

# Effectiveness of Selected Medicinal Plants in Reducing Blood Pressure in Pregnant Women with Hypertension in Banten Province (2024)

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**Abstract:** Hypertension in pregnancy is a major cause of maternal and fetal morbidity and mortality. This study aims to analyze the effectiveness of *Amaranthus Caudatus*, *Cocos Nucifera* L, *Punica Granatum* L, *Sechium Edule*, *Solanum Lycopersicum*, *Brassica Oleracea* L, *Moringa Oleifera*, *Apium Graveolens* L, *Persea Americana*, and *Cucumis Melo* L in reducing blood pressure in prehypertensive pregnant women in Banten Province. A quasi-experimental design with a pretest and posttest nonequivalent control group approach and total sampling technique was used. The results showed a significant reduction in blood pressure ( $p < 0.05$ ), with *Punica Granatum* L and *Sechium Edule* demonstrating a significant difference in effectiveness ( $p = 0.000$ ). This study confirms that non-pharmacological management can be an alternative for lowering blood pressure in prehypertensive pregnant women.

**Keywords:** *Amaranthus caudatus*; Blood pressure; Non-pharmacological therapy; Pregnancy hypertension; *Punica Granatum* L.

## Introduction

Maintaining and caring for maternal health from pregnancy, childbirth and postpartum is a priority in obstetric services. Maintaining maternal health can be done by preventing morbidity during pregnancy, childbirth and postpartum. According to the World Health Organization (WHO) (2019), pregnancy is an event that occurs in a woman, starting from the fertilization process (conception) to the birth of a baby, lasting 280 days (40 weeks or 9 months). One of the pregnancy complications that has received world attention is Hypertension in Pregnancy (HDK).

Hypertension is a condition when blood pressure is  $\geq 140/90$  mmHg, hypertension is one of the non-communicable diseases that is very dangerous because there are no typical symptoms as a warning, also called a *silent killer*. Hypertension will be very dangerous if it

occurs in pregnant women, this group is included in the vulnerable group because the immune system is working harder, supporting two people: the mother and the developing fetus. This also makes pregnant women more susceptible to certain viruses and bacteria (Sari et al., 2022). Hypertension that occurs during pregnancy is called hypertension in pregnancy (HDK) is hypertension in pregnant women after 20 weeks of gestation without protein in the urine or other signs of preeclampsia. Hypertension in pregnancy is divided into prehypertension, gestational hypertension, chronic, preeclampsia/eclampsia (Sulistiawati et al., 2024).

Hypertension in pregnancy is a global problem that has hit the world and is one of the 3 main causes of maternal death after bleeding and infection (Makmur et al., 2020). Hypertension in pregnancy affects around 10 of all pregnant women worldwide. Hypertension is the third largest risk factor for premature death, heart failure and

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brain disorders. Hypertension in pregnancy is an important cause of severe acute morbidity, long-term disability and maternal and infant mortality. Nearly one-tenth of all maternal deaths in Asia and Africa are related to hypertension in pregnancy, while a quarter of all maternal deaths in Latin America are due to complications (Ministry of Health, 2023).

According to the World Health Organization (WHO) in 2021, hypertension in pregnancy contributed to 14% of maternal deaths. The prevalence of hypertension in pregnancy increased in African countries by 46%, in the United States the incidence of hypertension in pregnancy reached 6-10%, where there were 4 million pregnant women and an estimated 240,000 accompanied by hypertension in pregnancy each year. In 2022, the incidence of hypertension in pregnancy worldwide ranged from 0.51% -38.4%, in Asia the incidence of hypertension in pregnancy was 5-15% which was the cause of one tenth of maternal deaths (WHO, 2023).

Based on data on the number of maternal deaths in Indonesia in 2022, hypertension in pregnancy ranks second as the highest cause of maternal death after bleeding. Cases of death due to hypertension in pregnancy have decreased in number, namely in 2020 there were 1,627 deaths, in 2021 there were 1,077 deaths, and in 2023 there were 412 cases. However, in 2022 hypertension is still the main cause of maternal death after obstetric hemorrhage as many as 360 cases and other obstetric complications as many as 204 cases. The data obtained shows that the incidence of hypertension in pregnancy contributed to the morbidity rate in 2021 as many as 3,821 cases, increasing in 2022 to 4,005 cases and in 2023 to 4,129 cases (Ministry of Health, 2023).

Based on data from the Banten Provincial Health Office, the number of maternal deaths due to hypertension in pregnancy in 2020 was 22.7%, in 2021 it increased to 22.8% and decreased to 14.6% in 2022. Meanwhile, the number of morbidity cases of hypertension in pregnancy handled in health facilities in 2020 was 3,815 cases, in 2021 there were 4,210 cases and in 2022 there were 4,231 cases (Banten Health Office, 2022). Based on data from the World, Asia, Indonesia and Banten Province, hypertension in pregnancy is the main cause of maternal death and is one of the causes of the greatest morbidity in pregnant women, this shows how important the attention we must give to pregnant women is.

Hypertension in pregnancy is caused by several factors such as stress, high salt diet, lack of physical activity, and history of high blood pressure before pregnancy. Conditions that occur in pregnant women with HDK/Pre-eclampsia include vasospasm, activation

of endothelial cells and angiotensin and antiangionic proteins. The inflammatory process that occurs systemically triggers vasospasm. Blood vessel constriction causes increased resistance so that blood pressure increases which causes hypertension in pregnancy (Farida, 2022).

