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## Case-Control Research on Hypertension Risk Factors in Karangasem Village, Karangasem Regency, Bali

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### Abstract

Hypertension is still a health problem globally. Several studies have been conducted to find the relationship between risk factors with the incidence of hypertension. There is no data yet on risk factors for hypertension in the community, especially in Karangasem Regency, Bali. This study aims to find the correlation of various risk factors with the incidence of hypertension in Karangasem Regency, Bali. A case-control studies was conducted on 100 subjects. Cases and controls were selected using consecutive sampling technique. Logistic regression was used to predict various risk factors for hypertension. The results showed a significant relationship with age (OR = 2,452; p = 0.047; 95% CI = 0.999-6.018), family history (OR = 4,373; p = 0.001; 95% CI = 1,854-10,316), BMI (OR = 3,341; p = 0.004; 95% CI = 1,440-7,753), smoking (OR = 2,698; p = 0.021; 95% CI = 1,148-6,341), high salt consumption (OR = 2,571; p = 0.024; 95% CI = 1,122 - 5,895) and coffee consumption (OR = 3,451; p = 0.016; 95% CI = 1,220-9,759), while no significant relationship was found between sexes (OR = 0.712; p = 0.476; 95% CI = 0.279 - 1,818), and alcohol consumption (OR = 0.786; p = 0.548; 95% CI = 0.358-1.725). We found an association between several risk factors (age, family history, BMI, smoking, high salt consumption, and coffee consumption) and the incidence of hypertension in the Karangasem Village, Karangasem Regency, Bali.

**Keywords:** risk factors, hypertension, Karangasem village

### Abstrak

[Penelitian Kasus-Kontrol Faktor-Faktor Risiko Hipertensi di Desa Karangasem Kabupaten Karangasem Provinsi Bali]

Secara global hipertensi masih merupakan masalah kesehatan di masyarakat. Beberapa penelitian telah dilakukan untuk mencari hubungan antara beberapa faktor risiko dengan kejadian hipertensi. Belum ada data mengenai faktor-faktor risiko kejadian hipertensi di masyarakat, khususnya di Kabupaten Karangasem Bali. Penelitian ini bertujuan untuk mencari hubungan berbagai faktor risiko dengan kejadian hipertensi di masyarakat Kabupaten Karangasem Bali. Penelitian kasus-kontrol dilakukan pada 100 subyek, dimana antara kasus dan kontrol dipilih menggunakan teknik non-random sampling yaitu consecutive sampling. Regresi logistik dipergunakan untuk memprediksi berbagai faktor risiko dengan kejadian hipertensi. Hasil penelitian menunjukkan adanya hubungan bermakna antara usia (OR=2,452; p=0,047; 95% CI=0,999-6,018), riwayat keluarga (OR=4,373; p=0,001; 95% CI=1,854-10,316), IMT (OR=3,341; p=0,004; 95%; CI=1,440-7,753), merokok (OR=2,698; p=0,021; 95%; CI=1,148-6,341), konsumsi tinggi garam (OR=2,571; p=0,024; 95%; CI=1,122-5,895) dan konsumsi kopi (OR=3,451; p=0,016; 95%; CI=1,220-9,759) dengan kejadian hipertensi. Tidak didapatkan hubungan secara bermakna antara jenis kelamin (OR=0,712; p=0,476; 95%; CI=0,279-1,818) dan konsumsi alkohol (OR=0,786; p=0,548; 95%; CI=0,358-1,725) dengan kejadian hipertensi. Didapatkan hubungan antara faktor risiko usia, riwayat keluarga, IMT, merokok, konsumsi tinggi garam, dan konsumsi kopi terhadap kejadian hipertensi di masyarakat Desa Karangasem Kabupaten Karangasem Bali.

**Kata Kunci:** faktor risiko, hipertensi, desa karangasem

## BACKGROUND

Hypertension is a clinical condition characterized by an increase in blood pressure of 140/90 mmHg. Its increasing prevalence makes hypertension as one of the major public health problems globally.<sup>1,2</sup> According to the American Heart Association (AHA), the Seventh Report of the Joint National Committee VII (JNC 7), and the World Health Organization (WHO), hypertension is the cause of death around 45% patients with coronary heart disease and 51% of patients with stroke.<sup>3,4</sup> Another report showed that 20 mmHg increase in blood pressure systolic or 10 mmHg in diastolic would increase the risk of stroke and cardiovascular diseases.<sup>5</sup> Hypertension occurs in almost all populations throughout the world. The National Health and Nutrition Examination Survey (NHANES) in the United States reports about 30% of the adult population or 65 million people suffering from hypertension. Besides, the incidence of hypertension increases in line with age as 65.4% of the population, > 60 years old, have hypertension.<sup>6</sup>

