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How Hypertension Disease Relates to Various Risk Factors as an Effort to Prevent Hypertension and Its Complications Applied

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Abstract

Myocardial infarction is the leading cause of morbidity and mortality, with PCI as the primary therapy. Anxiety in PCI patients' needs to be treated comprehensively. This study aims to analyze the effect of acupressure and classical music on anxiety and vital signs of Myocardial Infarction patients with PCI indications at Kudungga Hospital. Quantitative research with true pretest-posttest group design experiments on 27 elective PCI patients at Kudungga Hospital. Respondents were divided into three groups (acupressure, classical music, control) by simple random sampling. Independent variables: acupressure and classical music; dependent variables: anxiety and vital signs (diastolic systolic blood pressure, pulse rate, respiratory rate). Data were analyzed using paired t-test. The research will be carried out in May 2025. Research Ethics Number: 0823415/EC/KEPK/I/06/2025. The results of the analysis showed that there was an effect of acupressure therapy on anxiety levels (p=0.000), systolic blood pressure (p=0.001), diastolic (p=0.014), pulse frequency (p=0.004), and respiratory frequency (p=0.002). There was an effect of classical music therapy on anxiety (p=0.000), systolic blood pressure (p=0.000), diastolic (p=0.0023), pulse frequency (p=0.029), and cardiac frequency (p=0.023). The results of the study showed that acupressure and classical music had a significant effect on reducing anxiety and vital signs in myocardial infarction patients with PCI *(Percutaneous Coronary Intervention) indications* at Kudungga Hospital. The results of the Post hoc and Tukey analysis Acupressure is more effective in reducing anxiety, pulse, and breathing, while classical music is more effective in lowering systolic and diastolic blood pressure. No changes to the control group. Acupressure and classical music interventions have been proven to be effective in reducing anxiety levels, blood pressure, pulse frequency, and respiratory frequency of myocardial infarction patients with PCI indications at Kudungga Hospital, while in the control group the decrease was not significant. Specifically, acupressure is most effective at lowering anxiety, pulse, and breathing, while classical music is most effective at lowering blood pressure.

Keywords: Hypertension, Risk Factors, Health Education, Knowledge, Complication Prevention.

Introduction

Hypertension is still a significant health problem in Indonesia. This condition is often encountered in first-level health care facilities and has a high morbidity rate, reaching 34.1% in the adult population. The risk of death from hypertension also tends to increase along with an increase in systolic and diastolic blood pressure, which generally contributes to the main cause of heart failure, stroke, and impaired kidney function (Diandra, 2023).

Based on a 2019 World Health Organization report, around 22% of the global population is diagnosed with hypertension. Projections show that by 2025, the number of people with hypertension worldwide will increase to 1.5 billion people. In addition, hypertension is estimated to be the cause of death for around 9.4 million people each year. Based on data from the World Health Organization (2023), the region with the highest prevalence of hypertension globally is Africa, which reaches 27%, followed by Southeast Asia in third place with a figure of 25% of the world's total population. In Indonesia, the Minister of Health said that the number of hypertension cases is very high, and has even been dubbed as a *silent killer* because of its often asymptomatic but fatal nature. It is estimated that one in three Indonesians suffers from hypertension, and this number tends to increase every year. The results of a national survey show that the prevalence of hypertension in Indonesia reaches 34.1%, which means that more than 70 million people have been affected by this condition (Siti, 2024). Data from Basic Health Research (Riskesdas) in 2018 shows that the prevalence of hypertension in Indonesia has increased significantly compared to 2013, from 25.8% to 34.1%. A similar trend also occurred in Aceh Province, where the prevalence of hypertension increased from 21.5% in 2013 to 26.45% in 2018 (Ministry of Health of the Republic of Indonesia, 2019). Furthermore, according to a report by the Aceh Provincial Health Office in 2019, the number of people recorded as having high blood pressure reached 276,862 people or about 32% of the total population. This figure continued to increase in 2020, with the number of hypertension patients reaching 329,985 cases, or around 88.4% of the detected target (Aceh Provincial Health Office, 2020). In 2021, the number of hypertension patients decreased by 328,363 (67.1%) cases of hypertension (Aceh Provincial Health Office, 2021). The city of Banda Aceh still faces serious challenges related to public health, with hypertension rates remaining high with a total of 11,714 male and female hypertension patients or 73.9%. (Banda Aceh City Health Office, 2024).

Hypertension, otherwise known as high blood pressure, is often considered a trivial condition. In fact, this disease is also nicknamed the *silent killer* because it often does not cause symptoms, so many sufferers do not realize that they have hypertension until serious complications appear. On the other hand, there are still many patients who think that symptoms such as dizziness or headache are a sure indicator of increased blood pressure. As a result, they tend to think their blood pressure is normal if they do not experience these complaints (Mufida, 2023). Hypertension is generally classified into two types based on its cause, namely primary hypertension and secondary hypertension. Primary hypertension is the most common form, accounting for about 95% of cases, and generally has no specific identifiable clinical cause, although genetic factors are often thought to play a major role in its occurrence. Meanwhile, secondary hypertension occurs due to certain conditions or factors that can be recognized, such as renal artery stenosis, pregnancy, or the use of certain medications (Smeltzer, 2013). If left unchecked, hypertension can cause a variety of serious complications that affect vital organs such as the heart, brain, kidneys, eyes, and peripheral blood vessels (Kifle, Adugna, Chanie, & Mohammed, 2022).

Hypertension is one of the public health problems that can actually be minimized through lifestyle changes, one of which is by increasing physical activity. Sundari et al. (2013) state that a lack of physical activity can trigger an increase in heart rate, which causes the heart to work harder and contract more frequently. In addition, hypertension is also influenced by a number of factors such as family history, smoking habits, consumption of high-fat foods, lack of physical activity, and excessive sodium intake. Geographical factors, such as living in coastal areas, can also be one of the triggers (Saputra & Anam, 2016). Individuals with hypertension risk factors have a higher potential for complications, so it is important to implement prevention strategies that take these factors into account. Prevention efforts not only

play a role as a promotional step, but are also an integral part of hypertension management, as they can stop the progression of the disease and prevent further complications (Susanti, 2019).

An individual's level of knowledge plays an important role in shaping his or her attitudes and behaviors; The higher the knowledge you have, the more positive the behavior shown. A person's own knowledge is influenced by various factors, such as educational background, access to information sources, and personal experience. In general, knowledge is obtained through the process of sensing which can be influenced by intuition, chance, authority or authority, tradition, and public opinion. Research conducted by Sulastri and Hidayat (2021) shows that a good understanding of hypertension is positively correlated with an individual's ability to manage the condition effectively. In addition, according to Yulidar et al. (2023), one of the main elements that encourages changes in a person's behavior, understanding, and attitude in adopting new habits is psychological readiness, which is highly determined by the level of knowledge possessed.

Knowledge of appropriate prevention measures is essential, especially in the city of Banda Aceh, which has distinctive social and cultural characteristics that may affect the lifestyle and prevalence of hypertension. People who are less concerned about the importance of regular health check-ups and healthy lifestyles are at higher risk of developing uncontrolled hypertension, which in turn can increase the risk of fatal complications. Therefore, research on the relationship between hypertension and risk factors as a prevention effort is very important to be carried out to increase awareness and treatment of hypertension in the city of Banda Aceh.

Materials and Method

This study is a quantitative study using a descriptive-analytical design with *a cross sectional* approach to determine the relationship between age, sex, family history, diet, exercise, stress, physical activity, smoking, level of knowledge, preventive behavior and attitude with hypertension disease as an effort to prevent complications.

This research was carried out in 3 Banda Aceh City Health Centers, namely the Ulee Karang Health Center, the Baiturrahman Health Center and the Kopelma Darussalam Health Center. The research period will be carried out in March - April 2025. The selection of these three locations took into account **the three health centers included in the ranks of health facilities with the highest number of non-communicable disease cases, especially hypertension among the nine health centers in Banda Aceh City.**

The population in this study is all people who are registered as patients or visitors in three health centers in Banda Aceh City, namely: Ulee Kareng Health Center, Baiturrahman Health Center and Kopelma Darussalam Health Center as many as 3,922 people. The sample in this study is people who are registered as patients or visitors in three health centers, namely: Ulee Kareng Health Center, Baiturrahman Health Center and Kopelma Health Center that meet the inclusion criteria. Sampling in this study was carried out using *the purposive sampling* method.

1. Inclusion criteria, namely:
   a. The respondents' participation in this study was carried out voluntarily and was evidenced by the signing of an *informed consent* sheet.
   b. Age over 18 years old and have been diagnosed with hypertension, according to the diagnosis of services at the Health Center.
   c. He was recorded as a patient at one of the three research locations, namely the Ulee Kareng Health Center, the Baiturrahman Health Center, or the Kopelma Darussalam Health Center
2. Exclusion criteria, namely:
   a. Refuse/unwilling to participate
   b. Respondents who did not fill out the questionnaire completely.
   c. Breastfeeding mothers.
   d. Experiencing cognitive or communication impairments, which hinder the understanding and completion of the questionnaire validly.

Results

1. **Univariate Analysis Results**

   In univariate analysis, the frequency value (f) indicates the number or number of respondents

included in each category of a variable. Frequency is used to describe the data distribution of a single variable descriptively. While the percentage (%) reflects the proportion of each category to the total number of respondents.