The impact of hypertension in pregnancy according to Alatas (2022) is divided into short-term and long-term impacts, short-term impacts on the mother are eclampsia, hemorrhagic, ischemic stroke, liver damage, HELLP syndrome (Haemolysis Elevated Liver Enzymes Low Platelet Count), liver failure, kidney dysfunction, cesarean delivery, premature delivery, and abruptio placenta; and short-term impacts that occur on the fetus are preterm birth, labor induction, fetal growth disorders, respiratory syndrome, fetal death. Long-term impacts on mothers who experience hypertension during pregnancy, have a risk of experiencing hypertension again in subsequent pregnancies, can also cause cardiovascular complications, kidney disease and cancer. Hypertension in pregnancy can develop into preeclampsia, eclampsia and HELLP syndrome. Then it can manifest with cerebral ischemic or hemorrhagic events in pre, peri, and postpartum to become stroke. Long-term impacts on the fetus are vascular, cognitive, and psychiatric disorders in infants (Ministry of Health, 2021).

The proportion of hypertension in pregnancy in Indonesia is increasing, almost 30% of maternal deaths in Indonesia are caused by hypertension, therefore preventing hypertension in pregnancy is very important, it can be done since pre-hypertension symptoms are detected. Prehypertension is systolic blood pressure > 120-139 mmHg and diastolic blood pressure 80-90 mmHg (Solehati et al., 2023). This blood pressure control can be done with pharmacological and non-pharmacological treatment (complementary therapy). Pharmacological treatment is the use of drugs and their methods of administration in the treatment of diseases (Yanti et al., 2022). Pharmacological hypertension therapy such as amlodhipine and others have an effect experienced by patients because of the involvement of the choice of treatment therapy used by patients and can actually have an effect on the patient's condition such as side effects of drugs, or allergies that arise due to the drugs consumed (Salangka et al., 2024).

Non-pharmacological treatment is complementary therapy or therapy that does not involve drugs. Compared to pharmacological therapy, non-pharmacological therapy is more widely chosen to treat hypertension because this therapy does not have side effects on health (Farida, 2022). Non-pharmacological therapy such as consuming healthy

foods containing potassium and calcium. Therapies included in non-pharmacological therapy are consumption of *Amaranthus Caudatus* (spinach), *Cocos Nucifera L* (Young Coconut Water), *Punica Granatum L* (Pomegranate), *Sechium Edule* (Chayote), *Solanum Lycopersicum* (Tomato), *Brassica Oleracea L* (Broccoli), *Moringa Oleifera* (Moringa Leaves), *Apium Graveolens L* (Celery Leaves), *Persea Americana* (Avocado) and *Cucumis Melo L* (Melon), warm water therapy and deep breathing relaxation, consumption of yogurt 2-3 times a day, administration of rosella petal extract and cognitive behavioral therapy (Safitri et al., 2024). The results of this study are expected to provide informative benefits for health workers and pregnant women in choosing effective methods to lower blood pressure in prehypertensive and hypertensive pregnant women.

## Method

This study focuses on analyzing various nutritional and therapeutic interventions to lower blood pressure in prehypertensive pregnant women. The interventions analyzed include the administration of *Amaranthus Caudatus* and *Cocos Nucifera L*, *Punica Granatum L* and *Sechium Edule*, *Solanum Lycopersicum* and *Brassica Oleracea L*, *Moringa Oleifera* and *Apium Graveolens L*, *Persea Americana* and *Cucumis Melo*. This study is a quantitative study with *Quasi Experimental Design* (Pseudo Experimental Design) using the *Pretest and Posttest Nonequivalent Control Group design*, the research procedure is divided into two groups, namely the provision of different interventions by measuring blood pressure in prehypertensive pregnant women before and after being given intervention. The study was conducted in several locations in Banten Province.

The population in this study were all pregnant women who experienced pre-hypertension (systolic blood pressure > 120-139 mmHg and diastolic > 80-90 mmHg). The sampling technique used total sampling. The research instruments were observation sheets, digital tensiometer (with Omron brand), *Amaranthus Caudatus*, *Cocos Nucifera L*, *Punica Granatum L*, *Sechium Edule*, *Solanum Lycopersicum*, *Brassica Oleracea L*, *Moringa Oleifera*, *Apium Graveolens L*, *Persea Americana* and *Cucumis Melo L*. Data collection techniques were primary and secondary.

## Data Analysis

Data analysis was done univariately and bivariately using Wilcoxon and Mann Whitney test analysis.

## Result and Discussion

### Univariate Analysis

Univariate data analysis of the average decrease in blood pressure in prehypertensive pregnant women with the administration of *Amaranthus Caudatus*, *Cocos Nucifera L*, *Punica Granatum L*, *Sechium Edule*, *Solanum Lycopersicum*, *Brassica Oleracea L*, *Moringa Oleifera*, *Apium Graveolens L*, *Persea Americana* and *Cucumis Melo* after the intervention showed a decrease in blood pressure, with an average after being given *Amaranthus Caudatus*, namely systolic blood pressure from 127.76 mmHg to 118.52 mmHg and diastolic blood pressure before the intervention of 85.88 mmHg to 78.80 mmHg. In the *Cocos Nucifera* intervention, an average decrease in blood pressure was obtained after the intervention was given namely systolic blood pressure from 128.24 mmHg to 120.40 mmHg and diastolic blood pressure from 85.88 mmHg to 78.80 mmHg.

