088
High	0.000	
History of DM	0.000	1.766
Salty Consumption		
>1 times/day	0.002	1.419
1 times/day	0.000	1.555
3-6 times/week	0.000	1.722
1-2 times /week	0.000	1.700
<3 times/month	0.012	1.286
Never	0.000	
Smoking	0.006	0.782
Physical Activity	0.000	1.473
Obesity	0.000	1.646
Age with Obesity	0.000	1.764

This is because increasing age causes physiological changes in the body, such as the thickening of the uterine walls due to the buildup of collagen substances in the muscle layer so that blood vessels narrow and become stiff at the age of 45 years. This is also due to an increase in cardiac output, as well as a decrease in sensitivity to action potentials in response to blood pressure in the arteries resulting in a decrease in blood flow filtration in the glomerulus (Ainsyah et al., 2018). Changes in blood pressure from adolescence to adulthood, which mostly lead to hypertension, are due to increased blood pressure and impaired circulation in the blood vessels, where the structure of the blood vessel walls will harden and thicken with age (Guyton, 2011). Apart from that, based on bivariate data, it also shows that in this study those aged ≥45 years had a higher prevalence of hypertension, namely 1,388 individuals (27.4%) compared to those aged <45 years, namely 355 individuals (5.9%). In the multivariate test, an interaction test was also carried out between obesity and age, where the interaction test between obesity and age had an interaction relationship with the incidence of hypertension in Lampung province with a p-value of 0.000 (α<0.05) which means there is an interaction relationship between age and obesity on incidence of hypertension. This interaction is based on literature that states that as age increases, the risk of abdominal obesity increases. Previous research shows that abdominal obesity increases in the age group 30 years and over. The risk of abdominal obesity increases by 1.02 times more in individuals in the higher age group (Nurrahmawati & Fatmaningrum, 2018).

Obesity is a determinant factor in blood pressure in most ethnic groups of all ages. Physiological changes can explain the relationship between excess body weight and blood pressure, namely the occurrence of insulin resistance and hyperinsulinemia, activation of the sympathetic nervous system and the renin-angiotensin system, and physical changes in the kidneys (Nuraini, 2015).

Several possible pathophysiological pathways explain the association between high BMI and increased blood pressure and hypertension (Shaumi and Achmad, 2019). In conditions of obesity, insulin resistance occurs, and impaired blood vessel endothelial function causes vasoconstriction and sodium reabsorption in the kidneys which causes an increase in blood pressure leading to hypertension. Insulin increases the production of norepinephrine which can increase blood pressure. The increase in BMI associated with increased amounts of norepinephrine in the kidney suggests a link between obesity-related activation of the sympathetic nervous system and renin release. Increased activity of the sympathetic nervous system causes an increase in blood pressure by increasing the activity of the renin-angiotensin-aldosterone (RAA) system. RAA activity increases blood pressure directly (angiotensin II-mediated vasoconstriction and further activation of the sympathetic nervous system) and indirectly (angiotensin II and tubular reabsorption of water and salt mediated by angiotensin II and aldosterone) (Brady, 2017).

One of the risk factors for hypertension is central obesity. This is because central obesity accumulates more fat in the abdominal area. If abdominal fat is excessive, it will cause several things, including reducing adiponectin levels, reducing the uptake of intracellular free fatty acids by mitochondria so that oxidation is reduced, and causing accumulation of intracellular free fatty acids. Excess-free fatty acids can trigger insulin resistance. In this condition, hyperinsulinemia can cause the narrowing of the blood vessels and absorption of sodium in the kidneys, which ultimately results in hypertension. A person with a large abdominal circumference is very at risk of suffering from hypertension. This is because abdominal circumference is an indicator of the amount of fat accumulation in the abdominal area. The greater the value of a person's abdominal circumference, the fatter will accumulate in the abdominal area. This accumulation of fat in the abdomen is called abdominal obesity. The accumulation of fat in the abdomen is closely related to the accumulation of cholesterol. Fat cells in the stomach are easily separated and can enter

the blood vessels, which can cause blockage of blood flow. Ultimately this will cause hypertension (Ainsyah et al., 2018).

Next, an interaction test between age and obesity was carried out. This interaction was based on literature that states that as age increases, the risk of abdominal obesity increases. Previous research shows that abdominal obesity increases in the age group 30 years and over. The risk of abdominal obesity increases by 1.02 times more in individuals in the higher age group (Nurrahmawati & Fatmaningrum, 2018).

Next, a stratification test was carried out. In this study, a stratification test was carried out on the variables that were interacted with, namely the variable obesity and age. This stratification test was carried out manually by looking at the β (beta) value from data analysis in the interaction test with the formula:

In obesity (0), the OR value of age on the incidence of hypertension:

$$\text{Stratification test} = e^{\beta\text{variable}+\beta\text{interaction}}$$
$$\text{Stratification test} = e^{\beta\text{obesity}+\beta\text{interaction}}$$
$$= e^{0,498+0,568\ (0)}$$
$$= 1,645$$

In obesity (1), the OR value of age on the incidence of hypertension:

$$\text{Stratification test} = e^{\beta\text{variable}+\beta\text{interaction}}$$
$$\text{Stratification test} = e^{\beta\text{obesity}+\beta\text{interaction}}$$
$$= e^{0,498+0,568\ (1)}$$
$$= 2,903$$

Next, there was a stratification test on significant variables after conducting an interaction test between obesity (0) and age with a value of 1.645, which means that the relationship between obesity (0) and age on the incidence of hypertension has a risk of 1.645 times. Meanwhile, obesity (1) with age has a value of 2.903, which can be interpreted as obesity (1) with age having a chance of hypertension of 2.903 times.

Conclusion

There is a relationship between gender, age, education, diabetes mellitus, salt consumption, smoking, physical activity, obesity, and hypertension in Lampung Province with a p-value of 0.000 (<0.05). In this study, obesity is a modifying effect on the relationship between age and the incidence of hypertension, in obese people aged ≥45 the risk of experiencing hypertension is 3,804 times higher than those aged <45 years after controlling for gender, education, history of diabetes mellitus, salty consumption, smoking, physical activity.The public is expected to control blood pressure and intervene in lifestyle such as reducing salt consumption, stopping smoking, losing weight, consuming fruit and vegetables, and doing physical activity as a prevention of hypertension.

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In writing this research there was no conflict of interest whatsoever.

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