The characteristics of the respondents of this study based on age and gender were obtained as follows:

Table 1. Respondent Characteristics

Variables	*Frequency (f)*	Percentage (%)
Gender		
Man	75	20.7
Woman	287	79.3
Age		
Adult (18–59 yrs)	188	51.9
Senior (≥60 yrs)	174	48.1
Income		
< 1 Million	65	18
1-2 Million	57	15.7
3-5 Million	206	56.9
>5 Million	34	9.4
Hypertension		
Hypertension	328	90.6
Non-hypertension	34	9,4
Sum	**362**	100

Table 1. The total number of respondents in this study was 362 people spread across three health centers in the Banda Aceh City area. In terms of gender, the majority of respondents were women as many as 287 people (79.3%), while male respondents were 75 people (20.7%). This shows that women are more dominant in the number of hypertension sufferers or more active in accessing health service

Based on the age category, most of the respondents were in the adult age group (18–59 years), which was 188 people (51.9%), while the elderly age group (≥60 years) amounted to 174 people (48.1%). This percentage shows that hypertension does not only occur in the elderly, but also begins to be experienced by many productive age groups.

Judging from the monthly income level, respondents with an income of 3-5 million rupiah were the largest group, namely 206 people (56.9%), followed by the group with an income below 1 million as many as 65 people (18%), 1-2 million as many as 57 people (15.7%), and the rest had an income of more than 5 million rupiah, namely 34 people (9.4%). This data indicates that most of the respondents are from the middle economic group.

Meanwhile, based on hypertension status, 328 respondents were diagnosed with hypertension (90.6%), while the majority of respondents did not have hypertension as many as 34 people (9.4%). These findings are important in evaluating the risk factors that contribute to hypertensive disease, although the proportion of hypertensive people in the study population is relatively low.

Table 2 Characteristics of Respondents in Each Health Center

Characteristics	Phc								
	Kopelma Darussalam			**Ulee Kareng**			**Baiturrahman**		
		f	**%**		**f**	**%**		**f**	**%**
Gender	Man	31	25,6%	Man	23	19%	Man	22	18,3%
	Woman	90	74,4%	Woman	98	81%	Woman	98	81,7%
Age	Adult	70	57,9%	Adult	58	47,9%	Adult	60	50%
	Elderly	51	42,1%	Elderly	63	52,1%	Elderly	60	50%
Income	< 1 Million	42	34,7%	< 1 Million	0	0%	< 1 Million	42	34,7%
	1-2 Million	24	19,8%	1-2 Million	17	14%	1-2 Million	24	19,8%
	3-5 Million	44	36,4%	3-5 Million	94	77,7%	3-5 Million	44	36,4%
	>5 Million	11	9,1%	>5 Million	10	8,3%	>5 Million	11	9,1%
Sum	**121**			**121**			**120**		

Table 2. At the Kopelma Darussalam Health Center, of the 121 respondents who participated, most of them were women as many as 90 people (74.4%), while men amounted to 31 people (25.6%). Based on age group, the majority of respondents were in the adult age group as many as 70 people (57.9%) and the rest were included in the elderly category as many as 51 people (42.1%). In terms of income, respondents with an income of 3-5 million rupiah per month dominated 44 people (36.4%), followed by respondents with an income of less than 1 million as many as 42 people (34.7%), income of 1-2 million as many as 24 people (19.8%), and income above 5 million as many as 11 people (9.1%).

At the Ulee Kareng Health Center, the number of respondents was 120 people, with the gender distribution dominated by 98 women (81%), and 23 men (19%). Based on age, respondents were divided almost evenly between adults as many as 58 people (47.9%) and elderly people as many as 63 people (52.1%). Regarding income, the majority of respondents were in the income category of 3-5 million per month as many as 94 people (77.7%), then 17 people (14%) with an income of 1-2 million, and 10 people (8.3%) who had an income above 5 million. There are no respondents in the income category of less than 1 million rupiah at this health center.

Meanwhile, at the Baiturrahman Health Center, out of a total of 120 respondents, women also dominated as many as 98 people (81.7%) and men as many as 22 people (18.3%). Based on age, the number of adult and elderly respondents was the same, as many as 6 people (50%) each. For the income category, the majority of respondents had an income of 3-5 million as many as 44 people (36.4%), followed by an income of less than 1 million as many as 42 people (34.7%), an income of 1-2 million as many as 24 people (19.8%), and an income of more than 5 million as many as 11 people (9.1%).

Overall, the characteristics of the respondents showed that the majority of respondents in the three health centers were female and were in the adult to elderly age group. The highest income level is in the middle category, which is 3-5 million rupiah per month. This characteristic provides a preliminary overview of the socioeconomic distribution

and demographics of respondents that contribute to the risk pattern of hypertension in Banda Aceh City.

Table 3. Frequency distribution of risk factors as an effort to prevent complications

	Category	Frequency (f)	Presentase (%)
Gender	Man	75	20,7%
	Woman	287	79,3%
Age	Adult (18–59 yrs)	188	51.9%
	Senior (≥60 yrs)	174	48.1%
Family history	No History	234	64,4%
	There is a history	128	35,4%
Coffee consumption	No coffee consumption	136	37.6%
	Coffee consumption	226	62.4%
Physical Activity	No risk (high activity)	82	22.7%
	Risky (low activity)	280	77.3%
Smoke	No smoking	339	93.6%
	Smoke	23	6.4%
Stress	No stress	148	40.9%
	Stress	214	59.1%
Diet	Less good	100	27.6%
	Good	262	72.4%
Knowledge	Less good	157	43.4%
	Good	205	56.6%
Complication prevention behavior	Less good	175	48.3%
	Enough	187	51.7%
Attitude	Less good	170	47%
	Enough	192	53%
Hypertension	Non-hypertension	34	9,4%
	Hypertension	328	90,6%
Sum		**362**	**100%**

Table 3. It is known that the majority of respondents in this study are female, namely 287 people (79.3%), while the male respondents are 75 people (20.7%). Based on age distribution, the most respondents were in the elderly category

(60–90 years) as many as 169 people (46.4%), followed by the pre-elderly category (42–59 years) as many as 156 people (43.1%), and adults (18–41 years) as many as 38 people (10.5%).

Judging from the aspect of family history, the majority of respondents, namely 234 people (64.4%), did not have family members with a history of hypertension. Meanwhile, as many as 128 respondents (35.4%) reported a history of hypertension in their families.

In terms of coffee consumption habits, most of the respondents were known to consume coffee, namely 226 people (62.4%), while respondents who did not consume coffee amounted to 136 people (37.6%). The physical activity of the respondents also showed that most of them were in the risk category (low physical activity), namely 280 people (77.3%), while only 82 people (22.7%) had physical activity in the non-risk category (high activity).

Furthermore, regarding smoking habits, most of the respondents did not smoke, namely 339 people (93.6%), while only 23 people (6.4%) were smokers. Based on psychological conditions, as many as 214 respondents (59.1%) reported experiencing stress, while 148 respondents (40.9%) did not experience stress.

In terms of diet, the majority of respondents had a good diet, namely 262 people (72.4%), and the remaining 100 people (27.6%) had a poor diet. Based on the level of knowledge about hypertension, most of the respondents were in the category of poor knowledge, namely 205 people (56.6%), and the remaining 157 people (43.4%) had good knowledge.

Respondents' behavior in the prevention of hypertension complications showed a relatively balanced distribution, with 175 people (48.3%) in the poor behavior category and 187 people (51.7%) in the adequate category. In terms of attitudes towards the prevention of hypertension complications, most of the respondents showed a sufficient attitude, namely 192 people (53.0%), while 170 people (47.0%) had a poor attitude.

Based on hypertension status, it is known that most of the respondents in this study are classified as hypertensive patients, namely 328 people (90.6%), while only 34 people (9.4%) do not have hypertension.

2. Bivariate Analysis Results

a. Sex Relationship With Hypertension Disease

Table 4 Sex Relationship with Hypertensive Disease

Gender	Hypertension				Total		OR	CI 95%	P Value
	No Hypertension		**Hypertension**						
	F	**%**	**f**	**%**	**f**	**%**			
Woman	26	76.5%	261	79.6%	287	79.3%	1,199	0,519–2,767	0.671
Man	8	23.5%	67	20.4%	75	20.7%			
Sum	**34**	**100%**	**328**	**100%**	**362**	**100%**			

Table 4, Based on the table above, of the 328 respondents who experienced hypertension, it is known that most of the respondents with hypertension were women with 261 people (79.6%), while men as many as 67 people (20.4%). The results of the chi-square test showed that there was no significant relationship between sex and hypertension, with a p value of 0.671 > 0.05.

The results of the analysis showed that *the odds ratio* (OR) value was 1.199 with a *Confidence Interval* of 95% (CI 95%) in the range of 0.519 to 2.767. These findings indicate that women are about 1.2 times more likely to develop

hypertension than men. However, because the *confidence interval* range includes a value of 1, it can be concluded that there is no statistically significant relationship between sex and the incidence of hypertension in the population studied in the Banda Aceh City area.

b. The Relationship of Age and Hypertension Disease

Table 5 Age Relationship with Hypertension Disease

Age	Hypertension				Total		OR	CI 95%	P Value
	No Hypertension		**Hypertension**						
	F	**%**	**f**	**%**	**f**	**%**			
Senior (≥60 years old)	15	16.3%	159	48.5%	174	48.1%	1.192	0.585-2.426	0.628
Adults (18–59 years)	19	55.9%	169	51.5%	188	51.9%			
Sum	**34**	**100%**	**328**	**100%**	**362**	**100%**			

Table 5, Data in the table above, of a total of 328 respondents identified as having hypertension, the majority came from the adult age group (18–59 years), which was 169 people (51.5%). Meanwhile, respondents who belong to the elderly age group (≥60 years) amounted to 159 people (48.5%). Based on the results of the analysis using the chi-square test, a p value of 0.628 was obtained which was greater than 0.05, so it can be concluded that there is no statistically significant relationship between age and the incidence of hypertension. The odds ratio (OR) value of 1.192 with a *Confidence Interval* of 95% (CI 95%) was 0.585–2.426, indicating that elderly respondents had a 1.2 times greater chance of experiencing hypertension than elderly respondents, It can be concluded that age was not significantly associated with sex and disease in the Banda Aceh City area.