In the *Punica Granatum L* intervention, the average decrease in systolic blood pressure before the intervention was 132.27 mmHg and after the intervention was 122.83 mmHg, in diastolic blood pressure before the intervention was 87.72 mmHg and after the intervention was 79.77 mmHg, in the *Sechium Edule* decoction intervention, systolic blood pressure before the intervention was 132.277 mmHg and after the intervention became 122.833 mmHg, diastolic blood pressure before the intervention was 87.72 mmHg and after the intervention was 79.77 mmHg. In the administration of *Solanum Lycopersicum*, blood pressure before the intervention was systolic 113.62 mmHg and diastolic 74.71 mmHg, after the intervention, systolic blood pressure became 113.62 mmHg and diastolic 83.14 mmHg. In the administration of *Brassica Oleracea L*, blood pressure before the intervention was systolic 133.86 mmHg and diastolic 85.52 mmHg, blood pressure after the intervention was systolic 112.71 mmHg, diastolic became 75.76 mmHg.

In the administration of *Persea Americana*, systolic blood pressure before the intervention was 133.53 mmHg to 112.00 mmHg and diastolic before intervention 85.21 mmHg to 76.21 mmHg and in *Cucumis Melo L* intervention systolic blood pressure before intervention 133.31 mmHg to 113.15 mmHg and diastolic from 83.21 mmHg to 74.68 mmHg. In *Moringa Oleifera* decoction therapy intervention systolic blood pressure before intervention 131.25 mmHg and after intervention became 116.85 mmHg, diastolic blood pressure before intervention 86.55 mmHg and after intervention 77.15 mmHg. And in *Apium Graveolens L* decoction intervention systolic blood pressure before intervention 130.65 mmHg and after intervention became 120.80 mmHg, diastolic blood pressure with an

average decrease in blood pressure before intervention blood pressure 87.05 mmHg and after intervention 76.00 mmHg.

Administration of *Amaranthus Caudatus* and *Cocos Nucifera L*, *Punica Granatum L* and *Sechium Edule*, *Solanum Lycopersicum* and *Brassica Oleracea L*, *Moringa Oleifera* and *Apium Graveolens L*, *Persea Americana* and *Cucumis Melo L* showed that on average there was a decrease in blood pressure in prehypertensive pregnant women.

#### Bivariate Analysis

The results of bivariate data on the effect of lowering blood pressure in prehypertensive pregnant women by administering *Amaranthus Caudatus*, *Cocos Nucifera L*, *Punica Granatum L*, *Sechium Edule*, *Solanum Lycopersicum*, *Brassica Oleracea L*, *Moringa Oleifera*, *Apium Graveolens L*, *Persea Americana*, *Cucumis Melo L* after being given an intervention for 14 days, the majority experienced a decrease in blood pressure with a significant value of  $p=0.000$ . However, when administering *Amaranthus Caudatus*, it was obtained from 25 respondents, as many as 24 respondents (96%) experienced a decrease in blood pressure and 1 respondent (4%) with blood pressure that remained the same in systolic blood pressure and when administering *Cocos Nucifera* from 25 respondents, as many as 24 respondents (96%) experienced a decrease in blood pressure and 1 respondent (4%) with systolic blood pressure that did not change. However, when giving *Punica Granatum L*, *Sechium Edule*, *Solanum Lycopersicum*, *Brassica Oleracea L*, *Moringa Oleifera*, *Apium Graveolens L*, *Persea Americana* and *Cucumis Melo L*, all 100% experienced a decrease in blood pressure, both systolic and diastolic.

It is known that the administration of *Amaranthus Caudatus*, *Cocos Nucifera L*, *Punica Granatum L*, *Sechium Edule*, *Solanum Lycopersicum*, *Brassica Oleracea L*, *Moringa Oleifera*, *Apium Graveolens L*, *Persea Americana* and *Cucumis Melo L* can lower blood pressure after intervention for 14 days. In the *Amaranthus Caudatus* intervention, it was known that out of 25 respondents, 24 respondents (96%) experienced a decrease in systolic blood pressure and 1 respondent (4%) with the same blood pressure, while the decrease in diastolic blood pressure all experienced a decrease in blood pressure, namely 25 respondents (100%), the results of the *Wilcoxon test* obtained a  $p$ -value = 0.000 < 0.05,  $H_0$  was rejected, meaning that there was an effect of *Amaranthus Caudatus* on reducing systolic and diastolic blood pressure in prehypertensive pregnant women before and after intervention. In the *Cocos Nucifera* intervention, 24 respondents (96%) experienced a decrease in blood pressure and 1 respondent (4%) did

not experience a change in systolic blood pressure, while diastolic blood pressure from 25 respondents all (100%) experienced a decrease in blood pressure. In the *Wilcoxon test*, a  $p$  value of 0.000 < 0.05 was obtained,  $H_0$  was rejected, meaning that there was an effect of *Cocos Nucifera* on reducing systolic and diastolic blood pressure in prehypertensive pregnant women.

The results of the statistical analysis of changes in systolic and diastolic blood pressure before and after being given *Punica Granatum L* all experienced a decrease in systolic and diastolic blood pressure, in the *Wilcoxon test*, a  $p$ -value of 0.000 < 0.05 was obtained,  $H_0$  was rejected, meaning that there was an effect of giving *Punica Granatum L* on reducing systolic and diastolic blood pressure in prehypertensive pregnant women. The results of the statistical test analysis of changes in systolic and diastolic blood pressure before and after being given *Sechium Edule decoction therapy*, all experienced a decrease in systolic and diastolic blood pressure, in the *Wilcoxon test*, the  $p$ -value of systolic and diastolic = 0.000 < 0.05,  $H_0$  was rejected, meaning that there was an effect of giving *Sechium Edule decoction* on reducing systolic and diastolic blood pressure in prehypertensive pregnant women.

