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Salt taste threshold and sodium intake on the incidence of hypertension in adults in Depok, West Java

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ABSTRACT

Hypertension is one of the most non-communicable diseases in Indonesia. The prevalence of hypertension in Indonesia is 25.8% based on age ≥ 18 years of measurement. One of the factors that influences the occurrence of hypertension is sodium intake, and several studies have shown that there is a relationship between hypertension and salt taste threshold. This study aimed to analyze the relationship between salt taste threshold and sodium intake with the incidence of hypertension at the age of 18-60 years in the Cimanggis District Health Center, Depok City, in 2019. This study used a case-control design of outpatients in the Cimanggis District Health Center, Depok City. Subjects were selected by a purposive sampling technique. Data characteristics were collected through an administered questionnaire. Sodium intake was measured using the SQ-FFQ, and the salt taste threshold was measured using the Khobragade method, with five variations of sodium concentration. Sodium intake in the case group was higher than in the control group, with an average sodium intake in the case group of 2,620 mg compared to the control group of 2,100 mg. The taste threshold in the case group increased by 20%, while in the control group it decreased by 12%. There was no significant relationship between salted taste threshold and the incidence of hypertension, but there was a significant relationship between sodium intake and hypertension.

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Introduction

Hypertension is when an individual experiences an increase in blood pressure above normal or chronic for a long time (Saraswati, 2009). According to WHO (2011), nearly 1 billion people have high blood pressure, and about 2/3 of them are from developing countries, including Indonesia. Hypertension is one of the important causes of premature death worldwide, and the problem is getting bigger and bigger. In 2025, it is estimated that 1.56 billion adults will be living with hypertension.

The prevalence of hypertension in Indonesia at more than 18 years is 25.8%. West Java is the province with the fourth highest prevalence of hypertension, with 29.4% (Riskesdas, 2013). According to the West Java Health Office, Depok City has a hypertension prevalence of 4.60%, or as many as 34,928 people. Hypertension patients of the female gender are more dominant with a percentage of 5.5% or 20,802 people, compared to patients of the male sex of 14,126 people with a percentage of 3.7%. (West Java Health Office, 2016).

One of the risk factors for controlling hypertension is reducing salt intake in the body (Depkes, 2006). According to a study, subjects with hypertension positively correlated taste threshold and salt intake (Piovesana et al., 2013). There was a statistically significant relationship between gender and taste disturbances in individuals with hypertension;

women experienced more salty taste disorders than men (Amen & Raza, 2015).

Salt taste thresholds were not significantly different between the control and hypertensive groups and between sexes. Salt detection and tasting thresholds were not associated with 24-hour urinary sodium excretion, which estimates sodium intake. Systolic and diastolic blood pressures were positively correlated with 24-hour urinary sodium excretion, and there was an association with the female gender (Kim *et al.*, 2017).

There is a significant relationship between sodium intake and systolic blood pressure; the average sodium intake was greater than the recommended, which was 2952±794.11 mg, while the recommended sodium intake for >30 years was 1200-1500 mg per day for healthy individuals (Fayasari & Saliandri, 2016; AKG, 2019). Then, based on research, there is a relationship between sodium intake and hypertension and the risk of subjects with sodium consumption being 5.7 times more prone to hypertension than subjects consuming enough sodium (Atun *et al*., 2014). So, the researcher aims to find out the relationship between salt taste threshold and sodium intake in hypertension patients at Cimanggis Health Center.

Method

This study was carried out in the Cimanggis District Health Center, Depok City, from December 2018 to February 2019. Approval for this study was granted by the Health Research Ethics Commission of the UPN Veteran Jakarta with the number B/1956/5/2019/KEPK. This study used a case-control design with a patient from Cimanggis Health Center, Depok.

The inclusion criteria for the case group were as follows: being between the ages of 18 and 60, being able to read and write, being registered as hypertension patients at Cimanggis Health Center, and not having complication disease.The inclusion criteria for the control group were as follows: age 18–60, ability to read and write, and no degenerative diseases.

The sample size in this study was determined using the formula (Lemeshow, 1997), with a minimum sample of 24 subjects from each group taken by the purposive sampling method.