c. The Relationship of Family History to Hypertension

Table 6 Relationship of Family History to Hypertension

Family history	Hypertension				Total		OR	CI 95%	P Value
	No Hypertension		**Hypertension**						
	f	**%**	**f**	**%**	**f**	**%**			
No history	17	50%	217	66.2%	234	64.6%	0,512	0,251–1,041	0.061
There is a history	17	50%	111	33.8%	128	35.4%			
Sum	**34**	**100%**	**328**	**100%**	**362**	**100%**			

Table 6, Based on the table above, of the 328 respondents who experienced hypertension, it is known that most of the respondents with hypertension who did not have a family history of hypertension were 217 people (66.2%) while those who had a family history were 111 people (33.8%). The results of the chi-square test showed that there was no significant relationship between family history and hypertension, with a $p = 0.061 > 0.05$

The odds ratio (OR) value of 0.512 with a *Confidence Interval* (CI) of 95% of 0.251–1.041 indicates that respondents with no family history of hypertension have a 0.51 times (or lower) chance of developing hypertension compared to those with a family history. It can be concluded that in this study there is no significant relationship between family history and hypertension in the Banda Aceh City area.

d. The Relationship between Coffee Consumption and Hypertension

Table 7 Relationship between Coffee Consumption and Hypertension

Coffee consumption	Hypertension				Total		OR	CI 95%	P Value
	No Hypertension		**Hypertension**						
	f	**%**	**f**	**%**	**F**	**%**			
Coffee consumption	18	52.9%	208	63.4%	226	62.4%	1,541	0,758 –3,134	0.230
No coffee consumption	16	47.1%	120	36.6%	136	37.6%			
Sum	**34**	**100%**	**328**	**100%**	**362**	**100%**			

Table 7, Based on the table above, of the 328 respondents who experienced hypertension, it is known that most of the respondents with hypertension who did not consume coffee were 120 people (36.6%) while those who consumed coffee were 208 people (63.4%) The results of the chi-square test showed that there was no significant relationship between coffee consumption and hypertension, with a value of p = 0.230 > 0.05

The Odds Ratio (OR) value of 1.541 with a *Confidence Interval* (CI) of 95% is 0.758–3.134 indicating that respondents who consume coffee have a 1.5 times greater chance of experiencing hypertension compared to those who do not consume coffee, it can be concluded that in this study there is no significant relationship between coffee consumption and hypertension in the Banda Aceh City area.

e. The Relationship of Physical Activity with Hypertension

Table 8 Relationship of Physical Activity with Hypertension Disease

Physical activity	Hypertension				Total		OR	CI 95%	P Value
	No Hypertension		**Hypertension**						
	f	**%**	**f**	**%**	**f**	**%**			
Risk	25	73.5%	255	77.7%	280	77.3%	1,258	0,562 – 2,813	0.576
No risk	9	26.5%	73	22.3%	82	22.7%			
Sum	**34**	**100%**	**328**	**100%**	**362**	**100%**			

Table 8, Based on the table above, of the 328 respondents who experienced hypertension, it was known that most of

the respondents with hypertension who were not at risk of physical activity were 73 people (22.3%) while physical activity was at risk as many as 255 people (77.7%). The results of the chi-square test showed that there was no significant relationship between physical activity and hypertension with a value of p = 0.576 > 0.05.

An odds ratio (OR) value of 1.258 with a confidence interval (CI) of 95% in the range of 0.562–2.813 indicates that respondents with risky physical activity are 1.26 times more likely to develop hypertension than those with non-risk physical activity. However, because the confidence interval includes the number 1, it can be concluded that in this study there was no statistically significant relationship between the level of physical activity and the incidence of hypertension in the Banda Aceh City area.

f. The Relationship of Smoking with Hypertension

Table 9 Relationship between Smoking and Hypertension

Smoke	Hypertension				Total		OR	CI 95%	P Value
	No Hypertension		**Hypertension**						
	F	**%**	**f**	**%**	**f**	**%**			
No smoking	24	70.6%	315	96%	339	93.6%	0,099	0,039 – 0,249	0.000
Smoke	10	29.4%	13	4%	23	6.4%			
Sum	**34**	**100%**	**328**	**100%**	**362**	**100%**			

Table 9, Based on the table above, of the 328 respondents who experienced hypertension, it is known that most of the respondents with hypertension who did not smoke were 315 people (96%) and those who smoked as many as 13 people (4%). The results of the chi-square test showed that there was a significant relationship between smoking and hypertension with a value of p = 0.000 > 0.05.

The Odds Ratio (OR) value of 0.099 with a *Confidence Interval* (CI) of 95% is 0.039 –0.249, indicating that respondents who do not smoke have a 0.09 times lower risk of developing hypertension compared to those who smoke, it can be concluded that in this study there is a significant relationship between smoking and hypertension in the Banda Aceh City area.

g. The Relationship Between Stress and Hypertension

Table 10 Relationship Between Stress and Hypertension Disease

Stress	Hypertension				Total		OR	CI 95%	P Value
	No Hypertension		**Hypertension**						
	f	**%**	**f**	**%**	**f**	**%**			
Stress	31	91.25	183	55.8%	214	59.1%	0.122	0,037–	0.000
No stress	3	8.8%	145	44.2%	148	40.9%			

Sum	**34**	**100%**	**328**	**100%**	**362**	**100%**		0,40 8

Table 10, Based on the table above, of the 328 respondents who experienced hypertension, it is known that most of the respondents with hypertension who experienced no stress were 145 people (44.2%) while those who experienced stress were 183 people (55.8%). The results of the chi-square test showed that there was a significant relationship between stress and hypertension with a p value = 0.000 > 0.05.

The Odds Ratio (OR) value of 0.122 with a *Confidence Interval* (CI) of 95% is 0.037–0.408, indicating that respondents who experience stress have a 0.122 times lower risk of suffering from hypertension compared to those who experience stress, it can be concluded that in this study there is a significant relationship between stress and the incidence of hypertension in the Banda Aceh City area.

h. The Relationship of Diet and Hypertension

Table 11 Relationship of Diet with Hypertension

Diet	Hypertension				Total		OR	CI 95%	P Value
	No Hypertension		**Hypertension**						
	F	**%**	**f**	**%**	**f**	**%**			
Less good	31	91.2%	231	70.4%	262	72,4%	0.230	0,069–0,772	0.010
Good	3	8.8%	97	29.6%	100	27%			
Sum	**34**	**100**	**328**	**100%**	**362**	**100%**			

Table 11, Based on the table above, of the 328 respondents who experienced hypertension, it is known that most of the respondents with hypertension who had a poor diet were 231 people (70.4%) while those who had a good diet were 97 people (29.6%). The results of the chi-square test showed that there was a significant relationship between stress and hypertension with a value of p = 0.010 > 0.05.

The Odds Ratio (OR) value of 0.230 with a *Confidence Interval* (CI) of 95%: 0.069 – 0.772, shows that respondents with a good diet have a 0.23 times lower risk of developing hypertension than those who have a poor diet, it can be concluded that in this study there is a synergistic relationship between diet and hypertension in the Banda Aceh City area.

i. The Relationship of Knowledge with Hypertension Disease

Table 12 Relationship of Knowledge with Hypertension Disease

Knowledge	Hypertension				Total		OR	CI 95%	P Value
	No Hypertension		**Hypertension**						
	F	**%**	**f**	**%**	**f**	**%**			
Less good	31	91.2%	126	38.4%	157	43.4%	16.56	4.961-	0.000

							6	55.320
Good	3	8.8%	202	61.6%	205	56.5%		
Sum	**34**	**100**	**328**	**100%**	**362**	**100%**		

Table 12, Based on the table above, of the 328 respondents who experienced hypertension, it is known that most of the respondents with hypertension who had a good level of knowledge were 202 people (61.6%) while respondents with poor knowledge as many as 126 people (38.4%) suffered from hypertension. The results of the chi-square test showed a value of p = 0.000 (p < 0.05), which means that there is a significant relationship between the level of knowledge and the incidence of hypertension.

The Odds Ratio (OR) value of 16,566 with 95% CI = 4,961–55,320 shows that individuals with poor knowledge have a 16.6 times greater chance of developing hypertension than those with good knowledge, it can be concluded that in this study there is a significant relationship between the level of knowledge and hypertension disease in the Banda Aceh City area.

j. The Relationship of Preventive Behavior of Hypertension Complications with Hypertension Disease

Table 13 Relationship between Preventive Behavior of Hypertension and Hypertension Disease

Behaviour	Hypertension				Total		OR	CI 95%	P Value
	No Hypertension		**Hypertension**						
	f	**%**	**f**	**%**	**f**	**%**			
Less good	24	70.6%	151	46%	175	48.3%	2.813	1.304 -6.07	0.006
Good	10	29.4%	177	54%	187	51.7%			
Sum	**34**	**100%**	**328**	**100%**	**362**	**100%**			

Table 13, Based on the table above, of the 328 respondents who experienced hypertension, it was known that most of the respondents with hypertension had a lack of preventive behavior as many as 151 people (46%), while those who had good preventive behavior were 177 people (29.4%). The results of the chi-square test showed a value of p = 0.006 (p < 0.05), which means that there is a significant relationship between the level of knowledge and the incidence of hypertension.

The odds ratio (OR) value of 2.813 with a *Confidence Interval* (CI) of 95% is 1.304–6.070, indicating that respondents with poor behavior have a 2.8 times greater chance of developing hypertension compared to those who behave well, it can be concluded that in this study there is a significant relationship between behavior and hypertension disease in the Banda Aceh City area.

k. The Relationship of Attitude and Hypertension

Attitude	Hypertension				Total		OR	CI 95%	P Value
	No Hypertension		**Hypertension**						
	f	**%**	**f**	**%**	**f**	**%**			

Less good	29	85.3%	141	43%	170	47%	7.692	2.905-20.372	0.00
Good	5	14.7%	187	57%	192	53%			
Sum	**34**	**100%**	**328**	**100%**	**362**	**100%**			

Table 14 Relationship of Attitude with Hypertension Disease

Table 14, Based on the table above, of the 328 respondents who experienced hypertension, it is known that most of the respondents with hypertension who did not have a bad attitude towards the prevention of hypertension complications were 141 people (43%), while those who had a good attitude towards the prevention of hypertension complications were 187 people (57%). The results of the statistical test showed that there was a very significant relationship between attitude and hypertension disease (p = 0.000).