The results of the statistical analysis of changes in systolic and diastolic blood pressure before and after being given *Solanum Lycopersicum juice therapy*, all experienced a decrease in systolic and diastolic blood pressure, the results of the *Wilcoxon test* obtained a  $p$ -value of systolic and diastolic = 0.000 < 0.05,  $H_0$  was rejected, meaning that there was an effect of giving *Solanum Lycopersicum* on reducing systolic and diastolic blood pressure in prehypertensive pregnant women. The results of the statistical analysis of changes in systolic and diastolic blood pressure after being given *Brassica Oleracea L decoction therapy*, all experienced a decrease in systolic and diastolic blood pressure, the results of the *Wilcoxon test* obtained a  $p$ -value of systolic and diastolic = 0.000 < 0.05,  $H_0$  was rejected, meaning that there was an effect of giving *Brassica Oleracea L decoction* on reducing systolic and diastolic blood pressure in prehypertensive pregnant women.

The results of the statistical analysis of changes in systolic and diastolic blood pressure after being given *Cucumis Melo L* from 19 respondents all (100%) experienced a decrease in blood pressure, in the *Wilcoxon test*, a  $p$ -value of 0.000 < 0.05 was obtained,  $H_0$  was rejected, meaning that there was an effect of *Cucumis Melo L* on decreasing systolic and diastolic blood pressure in prehypertensive pregnant women. In the *Persea Americana intervention*, the results of the statistical analysis of changes in blood pressure from 19 respondents were obtained, all (100%) experienced a decrease in systolic and diastolic blood pressure, in the

Wilcoxon test, a p-value of 0.000 <0.05 was obtained, Ho was rejected, meaning that there was an effect of *Persea Americana* on decreasing systolic blood pressure in prehypertensive pregnant women before and after being given the intervention.

The results of the statistical test after being given *Moringa Oleifera* boiled water, all experienced a decrease in systolic and diastolic blood pressure. In the Wilcoxon test, the systolic and diastolic p-values were obtained = 0.000 <0.05, Ho was rejected, meaning that there was an effect of giving *Moringa Oleifera* on reducing systolic and diastolic blood pressure in prehypertensive pregnant women. The results of the statistical test analysis of changes in systolic and diastolic blood pressure before and after being given *Apium Graveolens L* boiled therapy, all experienced a decrease in systolic and diastolic blood pressure, in the Wilcoxon test, the systolic and diastolic p-values were obtained = 0.000 <0.05, Ho was rejected, meaning that there was an effect of giving *Apium Graveolens L* boiled water on reducing systolic and diastolic blood pressure in prehypertensive pregnant women.

Based on the research results, it was found that systolic and diastolic blood pressure before and after intervention for 14 days in the *Amaranthus Caudatus* group and the *Cocos Nucifera L* group with the Mann Whitney statistical test obtained a significant systolic value of p value= 0.289>0.05 and diastolic p value = 0.251>0.05, then Ho is rejected, meaning there is no

difference in the effectiveness of administering *Amaranthus Caudatus* and *Cocos Nucifera L* on reducing systolic and diastolic blood pressure in prehypertensive pregnant women. In the intervention of administering *Punica Granatum L* and *Sechium Edule*, it was found that Mann Whitney statistical test results with a systolic significance value of p value= 0.001<0.05 and diastolic p value = 0.000 <0.05, then Ho is accepted, meaning that there is a difference in the effectiveness of administering *Punica Granatum L* and *Sechium Edule* on reducing systolic and diastolic blood pressure in pregnant women, administering *Punica Granatum L* is more effective than administering *Sechium Edule*. In the intervention of administering *Solanum Lycopersicum* and *Brassica Oleracea L*, the results of the Mann Whitney statistical test were obtained with a systolic significance value of p value= 0.647>0.05 and diastolic p value= 0.339>0.05 then Ho is rejected, meaning there is no difference in the effectiveness of *Solanum Lycopersicum* and *Brassica Oleracea L* administration on reducing systolic and diastolic blood pressure in prehypertensive pregnant women. In the administration of *Persea Americana* and *Cucumis Melo L*, the results of the Mann Whitney statistical test showed a systolic significance value of p value=0.708>0.05 and a diastolic significance value of p value=0.212>0.05, then Ho is rejected, meaning there is no difference in the effectiveness of *Persea Americana* and *Cucumis Melo L*

**Table 1.** Analysis of Changes in Systolic and Diastolic Blood Pressure in Pregnant Women Before and After Intervention