There are several risk factors for hypertension in the community such as gender, high-salt diet, family history, alcohol consumption, coffee consumption, obesity, and smoking.<sup>6</sup> In Indonesia, the risk factors of hypertension are significantly associated with the conditions and circumstances of social and economic conditions in the community. The prevalence of hypertension is higher in people with high socio-economic conditions. According to the data of Indonesia Basic Health Research (RISKESDAS) in 2013, the prevalence of hypertension was 26.5%.<sup>7</sup> Meanwhile, Bali had 19.9% of the prevalence, while 24.4% of all cases were in Karangasem regency.<sup>8</sup>

There are no data on risk factors for the high incidence of hypertension in the Karangasem Regency with low socioeconomic status.

## METHODS

A case-control study was conducted in Karangasem Village, Karangasem Subdistrict, Karangasem Regen-

cy, Bali Province between November and December 2016. The research subjects were patients with hypertension which met the inclusion and exclusion criteria from affordable samples selected with consecutive sampling techniques. Selected subjects were those who agreed and signed the *informed consent* after obtaining ethical clearance approval to conduct the study. Anthropometrics status including height and weight were measured and body mass index (BMI) was calculated by dividing body weight in kg with height in m<sup>2</sup>. The diagnosis of hypertension was made by using criteria from JNC 7. Cases are individuals with hypertension who meet the inclusion and exclusion criteria, while controls are individuals without hypertension who had been selected from individuals around the cases without family relationships.

All subjects were interviewed using interview guidance instruments which included a family history of hypertension, smoking, alcohol consumption, coffee consumption, salt consumption, physical examination, anthropometry, and demographic status. Blood pressure was checked 3 times in a sitting position after a 5minute break. Systolic and diastolic blood pressure is determined based on the mean values of the three examinations. Subjects were said to have hypertension if their blood pressure was  $\geq 140/90$  mmHg. Secondary data were collected to determine the history and status of hypertensive subjects.

Blood pressure was examined using the sphygmomanometer (Reister) and body weight was measured using a scale (Camry) with a deviation level of 100 g (0.2 lb). Height was measured using the meter scale (Onemed) with prior calibration.

Baseline data characteristics between cases and controls were presented using mean and standard deviation. Statistical Package for Social Science (SPSS) version 15.0 was used to do the statistical analysis. The group average was compared using paired student's t-test which was then followed by post-hoc analysis. Homogeneity and normality of variance were checked by

using the Levene test and the Kosmogorov-Smirnov test, respectively. The correlation coefficient between hypertension and various parameters was calculated using Pearson's correlation test. Logistic regression analysis was used to measure odds ratios and confidence intervals (CI) of 95% as an estimate of the relative risk of hypertension. A statistically significant level of  $p < 0.005$  was used.

## RESULTS

The characteristics of the subjects involved in this study, both as cases and controls are shown in Table 1. Data, as presented in Table 1, are mostly normally distributed after being tested using the Kosmogorov-Smirnov test at a significance level of 5%.

**Table 1.** Basic characteristics of the research subjects

	Cases (n==50) Mean ± SD	Controls(n=50) Mean ± SD
<b>Gender</b>		
Male	37(48,1%)	40(51,9%)
Female	13(56,5%)	10(43,5%)
<b>Age</b>		
< 64 years	31(43,7%)	40(56,3%)
≥64 years	19(65,5%)	10(34,5%)
<b>Education Level</b>		
None	13(72,2%)	5(27,8%)
Elementary School	11(50,0%)	11(50,0%)
Junior High School	4(40,0%)	6(60,0%)
Senior High School	16(43,2%)	21(56,8%)
University	6(46,2%)	7(53,8%)
<b>Occupancy</b>		
Housewife	4(50,0%)	4(50,0%)
Civil servant	6(40,0%)	9(60,0%)
Private worker	2(100,0%)	0(0,0%)
Entrepreneur	9(41,0%)	13(59,0%)
Labor	2(50,0%)	2(50,0%)
Others	27(55,1%)	22(44,9%)

Bivariate analysis showed several factors that were found to have a significant effect ( $p < 0.005$ ) on the incidence of hypertension such as age, family history, BMI, smoking habits, salt consumption, and coffee

consumption. While other risk factors such as gender and alcohol consumption did not affect the incidence of hypertension ( $p > 0.005$ ) (Table 2).