The odds ratio (OR) value of 7.692 with a *Confidence Interval* (CI) of 95% is 2.905–20.372 indicating that respondents with poor attitudes have a 7.7 times greater risk of developing hypertension compared to those who have a good attitude, it can be concluded that in this study there is a significant relationship between attitude and hypertension disease in the Banda Aceh City area.

3. Multivariate Analysis Results

Multivariate analysis was carried out using the binary logistic regression method, which aims to find out which independent variables have the most simultaneous effect on the dependent variable, namely the incidence of hypertension.

The method used was *the Enter Method* with initial independent variables, namely: gender, age, family history, smoking, physical activity, coffee consumption, stress, diet, knowledge, preventive behavior, and attitude.

The regression model as a whole was statistically significant based on the results of the Omnibus *Test of Model Coefficients* test with Chi-square values = 64.155; df = 11; p = 0.000. This shows that the model has good predictive ability against the incidence of hypertension. The following table presents the final results of the multivariate logistic regression analysis:

Table 15 Multivariate Logistic Regression Results

Variabel	B	S.E.	Itself.	Exp(B)	95% CI for Exp(B)
Gender (female)	0,380	0,506	0,452	1,463	0,542 – 3,946
Age (Adult 18-59 years)	-0,082	0,419	0,844	0,921	0,405 – 2,093
Family History (No family history)	-0,545	0,422	0,197	0,580	0,253 – 1,326
Smoke	-0,799	0,550	0,147	0,450	0,153 – 1,323
Physical Activity (Low/Risky)	-0,048	0,477	0,919	0,953	0,374 – 2,427
Coffee Consumption	0,437	0,427	0,306	1,548	0,670 – 3,576
Stress	-1,131	0,676	0,095	0,323	0,086 – 1,215

Diet (Poor)	-0,895	0,664	0,178	0,409	0,111 – 1,501
Knowledge (Good)	-1,933	0,656	0,003	0,145	0,040 – 0,524
Preventive Behavior (Good)	0,327	0,458	0,475	1,386	0,565 – 3,398
Attitude (Good/Positive)	1,046	0,564	0,064	2,847	0,943 – 8,595
Konstanta	7,285	2,979	0,014	1458,810	-

Table 15, Based on the results of the table above, it can be concluded that the knowledge variable is the only factor that has a significant effect on the incidence of hypertension in this multivariate model. A p value = 0.003 and an odds ratio (Exp(B)) of 0.145 indicate that individuals with good knowledge have a much lower chance of developing hypertension compared to those with less knowledge.

Meanwhile, the variables of stress and attitude were close to significant (p = 0.095 and p = 0.064), so it needs to be a concern in the next intervention. Other variables such as gender, age, smoking, physical activity, coffee consumption, and diet did not show a statistically significant influence in this model.

Discussion

Sex Relationship With Hypertension Disease

The results showed that of the 328 respondents who experienced hypertension, it was known that most of the respondents with hypertension were women with 261 people (79.6%), while men were 67 people (20.4%). The results of the chi-square test showed that there was no significant relationship between sex and hypertension, with a p value of 0.671 (p > 0.05.

These findings are in line with research by Wardhani et al. (2024) at the Internal Medicine Polyclinic of Meuraxa Banda Aceh Hospital showing that there was no meaningful relationship between sex and hypertension incidence (p = 0.377). Similar results were found in a study by Yunus et al. (2021) at the Hajj Pemanggilan Health Center, Central Lampung Regency, which also showed that there was no significant relationship between sex and hypertension incidence (p = 0.841).

Gender is indeed one of the factors that affect blood pressure. In this study, it was found that women tend to have higher rates of hypertension compared to men. Biologically, at productive age, men tend to have higher blood pressure due to the influence of the hormone testosterone. However, in women, the risk of hypertension increases especially after menopause, due to decreased estrogen levels which previously played a role in maintaining blood vessel elasticity and blood pressure balance.

The results of this study are strengthened by the Hasibuan (2024) study of employees in Batam City which reported a significant relationship between sex and the incidence of hypertension (p = 0.021), where women have a higher tendency to develop hypertension than men. In addition, a study by Azhari (2017) at the Makrayu KEBARAT II Puskesmas Palembang also found that women have a 2.7 times greater chance of developing hypertension than men (OR = 2,708; 95% CI = 1,197–6,126). Several previous studies, such as those reported by Rosta (2011), Wahyuni & Eksanoto (2013), as well as data from the Indonesian Ministry of Health (2013), support these findings, especially that women who have entered menopause are more prone to hypertension due to hormonal changes. Research by Wahyuni and Eksanoto (2013) specifically highlighted that women experience an increased risk of hypertension after menopause, namely at the age of 45 years, caused by low levels of the hormone estrogen postmenopause.

In biological and hormonal contexts, women have a risk of hypertension that tends to increase with age, especially after menopause. The hormone estrogen, which acts as a protector of the cardiovascular system, will decrease drastically after menopause. This decrease leads to physiological changes, such as increased blood vessel stiffness and insulin resistance, which ultimately contribute to increased blood pressure (Coutinho & Goel, 2017).

In addition to biological factors, the psychosocial aspect also plays an important role. Women often face a double burden, namely as breadwinners as well as household managers, which can increase exposure to chronic stress. Women also tend to store emotions, which if not managed properly, risk triggering hypertension. This is in line with the psychosocial stress model which states that untreated psychic stress activates the sympathetic nervous system and increases levels of the hormone cortisol, which can chronically increase blood pressure.

In terms of behavior, although women tend to be more compliant in routine medical treatment and check-ups, many still have unhealthy lifestyles, such as high salt consumption, low physical activity, and limited access to health information. In this study, this is reflected in the uneven score of hypertension prevention knowledge and behavior among female respondents. WHO (2021) also reported that the prevalence of hypertension in women increased sharply after the age of 50. Meanwhile, Mills et al. (2020) highlight the role of socio-economic factors such as low education, economic dependence, and limited access to information that are more experienced by women, which contribute to vulnerability to chronic diseases, including hypertension.

Although the statistical results did not show a significant relationship, the high prevalence of hypertension in women in this study reflected a combination of biological factors (menopause), psychosocial (stress and dual roles), and behavioral (unhealthy lifestyle). Therefore, gender still needs to be considered as a potential risk factor, especially in the formulation of intervention and prevention strategies.

A gender-sensitive promotive and preventive approach is needed, taking into account the needs and social role of women. For example, education that emphasizes the effect of menopause on blood pressure, stress management training for housewives and female workers, and community strengthening through health support groups at the village or RW level. In addition, primary health facilities are advised to conduct routine hypertension screening in women aged 35 years and older as an effort to detect and prevent complications.

The Relationship of Age and Hypertension Disease

The results of the study showed that of the 328 respondents who experienced hypertension, it was known that most of the respondents with hypertension were in the adult age group (18–59 years) as many as 169 people (51.5%) and while in the elderly age group (≥60 years) 159 people (48.5%). The results of the chi-square test showed that there was no significant relationship between age and hypertension, with a value of $p = 0.628$ ($p > 0.05$).

The results of this study are in line with a study conducted by Novianti et al. (2021) at the Ciputat Health Center, which also found no significant relationship between age and hypertension ($p > 0.05$). They suggest that lifestyle, diet, and physical activity may be more dominant factors in influencing the incidence of hypertension in younger age groups.

Age is one of the non-modifiable risk factors in the occurrence of hypertension. According to Mills et al. (2020), it states that these physiological changes make the elderly group in general have a higher risk of hypertension. This view is reinforced by the theory of transitional epidemiology, in which chronic and degenerative diseases such as hypertension tend to dominate the burden of disease in the elderly population.

In the context of older women, especially those who have gone through menopause, the risk of hypertension tends to increase significantly. During the reproductive period, the hormone estrogen has a protective effect on the cardiovascular system through the mechanism of vasodilation, regulation of lipid metabolism, and inhibition of the activity of the renin-angiotensin system. However, after menopause, a decrease in estrogen levels leads to a loss of this protective effect, which contributes to increased blood pressure, insulin resistance, as well as endothelial dysfunction. A study by Gupta & Sharma (2022) states that post-menopausal women have a higher tendency to develop hypertension than men their age.

Furthermore, Sharma et al. (2019) revealed that the prevalence of hypertension increases sharply in women after the age of 50, suggesting that hormonal changes at menopause are an important transitional factor in women's cardiovascular health status. Therefore, hypertension screening and healthy lifestyle education efforts should also be focused on pre-menopausal and post-menopausal women as part of an age- and gender-based approach.

However, these results are also different from the study by Siregar (2020) at the Medan Johor Health Center, which found a significant relationship between old age (≥55 years) and hypertension. These differences in results can be influenced by variations in age distribution, number of samples, nutritional status, comorbidities, and the possibility of the effect of the use of antihypertensive drugs or hormonal therapy in the menopausal women's group.

Although there was no significant association between age and hypertension in this study, the trend of increasing proportion of hypertension in the elderly still needs serious attention, especially in the context of public health intervention planning. The elderly, especially post-menopausal women, are a group that is prone to experiencing hypertension complications such as stroke, heart failure, chronic kidney disorders, and ischemic heart disease. Therefore, this group should be a priority in promotive and preventive programs, such as routine blood pressure screening, low-salt nutrition education, increased light physical activity, and chronic stress management.