Variables	Blood pressure	Mean	Median	Mode	SD	Min-Max
<i>Amaranthus caudatus</i>	Systolic before being given <i>Amaranthus caudatus</i>	127.76	128.00	122.00 <sup>a</sup>	4.90985	121-139
	Systolic after being given <i>Amaranthus caudatus</i>	118.52	120.00	110.00 <sup>a</sup>	6.55184	108-130
	Diastolic before giving <i>Amaranthus caudatus</i>	85.60	84.00	83.00 <sup>a</sup>	3.02765	80-90
	Diastolic after being given <i>Amaranthus caudatus</i>	78.12	79.00	80.00	3.03205	72-84
<i>Cocos Nucifera</i>	Systolic before being given <i>Cocos Nucifera</i>	128.24	128.00	128.00 <sup>a</sup>	4.63932	121-137
	Systolic after being given <i>Cocos Nucifera</i>	120.40	121.00	120.00	5.93717	106-130
	Diastolic before being given <i>Cocos Nucifera</i>	85.88	86.00	84.00	3.19270	81-96
<i>Punica Granatum L (pomegranate)</i>	Diastolic after being given <i>Cocos Nucifera</i>	78.80	80.00	81.00	3.74166	70-85
	Systolic before being given <i>Punica Granatum L (pomegranate)</i>	130.11	130.00	135.00	4.70155	120-130
	Systolic after being given <i>Punica Granatum L (pomegranate)</i>	114.44	115.00	110.00	7.49292	100-130
	Diastolic before being given <i>Punica Granatum L (pomegranate)</i>	88.33	89.50	90.00	1.94029	85-95
<i>Sechium Edule (chayote)</i>	Diastolic after being given <i>Punica Granatum L (pomegranate)</i>	72.72	73.50	70.00	2.63027	70-76
	Systolic before being given <i>Sechium Edule (chayote) decoction</i>	132.277	131.50	130.00	2.37154	130-135
	Systolic after being given boiled <i>Sechium Edule (chayote)</i>	122.833	124.50	120.00	4.65580	110-130
	Diastolic before being given <i>Sechium Edule (chayote) decoction</i>	87.72	89.50	90.00	2.67462	83-90
<i>Solanum lycopersicum</i>	Diastolic after being given boiled <i>Sechium Edule (chayote)</i>	79.77	80.00	80.00	4.35965	70-85
	Systolic before being given <i>Solanum Lycopersicum</i>	132.95	133.00	134.00	3.08992	129-139
	Systolic after being given <i>Solanum Lycopersicum</i>	113.62	112.00	110.00	6.28869	102-124
	Diastolic before being given <i>Solanum Lycopersicum</i>	83.14	82.00	82.00	4.01604	78-89
<i>Brassica Oleracea L</i>	Diastolic after being given <i>Solanum Lycopersicum</i>	74.71	75.00	70.00	4.22070	70-83
	Systolic before being given a decoction of <i>Brassica Oleracea L</i> .	133.86	134.00	132.00	3.08684	129-139
	Systolic after being given a decoction of <i>Brassica Oleracea L</i> .	112.71	112.00	112.00	5.54205	102-125
	Diastolic before being given <i>Brassica Oleracea L</i> decoction	85.52	87.00	89.00	3.34094	80-89
	Diastolic after being given a decoction of <i>Brassica Oleracea L</i> .	75.76	75.00	70.00	4.32325	70-82

Variables	Blood pressure	Mean	Median	Mode	SD	Min-Max
<i>Persea Americana</i>	Systolic before being given <i>Persea Americana</i>	133.53	133.00	132.00 <sup>a</sup>	3.04354	129-139
	Systolic after being given <i>Persea Americana</i>	112.00	112.00	112.00 <sup>a</sup>	5.56986	102-125
	Diastolic before being given <i>Persea Americana</i>	85.21	82.00	89.00 <sup>a</sup>	3.35955	80-89
	Diastolic after being given <i>Persea Americana</i>	76.21	78.00	80.00	4.27628	70-82
<i>Cucumis melo L.</i>	Systolic before being given <i>Cucumis Melo L</i>	133.31	133.00	134.00	3.01943	129-139
	Systolic after being given <i>Cucumis Melo L</i>	113.15	112.00	112.00	6.13064	102-132
	Diastolic before being given <i>Cucumis Melo L</i>	83.21	82.00	82.00	4.14433	78-89
	Diastolic after being given <i>Cucumis Melo L</i>	74.68	75.00	70.00	4.12381	70-89
<i>Moringa Oleifera</i>	Systolic before being given <i>Moringa Oleifera</i>	131.25	132.00	130.00	3.46220	123-36
	Systolic after being given <i>Moringa Oleifera</i>	116.85	118.50	118.00	7.24950	100-130
	Diastolic before being given <i>Moringa Oleifera</i>	86.55	87.00	90.00	2.87411	81-90
	Diastolic after being given <i>Moringa Oleifera</i>	77.15	77.00	75.00	3.51351	70-84
<i>Apium Graveolens L</i>	Systolic before being given <i>Apium Graveolens L decoction</i>	130.65	130.50	130.00	3.70313	123-139
	Systolic after being given <i>Apium Graveolens L decoction</i>	120.80	110.50	121.50	6.82565	100-130
	Diastolic before being given <i>Apium Graveolens L decoction</i>	87.05	88.00	88.00	3.17017	80-90
	Diastolic after being given <i>Apium Graveolens L decoction</i>	76.00	75.00	75.00	5.06796	70-87