Data characteristics were collected using an administered questionnaire. Sodium intake was measured using the SQ-FFQ, which lists 51 items of high-sodium foods modified by Fayasari & Saliandri (2016). Nutrisurvey converted the intake data into intake data, which were then classified with a sodium cutoff of 1300mg, 1300–1500 mg, and >1500 mg.

The salt taste threshold was measured using the Khobragade method (Khobragade et al., 2012). Each participant was made to detect the presence of salt from paired samples of a sterile salt solution prepared from sodium chloride. This method consists of 5 solutions with salt concentrations described in Table 1.

Table 1. Salt concentration

No	Concentration (g/L)	Concentration mol/L
1	0,58	0,01
2	1,87	0,032
3	5,84	0,1
4	18,7	0,32
5	58,44	1

It is categorized as normal if the subjects feel salty at a concentration of 1-2, while it is said to increase if the subjets feels salty at a 3-5. Data were analyzed using statistical software, including bivariate data with the chi-square test and t-test methods with a 5% significance level.

Results

There were 100 subjects in this study, each with 50 subjects in the control and in the case group. Based on Table 2, the number of male subjects is 42% and 58% of female subjects. The average age of subjects in the case group was 46-60 years, 64%, while the control group was dominated by the age of 18-25 years, 30%. Most of the subjects in the control group had moderate education, at 46%, while in the case group, most of them had low education, at 46%. There were 26 subjects who worked as employees were 26 subjects (52%). Amlodipine was the type of drug most consumed by hypertension subjects, with 42%.

Table 2. Characteristic subject

Variable	Control		Case	
	n	%	n	%
Gender				
Male	25	50	17	34
Female	25	50	33	66
Age				
18-25 years	15	30	4	8
26-35 years	12	24	4	8
36-45 years	9	18	10	20
46-60 years	14	28	32	64

Variable	Control		Case	
	n	%	n	%
Education				
Low	14	28	23	46
Moderate	28	56	21	42
High	8	16	6	12
Occupation				
No	6	12	11	22
Yes	43	88	39	78
Family history of hypertension				
No	35	15	24	46
Yes	15	30	26	52

There was a family history of hypertension among 52%, and in the case group, and the control group with a family history of hypertension as much as 30%. The salt taste threshold in the control group with the solution most recognized as salty was first solution 1. In contrast, in the case group, solution 2 was the solution most recognized by subjects.

Table 3. Relationship between Age, Gender, Sodium Intake, Salt Taste Threshold on Hypertension Incidence

Variable	Control		Case		p-value
	n	%	n	%	
Age					
18-25 years	15	30	4	8	0.001
26-35 years	12	24	4	8	
36-45 years	9	18	10	20	
46-60 years	14	28	32	64	
Gender					
Male	25	50	17	34	0.08
Female	25	50	33	66	
Sodium intake					
<1300 mg	19	38	4	8	0.002
1300-1500 mg	7	14	11	22	
>1500 mg	24	48	35	70	
Salt taste threshold					
Normal	44	88	40	80	0.207
High	6	12	10	20	

Gender did not significantly affect blood pressure. The threshold for salty taste was increased in the case group by 20%, while in the control group, it was 12%. There is no significant relationship between the threshold for salty taste and the incidence of hypertension (p-value of 0.207).

As many as 70% of subjects in the case group had sodium intake of > 1500 mg, while in the control group it was as much as 48%. The subjects' sodium intake was obtained using the SQ-FFQ (Semi Quantitative-Food Frequency Questionnaire). There is a significant relationship between sodium intake and the incidence of hypertension (p-value <0.05).

Table 4. Average Between Salty Taste Threshold and Sodium Intake

Variable	Mean ± SD		p-value
	Control	Cases	
Salt taste threshold	1.12 ± 0.32	1.2 ± 0.40	0.078
Sodium intake	2.100 ± 0,93	2.620 ±0,63	0.002

The average salt taste threshold in the case group was greater than the control group, namely 1.2, and sodium intake in the case group was small. There is no relationship between smoking habits and the taste threshold (p-value > 0.05).

Discussion

There was a significant relationship between age and blood pressure in this study. The average age of subjects in the case group was 46-60 years, which was 64%, while the control group was dominated by the age of 18-25 years, 30%. According to the research results conducted by Pradono (2007), seen from demographic factors, the percentage of hypertension increases in the age group of 45 years or more.