The Relationship of Family History to Hypertension

Based on the results of the study, of the 328 respondents who experienced hypertension, it was known that most of the respondents with hypertension who did not have a family history of hypertension were 217 people (66.2%) while those who had a family history were 111 people (33.8%). The results of the chi-square test showed that there was no significant relationship between family history and hypertension, with a p = 0.061 p > 0.05.

The results of this study are in line with other studies that also found no significant association between family history and hypertension incidence. For example, Rini et al. (2020) in their research in the working area of the Jetis Health Center, Yogyakarta, reported that lifestyle and stress factors have a greater role than hereditary factors in the incidence of hypertension (p = 0.087). Similar results were also obtained by Sari and Putri (2021) at the Lubuk Buaya Health Center, West Sumatra, which showed that there was no meaningful relationship between family history and hypertension.

Theoretically, family history is one of the non-modified risk factors in the incidence of hypertension, which means that it cannot be changed, but it is important to recognize it as an early risk indicator. Genetic predisposition can affect the regulation of blood pressure through various biological mechanisms, such as the activation of the renin-angiotensin-aldosterone system, sensitivity to salts, as well as endothelial function and elasticity of blood vessels. Carretero and Oparil (2000) stated that genetic factors have an important role in the pathogenesis of essential hypertension. However, this influence is highly dependent on interaction with the environment, otherwise known as gene-environment interaction. This means that individuals with a family history of hypertension may have susceptibility genes, but they will not automatically develop hypertension if they live a healthy lifestyle, such as a low-salt diet, regular physical activity, and good stress management.

This study is not in line with a number of studies by Mulyasari et al. (2023) at the Kebumen I Health Center showing a significant relationship between the history of hypertension in the family and the incidence of hypertension at the age of 35–59 years. Similarly, research by Muaemana and Shafwan (2024) at the Tumbu-Tumbu Jaya Health Center showed that individuals with a family history of hypertension had a higher risk of developing hypertension (p = 0.001). Another study by Akmal et al. (2023) found that individuals with a family history of hypertension had a 2.9 times greater chance of developing hypertension than those without such a history.

Further, in an epigenetic perspective, genetic risk factors can be "activated" or "deactivated" by the environment through mechanisms such as DNA methylation and histone alterations. This means that even if a person has a gene that inherits susceptibility to hypertension from their parents, it will not always cause the disease unless triggered by a poor lifestyle. According to Whelton et al. (2018), this explains why two individuals with the same family background can have different health statuses depending on their environment and life habits.

However, modern research also highlights that the genetic influence on hypertension does not stand alone, but rather relies heavily on interaction with the environment or known as gene-environment interaction. For example, an individual with a family history of hypertension may have a predisposing gene, but if he or she leads a healthy lifestyle such as reducing sodium intake, being active, and being able to manage stress, the genetic potential may not develop into a disease.

These differences in findings can be explained by a number of confounding factors, including variations in the age and gender distribution of respondents, socio-economic and cultural differences, inaccurate *family history recall* by respondents, lack of control over salt intake, physical activity, and stress factors, and the influence of the use of antihypertensive drugs or hormonal therapy that is not recorded.

From a public health perspective, family history must still be taken into account as a risk indicator. Although this study was not significant, individuals with a family history of hypertension should be included in priority groups for early screening, health education, and routine blood pressure monitoring. Risk stratification models such as the Framingham Risk Score even explicitly include family history as one of the components of cardiovascular risk assessments.

In a promotive and preventive approach, understanding family history can be an educational tool to increase motivation for behavior change. This is in accordance with the *Health Belief Model* (HBM) theory, which states that perception of personal susceptibility can increase an individual's awareness to adopt a healthy lifestyle.

Although no statistically significant association was found between family history and hypertension incidence in this study, family history remains an important clinical risk factor that contributes to the pathogenesis of hypertension through genetic and epigenetic mechanisms. Therefore, family history must still be considered in the approach to screening and health education, especially in the productive age group and the elderly. The combination of behavioral interventions and genetic risk-based approaches needs to be a comprehensive strategy in the prevention and control of long-term hypertension.

The Relationship between Coffee Consumption and Hypertension

Based on the table above, of the 328 respondents who experienced hypertension, it was known that most of the respondents with hypertension were those who consumed coffee as many as 208 people (63.4%), while those who did not consume coffee were 120 people (36.6%). The results of the chi-square test showed that there was no significant association between coffee consumption and the incidence of hypertension, with *a value of p* = 0.230 ($p > 0.05$). This shows that although the proportion of coffee consumption is higher in people with hypertension, it is not statistically proven that coffee consumption has a direct effect on the incidence of hypertension.

The results of this study are in line with research by Mullo et al. (2023) conducted in the working area of the Paniki Bawah Health Center, Manado City. They found that there was no significant association between coffee drinking habits and the incidence of hypertension ($p > 0.05$), although descriptively there was a tendency to increase blood pressure in individuals with high coffee consumption.

Coffee contains caffeine, an alkaloid compound that acts as a stimulant of the central nervous system and cardiovascular system. In the short term, caffeine can cause an increase in blood pressure through the mechanism of vasoconstriction (narrowing of blood vessels) and stimulation of the release of catecholamines such as adrenaline. This happens because caffeine inhibits adenosine receptors in the brain, which normally function as vasodilators and nervous system relaxants. As a result, there is an increase in heart rate and systolic and diastolic blood pressure.

However, these effects are temporary and are usually more pronounced in individuals who are not used to consuming coffee. In people who regularly drink coffee, the body can experience physiological tolerance, in which the blood pressure response to caffeine becomes weaker. According to Mesas et al. (2011) and Widyastuti & Setiawan (2021), this tolerance arises due to the adaptation of the autonomic nervous system and the desensitization of adenosine receptors, so that the hypertensive effects of caffeine are minimal.

However, this study is not in line with the research conducted by Wahyu and Widyawati (2023) which states that excessive coffee consumption has a significant correlation with increased blood pressure, especially in the elderly group who have a history of hypertension. In the study, it was explained that the consumption of more than two cups of coffee per day can significantly increase the risk of hypertension, even though there is no control over the type of coffee and additional ingredients such as sugar or creamer. This difference in results is most likely due to the presence of various confounding variables that are not uniform between studies. Among them are the types of coffee consumed, whether in the form of tubruk, instant coffee, or espresso, each of which

has different levels of caffeine and additives. In addition, the method of presentation also has an effect, such as coffee brewed without a strainer tends to contain diterpene compounds (cafestol and kahweol) that can affect lipid metabolism. The sugar content or creamer added to coffee can also be an additional factor that affects cardiovascular risk. No less important, the frequency of consumption and individual sensitivity to caffeine also determine how much coffee affects blood pressure. Finally, other lifestyle factors such as stress levels, smoking habits, and poor sleep patterns can interact with coffee consumption and amplify its impact on blood pressure. Therefore, the difference in results between studies is understandable given the complexity of the effect of coffee consumption on hypertension which is highly dependent on the individual context and overall lifestyle habits.

According to *the American Heart Association* (AHA, 2022), moderate coffee consumption (about 2–4 cups per day or 200–400 mg of caffeine) is not associated with an increased risk of hypertension or cardiovascular disease in a healthy general population. In fact, some observational studies suggest that moderate coffee consumption may be related to a reduced risk of coronary heart disease, stroke, and type 2 diabetes, due to the antioxidant content such as polyphenols in coffee that have anti-inflammatory effects.

However, in certain groups such as the elderly, postmenopausal women, or individuals with metabolic disorders, sensitivity to caffeine tends to be higher, so coffee consumption still needs to be limited and adjusted.

Based on *the Health Belief Model* (HBM), a person's risk perception of the impact of coffee consumption on blood pressure will affect their behavioral decisions. Individuals who understand that caffeine can increase blood pressure—especially when consumed in excess, not combined with a healthy lifestyle—will be more motivated to control their consumption patterns. However, low nutritional literacy and the influence of a strong coffee drinking culture in the community can be an obstacle to behavior change.

Although no significant association was found between coffee consumption and hypertension in this study, coffee consumption is still worth considering, especially in high-risk individuals. The effects of coffee on blood pressure are individual and complex, depending on the dose, tolerance, type of coffee, and interactions with other factors.

Thus, health education programs should continue to convey the message of coffee consumption wisely and moderately, and integrate it with information on stress control, healthy sleep patterns, and regular blood pressure monitoring.

The Relationship of Physical Activity with Hypertension

Based on the results of the study, of the 328 respondents who experienced hypertension, it was known that most of the respondents with hypertension who did not consume coffee were 120 people (36.6%) while those who consumed coffee were 208 people (63.4%) The results of the chi-square test showed that there was no significant relationship between coffee consumption and hypertension, with a value of $p = 0.230$ $p > 0.05$.

This research is in line with the findings of Sari and Yuniarti (2021) conducted at the Karanganyar Health Center. They also reported that there was no meaningful association between physical activity and hypertension. They concluded that other factors such as diet, stress, and family history had a greater contribution to the incidence of hypertension than physical activity itself

Physiologically, physical activity has an influence on blood pressure regulation through several mechanisms, including increasing the elasticity of blood vessels, decreasing peripheral resistance, and improving endothelial function (Setiadi, 2013). Regular physical exercise also plays a role in lowering levels of stress hormones such as cortisol and adrenaline which can trigger an increase in blood pressure.

The research is not in line with Pertiwi and Kartika (2020) who conducted a study in the working area of the Sumbersari Health Center, Jember Regency. The study stated that there is a significant association between physical activity levels and the incidence of hypertension, where individuals who are less physically active have a higher risk of developing hypertension than those who are active. Similar findings were also reported by Lestari (2019) which showed that low physical activity contributed to an increased risk of high blood pressure in the young adult age group in Semarang City.

Exercise also helps lower stress hormones such as cortisol and adrenaline, which if left high in the long term will increase blood pressure (Cornelissen & Smart, 2013). Physical activity also plays an important role in weight

regulation, insulin sensitivity, and lipid profile, all of which contribute to the prevention of hypertension. Research by Tanaka & Safar (2005) also states that regular exercise helps maintain arterial elasticity and prevents stiffness of blood vessels, especially in the elderly.