**Table 2.** Analysis of Changes in Systolic and Diastolic Blood Pressure in Pregnant Women after Intervention

Variables	Blood pressure	Decrease	Increase	Same	p-value
<i>Amaranthus caudatus</i>	Systolic after being given <i>Amaranthus caudatus</i>	24 (96%)	0 (0%)	1 (4%)	0.000
	Diastolic after being given <i>Amaranthus caudatus</i>	25 (100%)	0 (0%)	0 (0%)	0.000
<i>Cocos Nucifera</i>	Systolic after being given <i>Cocos Nucifera</i>	24 (96%)	0 (0%)	1 (4%)	0.000
	Diastolic after being given <i>Cocos Nucifera</i>	25 (100%)	0 (0%)	0 (0%)	0.000
<i>Punica Granatum L</i> (pomegranate)	Systolic after being given <i>Punica Granatum L</i> (pomegranate)	18 (100%)	0 (0%)	0 (0%)	0.000
	Diastolic after being given <i>Punica Granatum L</i> (pomegranate)	18 (100%)	0 (0%)	0 (0%)	0.000
<i>Sechium edule</i> (chayote)	Systolic after being given <i>Sechium edule</i> (chayote)	18 (100%)	0 (0%)	0 (0%)	0.000
	Diastolic after being given <i>Sechium edule</i> (chayote)	18 (100%)	0 (0%)	0 (0%)	0.000
<i>Solanum lycopersicum</i>	Systolic after being given <i>Solanum Lycopersicum</i>	21 (100%)	0 (0%)	0 (0%)	0.000
	Diastolic after being given <i>Solanum Lycopersicum</i>	21 (100%)	0 (0%)	0 (0%)	0.000
<i>Brassica Oleracea L</i>	Systolic after being given <i>Brassica Oleracea L.</i>	21 (100%)	0 (0%)	0 (0%)	0.000
	Diastolic after being given <i>Brassica Oleracea L.</i>	21 (100%)	0 (0%)	0 (0%)	0.000
<i>Persea Americana</i>	Systolic after being given <i>Persea Americana</i>	19 (100%)	0 (0%)	0 (0%)	0.000
	Diastolic after being given <i>Persea Americana</i>	19 (100%)	0 (0%)	0 (0%)	0.000
<i>Cucumis melo L.</i>	Systolic after being given <i>Cucumis Melo L</i>	19 (100%)	0 (0%)	0 (0%)	0.000
	Diastolic after being given <i>Cucumis Melo L</i>	19 (100%)	0 (0%)	0 (0%)	0.000
<i>Moringa Oleifera</i>	Systolic after being given <i>Moringa Oleifera</i>	20 (100%)	0 (0%)	0 (0%)	0.000
	Diastolic after being given <i>Moringa Oleifera</i>	20 (100%)	0 (0%)	0 (0%)	0.000
<i>Apium Graveolens L</i>	Systolic after administration of <i>Apium Graveolens L</i>	20 (100%)	0 (0%)	0 (0%)	0.000
	Diastolic after administration of <i>Apium Graveolens L</i>	20 (100%)	0 (0%)	0 (0%)	0.000

**Table 3.** Differences in the Effectiveness of Giving *Amaranthus Caudatus* and *Cocos Nucifera L*, *Punica Granatum L* and *Sechium Edule*, *Solanum Lycopersicum* and *Brassica Oleracea L*, *Moringa Oleifera* and *Apium Graveolens L*, *Persea Americana* and *Cucumis Melo* on Reducing Systolic and Diastolic Blood Pressure in Prehypertensive Pregnant Women

Variables	Mean Rank	Sum of rank	P Value
Systolic blood pressure <i>Amaranthus caudatus</i>	23.32	583.00	0.289
Systolic blood pressure <i>Cocos Nucifera</i>	27.68	692.00	
Diastolic blood pressure <i>Amaranthus Caudatus</i>	23.16	579.00	0.251
Diastolic blood pressure <i>Cocos Nucifera</i>	27.84	696.00	
Systolic blood pressure <i>Punica Granatum L</i> (pomegranate)	12.53	225.50	0.001
Systolic blood pressure <i>Sechium edule</i> (chayote)	24.47	440.50	
Diastolic blood pressure <i>Punica Granatum L</i> (pomegranate)	11.42	205.50	0,000
Diastolic blood pressure <i>Sechium edule</i> (chayote)	25.58	460.50	
Systolic blood pressure <i>Solanum Lycopersicum</i>	22.36	469.50	0.647
<i>Brassica Oleracea L</i> systolic blood pressure	20.64	433.50	
<i>Solanum Lycopersicum</i> diastolic blood pressure	19.71	414.00	0.339
Diastolic blood pressure <i>Brassica Oleracea L.</i>	23.29	489.00	
Systolic blood pressure <i>Persea Americana</i>	18.82	357.50	0.708

Systolic blood pressure <i>Cucumis Melo L</i>	20.18	383.50	
Diastolic blood pressure <i>Persea Americana</i>	21.76	413.50	0.212
Diastolic blood pressure <i>Cucumis Melo L</i>	17.24	327.50	
Systolic blood pressure of <i>Moringa Oleifera</i>	16.32	326.50	
Systolic blood pressure of <i>Apium Graveolens L</i>	24.68	493.50	0.023
<i>Moringa Oleifera</i> diastolic blood pressure	22.55	451.00	
Diastolic blood pressure of <i>Apium Graveolens L</i>	18.45	369.00	0.277