**Table 2.** Association several risk factors with hypertension

Variables	Cases (n=50)	Controls (n=50)	OR	95%CI	p
Gender			0,712	0,279-1,818	0,476
Male	37(74,0%)	40(80,0%)			
Female	13(26,0%)	10(20,0%)			
Age			2,452	0,999-6,018	0,047*
≥64 years	19(38,0%)	10(10,0%)			
< 64 years	31(62,0%)	40(80,0%)			
Family History			4,373	1,854-10,316	0,001*
Yes	29(58,0%)	12(24,0%)			
No	21(42,0%)	38(76,0%)			
BMI			3,341	1,440-7,753	0,004*
≥25Kg/m <sup>2</sup>	27(54,0%)	13(26,0%)			
<25Kg/m <sup>2</sup>	23(46,0%)	37(74,0%)			
Smoking			2,698	1,148-6,341	0,021*
Yes	38(76,0%)	27(54,0%)			
No	12(24,0%)	23(46,0%)			
Salt Consumption			2,571	1,122-5,895	0,024*
≥ 6 Gram	36(72,0%)	25(50,0%)			
< 6 Gram	14(28,0%)	25(50,0%)			
Coffee Consumption			3,451	1,220-9,759	0,016*
Yes	44(88,0%)	34(68,0%)			
No	6(12,0%)	16(32,0%)			
Alcohol Consumption			0,786	0,358-1,725	0,548
Yes	24(48,0%)	27(54,0%)			
No	26(52,0%)	23(26,0%)			

Note: \* p<0,05 based on chi-square test.

Subsequently, an analysis was performed using logistic regression to evaluate the relationship between smoking, drinking coffee, and alcohol consumption on the incidence of hypertension (Table 3). There was a significant relationship between smoking habits of ≥ 20 cigarettes with the incidence of hypertension which was

2.81 (95%, CI = 1.05 - 7.49), compared with those who smoked <20 cigarettes per day. Besides, a significant relationship was found between the habit of drinking ≥ 3 cups of coffee per day with the occurrence of hypertension, which was 5.2 (95%, CI = 1.04 - 25.77), compared with subjects who drink <3 cups of coffee per day.

**Table 3.** Logistic regression of hypertension prevalence based on number of cigarettes, coffee and alcohol consumption

Variables	Cases (n=50)	Controls (n=50)	B	Adjusted OR	95%CI	p
<b>Number of Cigarettes</b>						
≥20 cigarettes	19(38,0%)	7(14,0%)	1,034	2,811	1,055-7,491	0,039*
<20 cigarettes	22(44,0%)	20(40,0%)	-0,903	0,405	0,141-1,166	0,094
None (0 cigarettes)	9(18,0%)	23(46,0%)	0,00	1,00	Reference	-
<b>Amount of Coffee</b>						
≥3 cups	28(56,0%)	12(24,0%)	1,649	5,200	1,049-25,772	0,044*
<3 cups	20(40,0%)	25(50,0%)	-1,070	0,343	0,140-0,840	0,019
None (0 cup)	2(4,0%)	13(26,0%)	0,00	1,00	Reference	-
<b>Amount of Alcohol</b>						
≥3 cups	18(36,0%)	21(42,0%)	-0,123	0,885	0,250-3,128	0,849
<3 cups	6(12,0%)	6(12,0%)	0,154	1,167	0,320-4,259	0,816
None (0 cup)	26(52,0%)	23(46,0%)	0,00	1,00	Reference	-

Note: \* p<0,05 based on logistic regression test.

## DISCUSSION

Several risk factors are reported to have a significant correlation with the incidence of hypertension in the community in Karangasem village, such as age, family history, BMI, smoking, salt consumption, and coffee consumption.

Age is a risk factor of hypertension in the community that cannot be modified. This is related to the increasing age of an individual which followed by decreasing elasticity of arteries. Besides, increasing age is also in line with decreasing plasma renin causing sodium retention which leads to increase blood pressure.<sup>12</sup> Kartikasari et al reported that the risk of getting hypertension at the age of 60 years was 11 times greater than the age of less than 60 years.<sup>9</sup> Anggara and Prayitno reported increasing the risk of hypertension at the age of 40 years and above are 12 times greater than with age far under ah 40 years. The risk of hypertension at a young age is related to health-related lifestyles.<sup>10</sup>