Health behavior theory, *the Health Belief Model* (HBM) asserts that an individual's awareness of susceptibility to hypertension as well as the perception of benefits from physical activity can affect a person's adherence to exercise. Meanwhile, *the Transtheoretical Model* (TTM) illustrates that active behavior is not formed immediately, but through stages such as contemplation, preparation, and maintenance, so that interventions are needed that are tailored to the individual's readiness to change. This is important in explaining why some respondents may not be at the active behavioral stage despite having knowledge of the benefits of exercise.

However, differences in results between studies can be influenced by various factors, such as differences in respondent characteristics, methods of measuring intensity and duration of physical activity, and the presence of other uncontrolled confounding factors such as stress, salt intake, and smoking habits. In the context of this study, there may be a bias in the reporting of physical activity because it uses a questionnaire method that is subjective and does not take into account daily activities in detail.

Although no statistically significant association between physical activity and hypertension was found in this study, physical activity remains a key component in hypertension prevention strategies. The WHO (2020) recommends at least 150 minutes of moderate-intensity physical activity per week to maintain cardiovascular health. Therefore, healthy lifestyle interventions for hypertension prevention must still integrate increased physical activity alongside low-salt diet settings, stress management, and weight control, in order to make prevention more effective and sustainable.

Thus, although physical activity did not show a significant association in this study, it does not mean that physical activity is not important in the context of hypertension prevention. Physical activity is still recommended as part of a healthy lifestyle, but it needs to be combined with other factors such as a balanced diet, stress management, and weight control to make hypertension prevention efforts more effective.

The Relationship of Smoking with Hypertension

Based on the results of the study, of the 328 respondents who experienced hypertension, it was known that most of the respondents with hypertension did not smoke as many as 315 people (96%) and those who smoked as many as 13 people (4%). The results of the chi-square test showed that there was a significant relationship between smoking and hypertension with a value of $p = 0.000 > 0.05$.

Physiologically, smoking habits are known to increase blood pressure through the stimulation of the sympathetic nervous system due to the nicotine content in cigarettes. Nicotine causes vasoconstriction of blood vessels, increases heart rate, and stimulates the release of catecholamines, all of which contribute to increased blood pressure. Therefore, smoking habits are generally considered an important risk factor in the development of hypertension.

The results of this study are in line with a study conducted by Mullo et al. (2022) at the Paniki Bawah Health Center, Manado City, which showed a significant relationship between smoking habits and the incidence of hypertension. The study concluded that smokers have a higher risk of developing hypertension.

Another study supported by Dilla et al. (2024) The results showed a significant association between smoking behavior and the incidence of hypertension at productive age with a value of $p = 0.001$ ($p < 0.05$). These findings suggest that smoking increases the risk of hypertension in productive age individuals, emphasizing the need for health interventions to reduce smoking habits and lower the prevalence of hypertension.

According to the *World Health Organization* (2021), smoking is one of the main risk factors for cardiovascular diseases, including hypertension, due to its long-term effects on the vascular and metabolic systems. Smoking also plays a role in accelerating atherosclerosis and endothelial dysfunction, which worsens blood pressure control.

Physiologically, smoking is known to trigger an increase in blood pressure through several mechanisms. The nicotine in cigarettes stimulates the release of catecholamines which causes vasoconstriction and increased heart work. In addition, toxic substances such as carbon monoxide cause endothelial dysfunction and decrease the elasticity of blood vessels, thus accelerating

the occurrence of hypertension. This is in line with a study from Guyton & Hall (2017) in *the Textbook of Medical Physiology*, which states that long-term exposure to active substances in cigarettes can worsen blood pressure regulation and trigger cardiovascular disease.

Interestingly, the results of this study also show that most of the people with hypertension are women, namely 261 out of 328 people (79.6%), while men are only 67 people (20.4%). Although statistical tests did not show a significant association (p = 0.671), this proportion showed a tendency for a higher prevalence of hypertension in women in the study population.

Theoretically, the female gender has several physiological and hormonal characteristics that can affect blood pressure, especially after entering the age of menopause. A decrease in the hormone estrogen can lead to a loss of natural vascular protection, increasing the risk of vasoconstriction and arterial stiffness. In addition, some studies show that women who smoke experience heavier cardiovascular effects than men, due to different nicotine metabolism and more complex hormonal impacts (Sandberg & Ji, 2012).

The link between women and smoking to hypertension cannot be ignored either. Although the number of female smokers is generally lower than that of men, the impact on blood pressure can be more significant, especially when combined with other factors such as stress, obesity, or lack of physical activity. In this study, the findings regarding the high proportion of hypertensive women may be an important indication that gender factors and habits such as smoking contribute to each other in increasing the risk of hypertension.

Overall, the results of this study support the theory that smoking is one of the main risk factors for hypertension, and when combined with the female gender, can have a greater impact on cardiovascular health. Therefore, the factors of smoking habit and the biological differences between men and women need to be carefully considered in understanding the distribution pattern of hypertension in the community.

The Relationship Between Stress And Hypertension

Based on the results of the study, of the 328 respondents who experienced hypertension, it was known that most of the respondents with hypertension experienced no stress as many as 145 people (44.2%) while 183 people (55.8%) experienced stress. The results of the chi-square test showed that there was a significant relationship between stress and hypertension with a p value = 0.000 > 0.05.

These findings are in line with the results of a study by Delavera et al. (2021) who used *Indonesian Family Life Survey* (IFLS-5) data and found that psychological stress is significantly related to hypertension, especially after controlling for body mass index and diet. This study confirms that stress has an important role in the etiology of hypertension in Indonesian society.

Similar results were also found in a study by Hidayati et al. (2022) at Sumberglagah Leprosy Hospital, Mojokerto, which showed that the higher a person's stress level, the greater the chance of experiencing an increase in blood pressure. This condition is caused by the body's physiological reaction to stress that impacts the cardiovascular system.

This study is consistent with the results of previous studies that showed that chronic stress can trigger the activation of the sympathetic nervous system and hypothalamic-pituitary-adrenal (HPA axis), leading to an increase in the hormones cortisol, adrenaline, and noradrenaline. These hormones contribute to an increase in heart rate and narrowing of blood vessels, which in the long run can lead to high blood pressure.

Stress can activate the sympathetic and hypothalamic-pituitary-adrenal nervous systems (HPA axis), which triggers the release of stress hormones such as cortisol, adrenaline, and noradrenaline. These hormones cause increased heart rate and vasoconstriction of blood vessels, which ultimately increases blood pressure. If stress persists chronically, these physiological effects can lead to permanent hypertension. In addition, stress can also affect unhealthy behaviors such as poor diet, lack of physical activity, and smoking habits, all of which contribute to increasing the risk of hypertension.

In the context of preventing hypertension complications, stress management is one of the most important interventions. Psychosocial interventions such as relaxation techniques, psychological counseling, social support, and good time management have been shown to be effective in lowering stress levels and ultimately helping to control blood pressure.

Thus, based on these various studies, it can be concluded that stress has a significant relationship with the incidence of hypertension. Therefore, effective stress management is one of the important strategies in the prevention and control of hypertension.

The Relationship of Diet and Hypertension

Based on the results of the study, of the 328 respondents who experienced hypertension, it was known that most of the respondents with hypertension had a poor diet as many as 97 people (29.6%) while those who had a good diet were 231 people (70.4%). The results of the chi-square test showed that there was a significant relationship between stress and hypertension with a value of $p = 0.010 > 0.05$.

This study is in line with the results of the study of Mardianto et al. (2023), which showed a significant relationship between diet and the incidence of hypertension ($p = 0.000$). The study emphasizes that lifestyles that involve the consumption of foods high in salt, saturated fat, and low in fiber are the main factors that increase blood pressure. Similarly, Sistikawati et al. (2021) in their literature review stated that diets involving caffeine consumption, processed foods high in sodium, and irregular eating habits are associated with increased blood pressure.

Physiologically, diet plays an important role in regulating blood pressure through various mechanisms. High sodium intake leads to water retention and an increase in blood plasma volume, which directly increases blood pressure. In addition, excessive consumption of saturated fats can trigger endothelial dysfunction, chronic inflammation, and the development of atherosclerosis, which interferes with normal blood flow. In contrast, high-fiber foods such as fruits and vegetables help increase the excretion of sodium through the urine and improve the elasticity of blood vessels, thus lowering blood pressure.

The scientific approach underlying dietary regulation to prevent hypertension is the DASH (*Dietary Approaches to Stop Hypertension*) Diet Theory developed by *the National Institutes of Health* (NIH). This approach emphasizes the importance of consuming fruits, vegetables, whole grains, low-fat milk, and low-sodium foods. The study of Appel et al. (1997) showed that the DASH diet can lower systolic blood pressure by 8–14 mmHg, even in individuals without hypertension. This approach is the basis for the development of balanced nutrition guidelines in many countries.

From the perspective of health behavioral theory, *the Health Belief Model* (HBM) explains that an individual's perception of the risk of hypertension due to an unhealthy diet greatly influences the willingness to change. Individuals who understand the consequences of excessive salt and saturated fat consumption will be more motivated to adopt healthy eating habits. However, reinforcing factors such as the social environment, availability of healthy food, and support of health workers also play an important role in the success of dietary changes.

These findings are also strengthened by the research of Diana and Hastono (2023) which showed a significant relationship between diet and the incidence of hypertension with a $p = 0.002$ value. In the study, it was explained that respondents who had fatty, salty, and instant eating habits were more likely to experience an increase in blood pressure.

Furthermore, an unhealthy diet not only has a direct impact on blood pressure, but also contributes to metabolic syndrome, which is a combination of obesity, hyperglycemia, and dyslipidemia—all secondary risk factors for hypertension. Therefore, a poor diet can create a double risk cycle that accelerates the progression of hypertension and increases the likelihood of complications, such as stroke and coronary heart disease.