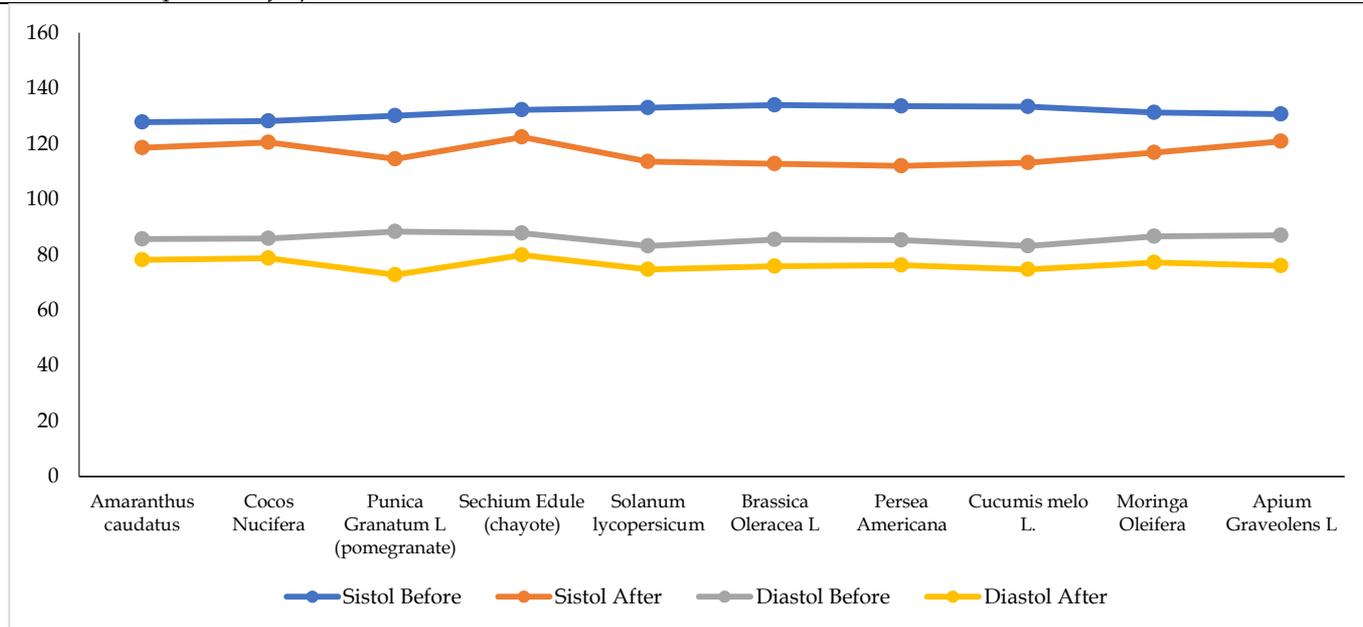


Figure 1. Before and after intervention

Administration on reducing systolic and diastolic blood pressure in prehypertensive pregnant women. In the intervention of administering *Moringa Oleifera* and *Apium Graveolens L*, the results of the Mann Whitney statistical test showed a systolic significance value of  $p\text{ value}=0.708>0.05$  and a diastolic significance value of  $p\text{ value}=0.212>0.05$ . value =  $0.023 <0.05$  then  $H_0$  is accepted, meaning there is a difference in the effectiveness of giving *Moringa Oleifera* and *Apium Graveolens L* to reduce systolic blood pressure in prehypertensive pregnant women, giving *Moringa Oleifera* is more effective in reducing systolic blood pressure compared to giving *Apium Graveolens L*, while for diastolic blood pressure with a diastolic significance value of  $p\text{ value} = 0.277>0.05$ , then  $H_0$  is rejected, meaning that there is no difference in the effectiveness of administering *Moringa Oleifera* and *Apium Graveolens L* in reducing diastolic blood pressure in prehypertensive pregnant women, so it is concluded that *Moringa Oleifera* is more effective in reducing systolic blood pressure than administering *Apium Graveolens L*, but both are equally effective in reducing diastolic blood pressure.

*Punica Granatum L* (pomegranate) showed the highest effectiveness, with a reduction in systolic blood pressure from 130.11 mmHg to 114.44 mmHg and diastolic blood pressure from 88.33 mmHg to 72.72

mmHg. *Moringa Oleifera* was also highly effective, reducing systolic blood pressure from 131.25 mmHg to 116.85 mmHg and diastolic blood pressure from 86.55 mmHg to 77.15 mmHg. *Persea Americana* and *Cucumis Melo L* exhibited similar effects, showing significant reductions in blood pressure but not as pronounced as *Punica Granatum L* and *Moringa Oleifera*.

Discussion

Difference in the Effectiveness of Giving *Amaranthus Caudatus* (Spinach) and *Cocos Nucifera L* (Young Coconut Water) on Reducing Systolic and Diastolic Blood Pressure in Prehypertensive Pregnant Women

Based on the results of the study, a decrease in systolic and diastolic blood pressure was obtained before and after intervention in the *Amaranthus Caudatus* group and the *Cocos Nucifera L* group. In the Wilcoxon test, a p-value of  $0.000 <0.05$  was obtained,  $H_0$  was rejected, meaning that there was an effect of giving *Amaranthus Caudatus* and *Cocos Nucifera* on reducing systolic and diastolic blood pressure in prehypertensive pregnant women. Based on the Mann Whitney statistical test, a significant systolic p value was obtained. value=  $0.289$  and diastolic significance value  $p\text{ value} = 0.251$ , then  $H_0$  is rejected, meaning there is no difference in the effectiveness of administering *Amaranthus Caudatus* and *Cocos Nucifera*

L on reducing systolic and diastolic blood pressure in prehypertensive pregnant women.

Coconut water is rich in potassium (K), old coconut water contains 312 mg/100 ml of potassium while young coconut water (*Cocos Nucifera L*) contains 7300 mg/100 ml of potassium. The high potassium content in *Cocos Nucifera L* that enters the body can cause blood vessels to experience vasodilation, inhibit the secretion of renin and aldosterone hormones so that it can lower blood pressure. The content of folic acid which increases the synthesis of nitric oxide in endothelial cells, reduces plasma homocysteine concentrations, improves endothelial function so that blood pressure decreases. Folic acid plays a role in the production of nitric oxide in the body, which helps dilate blood vessels and increase blood flow. This can help lower blood pressure. In addition, folic acid is also important for maintaining a healthy cardiovascular system and supporting homocysteine metabolism, which if the levels are too high, can increase the risk of heart disease and hypertension (Farida, 2022).

Vitamin C contained in young coconut (*Cocos Nucifera L*) is one of the antioxidants and can lower blood pressure by about 5 mmHg, through its role in repairing arterial damage due to hypertension. Vitamin C helps maintain normal blood pressure by increasing the excretion of lead from the body, chronic exposure to lead can increase blood pressure. So, with the release of lead from within the body, blood pressure will also decrease. Vitamin C restores the elasticity of blood vessels (Simamora, 2021). In addition, young coconut water contains vitamin C, calcium, folic acid, iron, magnesium and phosphorus which can meet the needs minerals and nutrients needed by the body (Farida, 2022).