The salty taste threshold is the lowest concentration at which subjects perceive a taste as salty. The procedure used is a modified of the Khobragade method, which uses seven salt solutions with different concentrations to five salt solutions (Khobragade et al., 2012). The salt taste threshold is categorized as normal if the subject feels salty for the first time in solutions 1-2 and is categorized as increased if he feels salty for the first time in solutions 3-5. This study showed no significant difference between the threshold for salty taste in the case group and the control group. However, there was a difference in the taste threshold of saltiness in the case group and the control group. In the case group, the taste threshold increased by 20%, greater than in the control group by 12% (Table 3). The case group had an average salty taste threshold of 1.2, and the control group was 1.12, which was a slight difference (Table 4).

Based on research conducted by Rabin (2009), there is a relationship between salty taste sensitivity and increased blood pressure as a response to exercise. Blood pressure will develop into hypertension with decreased sensitivity to salty tastes related to the desire to consume salty flavours, which will affect eating patterns in the long term (Rabin, 2009)

The Piovesana study in Brazil showed that subjects with hypertension positively correlated taste threshold and salt intake (Piovesana *et al.,* 2012). One of the risk factors for controlling hypertension is reducing salt intake in the body (Depkes, 2006). There is a relationship between sodium intake and blood pressure (Mahan & Escott-Stumps, 2013). It is said that hypertensive patients have an elevated recognition of salt (Viskopers & Lugassy, 1979)

In contrast, a study in South Korea of untreated hypertensive patients showed no significant difference in the detection and recognition of salt taste threshold between the control and hypertensive groups, but the 24-h urinary excretion of hypertensive patients was significantly higher than that of the control group (Kim et al, 2017). But, in this study, we do not measure urinary excretion. The 24-h urinary excretion may be a more accurate measure of sodium intake than the 12-h urinary frequency.Sodium intake among those with hypertension was 55% greater than the recommended upper limit of 2300 mg per day, and it showed in higher mean sodium intake (2564 mg/day) (Elfassy et al., 2020)

The taste threshold for salt was not significantly different between the control and hypertension groups. It can be caused by the salt-taste sensitivity itself, which did not seem to affect the individual's habitual salt intake, which is sourced from food processing, use of cooking and table salt, inherent salt in food, added salt in processing, etc to comprise an individual's total sodium intake (Kim et al, 2017).

It's shown in the case group, that the average sodium intake was 2,620 mg, and in the control group, it was 2,100 mg. The combined average of the two groups was 2952 794.11 mg, whereas the recommended sodium intake for >30 years of age was 1200–1500 mg per day for healthy individuals (AKG, 2019). These results follow Fayasari & Saliandri's research at the Sawangan Health Center, which showed a significant relationship between sodium intake and systolic blood pressure (Fayasari & Saliandri, 2016).

The results of research conducted by Mulyati (2017) stated a relationship between sodium intake and hypertension. Subjects who consume more sodium suffer from hypertension more often than those who consume less sodium. There is a relationship between sodium intake and the incidence of hypertension (Lestari, 2010).

Based on Atun's research (2014), there is a relationship between sodium intake and hypertension. The threshold for salty taste in the increased category was more found in the case group than in the control group, which was related to sodium intake in the case group, which was higher than the control group with a difference in sodium intake of 520 mg.

In our study, the education of hypertensive patients is regularly conducted by health workers, their knowledge should be in good terms. The public awareness about the benefits of reducing salt intake is important, but not enough. It is necessary to understand the factors that contribute to the excessive consumption, proposing strategies for effectively helping subjects to change their behavior. Making people aware of their own taste of salt along with the quantification and identification of the main sources of salt intake may be useful for educational purposes aimed at reducing salt intake.

Conclusion

This study concluded that there is a significant relationship between sodium intake and the incidence of hypertension. There is no significant relationship between the salt taste threshold and the incidence of hypertension. In contrast, the salt taste threshold in the case group was slightly higher than in the control group. This study suggests that hypertension in adults increases with higher sodium intake and age. Hypertensive adults should keep sodium intake lower than 2300 mg or 1500 mg per day.

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Author Contribution and Competing Interest

The author's contribution to this research includes designing a research project, collecting data or analyzing results, and preparing or revising scientific papers.

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