Thus, the results of this study strengthen the evidence that diet is a significant determinant factor in the incidence of hypertension. Therefore, lifestyle-based interventions, especially nutrition education and promotion of healthy food consumption, are very important to be integrated into promotive and preventive programs, especially in first-level health care facilities (FKTP).

These efforts include education on reducing salt and saturated fat intake, promoting local vegetable and fruit consumption that is easily accessible to the public, and strengthening the role of health workers as agents of changing eating behavior. Public health policies also need to encourage monitoring of hidden salt consumption in processed foods and providing clear nutrition labels on food products.

There is a significant relationship between diet and the incidence of hypertension. Therefore, dietary changes are the main strategies in the prevention and control of hypertension, through educational approaches, nutritional intake monitoring, and community-based long-term eating behavior changes.

The Relationship of Knowledge with Hypertension Disease

Based on the results of the study, of the 328 respondents who experienced hypertension, it was known that most of the respondents with hypertension who had a good level of knowledge were 202 people (61.6%) while respondents with poor knowledge as many as 126 people (38.4%) suffered from hypertension. The results of the chi-square test showed a value of $p = 0.000$ ($p < 0.05$), which means that there is a significant relationship between the level of knowledge and the incidence of hypertension.

Although the majority of people with hypertension are classified as having good knowledge, this does not guarantee a low incidence of hypertension overall. This means that good knowledge is not necessarily fully followed by effective preventive behavior. Nevertheless, knowledge remains a very important basic component in the process of forming one's attitudes and behaviors, especially in the control of non-communicable diseases such as hypertension.

The results of this study are in line with findings from Fadilah et al. (2022) who show that good knowledge of hypertension is significantly correlated with adherence to hypertension prevention behaviors, including medication consumption, healthy diet, and regular blood pressure control. Similarly, research by Ningrum and Wahyuni (2021) at the Jatiroto Health Center shows that the level of knowledge affects healthy living behavior and blood pressure status.

Theoretically, knowledge is a cognitive component that is the basis for the formation of a person's attitudes and behaviors (Notoatmodjo, 2014). In the context of health, knowledge affects a person's ability to recognize symptoms, understand the importance of prevention, and make the right decisions to maintain health. When individuals understand that hypertension is a "*silent killer*" that can cause serious complications such as stroke, heart attack, and kidney failure, they will be more motivated to adopt a healthy lifestyle and carry out early detection.

The Health Belief Model (HBM) also supports this theory, that a person will be more likely to adopt healthy behaviors if they feel they have *susceptibility*, an understanding of the seriousness of the disease (*perceived severity*), and realize the benefits of preventive measures (*perceived benefit*), all of which are influenced by knowledge.

This research is also consistent with a study by Saputri et al. (2023) which emphasizes that health education plays an important role in increasing knowledge and shaping hypertension prevention behaviors. The lack of accurate information about the causes, prevention methods, and management of hypertension will hinder efforts to control this disease in the community.

Further analysis of the 20 statements in the knowledge questionnaire provides a detailed picture of the level of public understanding of specific aspects of hypertension. The frequency results show that the level of knowledge of respondents is still varied and uneven, both in terms of definition, prevention, and complications.

The statement with the highest correct answer was P1: "High diastole or systolic blood pressure indicates hypertension", with 205 respondents (56.6%) answering yes. This shows that the basic understanding of the meaning of hypertension is relatively good, possibly because this information is often conveyed during blood pressure checks in primary health services.

The statement with the lowest correct answer was P14: "Increased blood pressure can lead to stroke, if left untreated", with only 120 respondents (33.1%) answering yes. These findings are quite concerning, as stroke is one of the main complications of hypertension, and ignorance of these risks can lead to neglect in controlling blood pressure on a regular basis, even if basic knowledge is good enough.

In addition, many respondents also mistakenly answered statements that contain myths or false habits, such as:

Meanwhile, some respondents also do not understand that hypertension can cause damage to organs such as the heart and kidneys, as seen from the low scores on:

P13: "Uncontrolled hypertension will result in stroke, heart failure and kidney failure" (37.3% true),

P20: "Chronic kidney failure due to hypertension can result in a gradual decline in kidney function" (50.8%

true).

The lack of understanding of these complications has a serious impact on an individual's motivation to seek long-term treatment, given that many patients only comply when they feel they have symptoms.

These results confirm that although general knowledge about hypertension is already possessed by a large part of society, there are still many important aspects that are not fully understood, especially related to complications and lifestyle. Therefore, health education programs in health centers and communities must be directed to increase literacy about the risk of complications, the importance of a healthy lifestyle, and regular blood pressure control.

Educational strategies also need to be adjusted to the social, cultural, and educational backgrounds of the community. Participatory approaches such as group discussions, visual media, and community-based counseling are considered more effective than one-way counseling.

In addition, there is a need for a regular evaluation of public knowledge, so that educational content can be adjusted to the weaknesses found, such as increasing emphasis on stroke risk, the importance of a low-salt diet, and the dangers of alcohol in hypertensive patients.

Thus, it can be concluded that the level of knowledge has a significant relationship with hypertensive diseases, where individuals with good knowledge tend to have a lower risk of developing hypertension. Community-based health education is an important strategy in efforts to prevent hypertension as a whole, especially in the productive age and elderly populations.

The Relationship between Preventive Behavior of Hypertension Complications and Hypertension Disease

Based on the results of the study, of the 328 respondents who experienced hypertension, it was known that most of the respondents with hypertension had a lack of preventive behavior as many as 151 people (46%), while those who had good preventive behavior were 177 people (29.4%). The results of the chi-square test showed a value of $p = 0.006$ ($p < 0.05$), which means that there is a significant relationship between the level of knowledge and the incidence of hypertension.

These findings reinforce the results of Taukhit's (2021) research which confirms that good preventive behaviors such as weight control, regular physical activity, limiting salt and saturated fat intake, and effective stress management, can significantly reduce the risk of hypertension complications. Research at Bakti Timah Pangkalpinang Hospital also supports these findings, stating that variables such as adherence to medication, periodic blood pressure checks, and healthy food consumption are closely related to success in preventing hypertension complications ($p = 0.000$).

According to *the Health Belief Model* (HBM) developed by Rosenstock, it emphasizes that a person will be moved to take preventive measures if they have a high perception of their susceptibility to a disease, the perception that the disease can be prevented, and the belief that preventive measures taken bring benefits. In the context of hypertension, individuals who are aware of potential complications such as stroke or kidney failure, and believe that lifestyle changes can prevent them, will be more encouraged to behave healthily.

In addition, *Pender's Health Promotion Model* theory (1996) is also relevant to explain this relationship. This model emphasizes the importance of individual factors such as health knowledge, social support, and perceptions of barriers and benefits in shaping preventive behaviors. With sufficient knowledge and motivation, and supported by an adequate social environment and health services, preventive behavior against hypertension will be easier to implement.

Hypertension prevention behaviors are a series of conscious and continuous actions aimed at controlling blood pressure and preventing serious complications. These actions include reducing salt and fat consumption, engaging in at least 150 minutes of physical activity per week, and managing stress in a positive way. In addition, preventive behavior also involves compliance in controlling blood pressure regularly, taking medication as recommended by doctors, quitting smoking, limiting alcohol consumption, and maintaining a balanced sleep and lifestyle. Lack of implementation of these behaviors, either due to limited knowledge, low motivation, or inadequate access to health services, can cause blood pressure to not be optimally controlled and increase the risk of complications such as stroke, heart disease, or kidney failure. Therefore, the application of consistent preventive behaviors is essential in efforts to control hypertension as a whole.

Analysis of the items of the behavioral questionnaire provides a more detailed picture of the most common and least frequently performed aspects of hypertension prevention behaviors by respondents. It is important to understand which aspects need to be strengthened in public health education and interventions.

Based on frequency data, the most common behavior carried out by respondents was in the statement "I do physical activities such as sweeping, mopping, and washing clothes every day", where as many as 182 respondents (50.3%) answered "Always". These results show that most of the respondents are already active in daily light physical activities, especially domestic activities. Although this activity is not classified as a moderate intensity exercise, it still contributes to energy expenditure and blood circulation, so it has a positive impact on gradually lowering blood pressure. This is in line with Pender's Health Promotion Model theory which emphasizes the importance of daily behavior and physical habits as a form of preventive health promotion.

In contrast, the lowest frequency behavior item in the "Always" category was found in the statement "I do physical exercise such as jogging, cycling or gymnastics 5–7 times per week", where only 51 respondents (14.1%) answered "Always". These findings suggest that structured and planned physical exercise is still not the dominant habit in respondents' lives. Lack of free time, workload, limited sports facilities, or low motivation to exercise can be reasons why these behaviors are not implemented. In fact, WHO (2020) recommends a minimum of 150 minutes of moderate-intensity physical activity a week to prevent non-communicable diseases, including hypertension.

Another behavior that also showed a low score was on the statement "I like to slam things when I'm angry or emotional", where the "Never" category was chosen by only 43 respondents (11.9%), while the rest answered a higher frequency. This reflects that managing negative emotions is still a challenge for some respondents, even though emotional stress and high reactivity have been shown to contribute to spikes in blood pressure, as described in stress theory and emotion regulation (Lazarus & Folkman, 1984).

The imbalance between high domestic physical activity but low structured physical exercise, as well as low emotional control abilities, indicates that behavioral interventions must include a multidimensional approach, including: appropriate physical activity education, stress management techniques, and changes in eating habits. Community-based approaches and social support can be used to increase motivation and adherence to healthier lifestyle changes.

These findings indicate that although some hypertension prevention behaviors have been consistently performed by respondents, there are still gaps in more comprehensive healthy behavior practices. Therefore, health promotion is not enough to convey information, but must also be able to facilitate behavior change through behavioral, motivational, and structural approaches, so as to encourage respondents to actively carry out hypertension prevention behaviors more optimally.