An individual with history of hypertension on his/her family has the potential to suffer decreasing vagal function response that plays a role in regulating blood pres-

sure. The chance of developing hypertension in someone with a family history, where only one parent has hypertension is 25%, and if both parents are affected by hypertension, the chance is 60%.<sup>13,14</sup> Based on the results of this study, it was found that the family history factor was significantly related to the prevalence of hypertension. Subjects with a family history of hypertension increase the risk of hypertension, four times, compared with subjects without a family history of hypertension. In line with this study, Kartikasari et al reported that the risk of hypertension was 14 times greater in individuals with a family history of hypertension.<sup>9</sup> In another study, it was reported that the risk of developing hypertension in someone with family history, where only one parent suffered from hypertension, was 25%. If both parents were suffered from hypertension, the chance of becoming hypertensive was 60%.<sup>13,14</sup>

Obesity is a risk factor of cardiometabolic disorders such as diabetes and hypertension.<sup>17</sup> Obesity causes an increase of free fatty acids that increase the sensitivity of renin activity in the plasma leading to



sodium retention<sup>5,18</sup>. This study found that cases with obesity (BMI  $\geq 25 \text{ kg/m}^2$ ) increase the risk of hypertension 3 times higher than those with BMI  $< 25 \text{ kg/m}^2$ . This result is in line with Pradono and Junaidi who showed that cases with BMI  $\geq 25 \text{ kg/m}^2$  have 2 times higher risk of hypertension compared to those with BMI  $< 25 \text{ kg/m}^2$ .<sup>15</sup> Hendy et al, reported that obese individuals with BMI  $\geq 25 \text{ kg/m}^2$  have 7 times higher risk of hypertension than individuals with BMI  $< 25 \text{ kg/m}^2$ .<sup>16</sup>

Smoking is identified by consuming  $\geq 1$  cigarette per day for  $\geq 1$  year.<sup>19</sup> Smoking habit is one of the factors related to hypertension.<sup>19</sup> Nicotine in cigarette can lead to hypertension by damaging endothelial lining of the blood vessel wall.<sup>10</sup> We found that cases with a smoking habit of  $\geq 20$  cigarettes per day have 3 times higher risk of hypertension compared to those who consume  $< 20$  cigarettes per day. Anggara dan Prayitno also found a similar result showing that people with smoking habit have 8 times higher risk of getting hypertension than those who do not have a smoking habit.<sup>10</sup> Sugiharto reported that smoking habit increases the risk of hypertension by 2,4 times than without smoking habit.<sup>11</sup> A study conducted by Narayana dan Sudhana showed that increasing systolic blood pressure by 10-25 mmHg and heartbeat by 5-20 times per minutes during smoking one cigarette.<sup>20</sup> Another study from Bowman et.al conducted a longitudinal observation of 28,236 women for 9,8 years. Women who at the beginning have no hypertension had increased risk of hypertension after consuming 15 cigarettes per day.<sup>21</sup>

Excessive salt consumption can increase the risk of having cardiovascular disorders.<sup>22</sup> The amount of salt intake needed to make an individual suffer from hypertension varies from each individual because of different levels of salt sensitivity. Recommended daily salt consumption is  $\leq 6$  grams per day.<sup>23</sup> This study found that cases with salt consumption  $\geq 6$  grams per day have 2 times higher risk of hypertension compared to those who consume  $< 6$  grams of salt per

day. Sugiharto reported that subjects with frequently consuming salty food ( $\geq 6$  gram) have 3,95 times higher risk of hypertension than those with less frequent salt consumption ( $< 6$  gram).<sup>11</sup> Increase the prevalence of hypertension by 15-20% was observed from consuming 5-15 gram of salt per day.<sup>9</sup>

The result of coffee consumption showed that coffee consumption is associated with the risk of hypertension. Individuals who drink coffee have 3 times higher risk of developing hypertension than those who do not drink coffee. The result showed an increased risk of hypertension 5 times higher at cases who drink  $\geq 3$  cups of coffee per day compared to those who drink  $< 3$  cups of coffee per day. That finding is in line with a study conducted by Martiani dan Lelyana who reported that consuming 1-2 cups of coffee per day has 4 times higher risk of hypertension compared to not consuming coffee.<sup>24</sup> There is no evidence yet of the amount of coffee associated with the risk of developing hypertension. However, drinking coffee containing 200-300 mg of caffeine or equal to 3-4 cups of coffee is associated with an increase in blood pressure.<sup>25</sup>

There are several weaknesses in this study because of the research design used and the number of samples. The case-control design used in this study often creates information bias, so the results obtained are often not in accordance with reality.

## CONCLUSION

This study found that age, family history, BMI, smoking, high consumption of salt, and coffee consumption are significant risk factors for hypertension in subjects located in the Karangasem village, Karangasem regency, Bali.

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