Hypertension prevention behavior cannot be separated from the process of public health education and coaching. Therefore, community-based promotive and preventive efforts must be carried out intensively, with a participatory approach that is in accordance with the local culture. Group counseling, social media, the use of infographics, and family-based education can be effective strategies to increase understanding and implementation of healthy behaviors.

Puskesmas as the spearhead of primary services need to integrate hypertension screening programs with routine educational interventions, as well as periodically monitor patient behavior to identify changes and obstacles faced by the community.

Preventive behaviors of hypertension complications have been shown to have a significant relationship with the incidence of hypertension. Individuals with good preventive behaviors have a lower tendency to develop hypertension or its complications. Although some behaviors are good enough, such as light physical activity and weight control, there are still many aspects that need to be improved, especially in regular exercise, salt consumption, processed foods, and stress management.

Thus, more targeted and sustainable educational interventions are needed, to foster awareness and form healthy lifestyle habits that can effectively prevent hypertension complications.

The Relationship of Attitude and Hypertension

Based on the results of the study, of the 328 respondents who experienced hypertension, it was known that most of the respondents with hypertension did not have a bad

attitude towards the prevention of hypertension complications as many as 141 people (43%), while those who had a good attitude towards the prevention of hypertension complications were 187 people (57%). The results of the statistical test showed that there was a very significant relationship between attitude and hypertension disease p = 0.000 < 0.05).

These findings are in line with the results of research by Kuswoyo and Tuasamu (2022) in the working area of the Piyungan Health Center, Bantul, which found that a positive attitude correlates with the incidence of hypertension in the elderly. Another study at the Air Santok Health Center, Pariaman City also showed a meaningful relationship between attitude and efforts to prevent hypertension complications. These results corroborate that attitude is an important factor that can drive hypertension prevention behavior.

Theoretically, attitudes are internal predispositions formed from a person's experience, knowledge, and beliefs about an object or condition, which include three components: cognitive (belief or knowledge), affective (feelings or emotions), and conative (tendency to act). According to Notoatmodjo (2014), a good attitude towards health will affect a person's behavior in maintaining and improving his health status.

The Health Belief Model (HBM) theory also emphasizes that a person will be encouraged to behave healthily if they have a high perception of susceptibility, disease severity, benefits of preventive measures, and confidence to act (self-efficacy). The attitude in this model is a reflection of this perception, so the stronger a person's perception of the dangers of hypertension and its prevention benefits, the greater the likelihood of forming a positive attitude.

Furthermore, *the Theory of Planned Behavior* (TPB) by Ajzen states that attitude is one of the main determinants of a person's intention to behave. In this context, individuals who have a positive attitude towards hypertension prevention are more likely to intend and strive to live a healthy lifestyle such as maintaining a healthy diet, exercising regularly, and regularly controlling blood pressure.

Attitudes are part of the psychological factors that play a role in the formation and change of health behaviors. According to Notoatmodjo (2014), attitude is a closed reaction or response of a person to a stimulus or object, which is not necessarily manifested in real actions. In the context of hypertension, positive attitudes include the perception of the importance of maintaining a healthy diet, regular physical activity, adherence to medication, and avoiding risk factors such as smoking and excessive salt consumption. However, positive attitudes are not always directly proportional to behavior, as their implementation is also influenced by various external factors, such as access to health facilities, social support, and stress levels.

The analysis of the attitude questionnaire items showed a more detailed picture of respondents' perception and understanding of hypertension. The most positively approved statement is "I know that sport is good. But because I'm busy I rarely exercise", with 152 respondents (42.0%) stating "Strongly Agree". This shows that most respondents have a positive understanding of the benefits of exercise, but are constrained in its implementation due to busy schedules or other priorities. This phenomenon supports the theory of Theory of Planned Behavior (Ajzen, 1991), which explains that even if a person has a positive attitude towards a behavior, it does not automatically lead to action, if the intention or external supporting factors are not met.

In contrast, the least approved statement was "I would rather take weight loss medication than exercise", with only 38 respondents (10.5%) answering "Strongly Agree". These findings indicate that most respondents prefer a natural approach and a healthy lifestyle to a risky instant solution. This attitude should be appreciated, because it shows the awareness of the importance of rational and sustainable health management.

However, attitude errors are also still found in this study. A total of 140 respondents (38.7%) stated "Strongly Agree" with the statement that "Hypertensive people can smoke if their complaints have disappeared". This is an indication of serious misconceptions among respondents regarding the dangers of smoking, even when the symptoms of hypertension do not appear noticeably. This permissive attitude can be a major obstacle in blood pressure control and complication prevention, especially if it is not corrected immediately through proper education.

Based on *the Health Belief Model* (HBM) theory, attitudes are formed from individual perceptions of *susceptibility*, perceived *severity*, perceived *benefits*, and

perceived *barriers*. In this study, although perceptions of the benefits of exercise and healthy diets have been formed, there are still perceptions of barriers such as time constraints and misinformation about smoking, which hinder the consistent implementation of healthy behaviors.

Thus, it can be concluded that attitude has a significant relationship with the incidence of hypertension. A positive attitude towards the prevention of hypertension complications is an important foundation in health decision-making, but it needs to be accompanied by strengthening strategies through education, health promotion, and community empowerment. Interventions that are participatory, community-based, and take into account social and cultural backgrounds will be more effective in shaping the right attitudes and encouraging sustainable behavior change.

Efforts to Prevent Hypertension Complications

Based on the results of the study, there are several factors that have a significant relationship with the incidence of hypertension, namely smoking, stress, diet, knowledge, complication prevention behavior, and attitude. These findings suggest that the prevention of hypertension complications should be directed at the control of risk factors that are statistically proven to contribute to the high incidence of hypertension.

Smoking factors show a significant association with the incidence of hypertension. These results are in line with research by Mullo et al. (2022) and Dilla et al. (2024), which states that smoking increases the risk of hypertension, especially in the productive age group. Physiologically, the nicotine content in cigarettes can stimulate the sympathetic nervous system and cause vasoconstriction, increased heart rate, and blood pressure.

Stress was also found to be significantly related to the incidence of hypertension. These findings are supported by Delavera et al. (2021) and Hidayati et al. (2022) who show that stress increases the risk of hypertension through the activation of the sympathetic nervous system and the release of hormones such as cortisol and adrenaline. Chronic stress, if left unchecked, can lead to a persistent increase in blood pressure.

Furthermore, diet has been shown to have a meaningful relationship with hypertension. Respondents with poor diets had a higher prevalence of hypertension. This is in accordance with research by Mardianto et al. (2023) and Diana & Hastono (2023) which affirms the importance of reducing salt and saturated fat as well as increasing fiber consumption in the prevention of hypertension.

Knowledge, attitudes, and preventive behaviors also have a significant effect. Good knowledge can encourage individuals to adopt a healthy lifestyle. This is in line with the *Health Belief Model* theory (Notoatmodjo, 2012), which states that understanding the risks and benefits of prevention influences health measures. Positive attitudes and good preventive behaviors, such as adherence to treatment, regular exercise, and blood pressure checks, have been shown to play a role in lowering the risk of hypertension complications.

Based on the results of this study, health efforts that can be made to prevent hypertension complications include promotive and preventive interventions that focus on significant risk factors. These efforts include: ongoing health education about the dangers of smoking and the importance of quitting smoking, stress management training such as psychological counseling and relaxation techniques, and balanced nutrition campaigns to improve people's diets. In addition, increasing health literacy through counseling, print and digital media is also important to increase public knowledge related to hypertension. Health facilities need to encourage changes in people's attitudes and behaviors towards prevention efforts, such as increasing adherence to medication consumption, facilitating regular blood pressure checks, and providing nutrition and lifestyle counseling services. This health effort is expected to reduce the prevalence of hypertension and prevent further complications, such as stroke, heart disease, or kidney failure.

The findings in this study provide a solid basis for designing strategies for preventing hypertension complications based on education, behavior change, and strengthening primary services in the community.

Conclusion

Based on the results of research on the relationship between hypertension and various risk factors as an effort to prevent complications, the following can be concluded:

1. There was no significant association between sex and the incidence of hypertension (p value = 0.671; $p > 0.05$).

2. There was no significant association between age and the incidence of hypertension (p value = 0.628; p > 0.05).
3. There was no significant association between family history of hypertension and the incidence of hypertension (p value = 0.061; p > 0.05).
4. There was no significant association between coffee consumption and the incidence of hypertension (p value = 0.230; p > 0.05).
5. There was no significant association between physical activity levels and hypertension incidence (p = 0.576; p > 0.05).
6. There was a significant association between smoking habits and the incidence of hypertension (p value = 0.000; p < 0.05).
7. There was a significant relationship between stress levels and the incidence of hypertension (p value = 0.000; p < 0.05).
8. There was a significant association between diet and the incidence of hypertension (p value = 0.010; p < 0.05).
9. There was a significant relationship between knowledge level and hypertension incidence (p value = 0.000; p < 0.05).
10. There was a significant association between the prevention behavior of hypertension complications and the incidence of hypertension (p value = 0.006; p < 0.05).
11. There was a significant relationship between respondents' attitudes and the incidence of hypertension (p value = 0.000; p < 0.05).
12. Based on multivariate analysis, the variable that has the most significant effect on the incidence of hypertension is knowledge (p = 0.003), which means that increasing public knowledge can be the main key in reducing the incidence of hypertension.
13. Efforts to prevent hypertension complications as a whole should be focused on behavioral interventions and health education, especially those related to increasing knowledge, stress control, smoking cessation, regulating healthy diets, and forming good preventive attitudes and behaviors. A holistic approach through health promotion and strengthening of primary services is indispensable to reduce the risk and prevent long-term complications due to hypertension.

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