Based on existing literature, non-pharmacological therapy by consuming *Amaranthus Caudatus* (spinach) is able to relax the walls of blood vessels, thereby lowering blood pressure and protecting against muscle cramps. In addition, the risk of developing hypertension can be reduced because of the Folate content which functions to calm blood vessels, Natural Nitrate: Opens blood vessels in increasing blood flow and lightening the workload on the heart and Potassium: Blood vessels experience vasodilation (Department Livestock Food Security, 2022). So that *Amaranthus Caudatus* is one alternative in lowering blood pressure during pregnancy, namely by consuming it early in pregnancy entering the 2nd trimester, so that it can prevent and reduce the occurrence of hypertension in pregnant women (Indonesian Ministry of Health, 2020).

Based on several literatures, the content of *Amaranthus Caudatus* and *Cocos Nucifera* both lower

blood pressure. *Amaranthus Caudatus* has potassium content that can relax the walls of blood vessels, thereby lowering blood pressure and protecting against muscle cramps. Endothelial hyperpolarization occurs through vascular smooth muscle cells because it causes less cytosolic calcium, which results in vasodilation, and thus lowers blood pressure. In addition, the risk of developing hypertension can be reduced because of the folate content which functions to calm blood vessels (Department Livestock Food Security, 2022). Folate contained in *Amaranthus Caudatus* can increase nitric oxide synthesis in endothelial cells, reduce plasma homocysteine concentrations, improve endothelial function so that blood pressure decreases and relaxes blood vessels which can ultimately reduce the smoothness of the blood flow system.

Researchers assume that there is no difference between the interventions of *Amaranthus Caudatus* and *Cocos Nucifera L* because both interventions are equally able to significantly lower blood pressure, so both interventions are very good to be given to pregnant women with prehypertension. *Amaranthus Caudatus* and *Cocos Nucifera* both contain 3 contents that affect lowering blood pressure, namely the contents of *Amaratus Caudatus* including nitrate, potassium and folate and the content in *Cocos Nucifera* includes vitamin C, calcium, folic acid, although the way these substances work and the mechanisms are different, but when compared there is no significant difference between *Amaranthus Caudatus* and *Cocos Nucifera*, both of these contents function equally to lower blood pressure.

#### *Differences in the Effectiveness of Giving Punica Granatum L (Pomegranate) and Sechium Edule (Chayote) on Reducing Systolic and Diastolic Blood Pressure in Prehypertensive Pregnant Women*

Based on the research results, it was found that there was a decrease in systolic and diastolic blood pressure before and after being given *Punica Granatum L* and *Sechium Edule* decoction in prehypertensive pregnant women. In the Wilcoxon test, the p-value was obtained = 0.000 < 0.05,  $H_0$  was rejected, meaning that there was an effect of giving *Punica Granatum L* and *Sechium Edule* on reducing systolic and diastolic blood pressure in prehypertensive pregnant women. Based on the Mann Whitney statistical test, the systolic significance value was obtained with p value = 0.001 < 0.05 and p value = 0.000 < 0.05, then  $H_0$  is accepted, meaning that there is a difference in the effectiveness of administering *Punica Granatum L* and *Sechium Edule* on reducing systolic and diastolic blood pressure in pregnant women, administering *Punica Granatum L* is more effective than administering *Sechium Edule*.

*Punica Granatum L* contains compounds and minerals that can help lower blood pressure, including: polyphenols: antioxidant compounds that can help improve blood vessel elasticity and reduce inflammation. Natural nitrates: Compounds that can widen blood vessels so that blood flow becomes smoother. Potassium: Minerals that can help balance sodium intake in the body. The decrease in systolic and diastolic blood pressure after drinking pomegranate juice is because pomegranates contain flavonoid compounds in the form of anthocyanins which play an important role in lowering blood pressure. Flavonoids will affect the work of *Angiotensin Converting Enzyme* (ACE) which will inhibit the conversion of angiotensin I to angiotensin II, which causes vasodilation so that TPR decreases and can lower blood pressure. Plasma levels of angiotensin II and aldosterone decrease, while plasma levels of angiotensin I and plasma renin activity increase due to compensatory mechanisms. Aldosterone secretion, which is influenced by other factors besides the renin angiotensin system, may return to baseline values in long-term therapy. Because the vasoconstrictive effect of angiotensin II is strongest among others in the renal blood vessels, the reduced formation of angiotensin II by ACE inhibitors causes strong renal vasodilation, resulting in increased renal blood flow.

The decrease in blood pressure by ACE inhibitors is accompanied by a decrease in peripheral resistance, without reflex tachycardia (MSBK, 2000). In addition, pomegranates contain very high potassium (259 mg/100 g), so that high potassium can maintain osmotic pressure, in addition, the function of this potassium can help activate enzyme reactions, such as pyruvate kinase which can produce pyruvic acid in the carbohydrate metabolism process. Pomegranates contain very low sodium minerals (3 mg/100g). This is beneficial because sodium has the potential to cause hypertension (Anonymous, 2012). According to Martadila et al. (2024), consuming 350 grams of *Punica Granatum L* fruit or 2 fruits consumed in the morning and evening for 14 days has an effect on lowering blood pressure. Consuming pomegranates in the morning and evening is done because at that time there is a spike in blood pressure, so treatment therapy is very good at that time.

*Sechium Edule* has benefits, namely the content of Vitamin C is useful for restoring the elasticity of blood vessels, and the potassium content controls sodium in the blood, which has implications for lowering blood pressure. Folic acid lowers blood pressure by lowering homocysteine levels in the blood. Homocysteine is an amino acid that can damage the lining of blood vessels and contribute to the formation of plaque on the walls

of arteries, which ultimately increases the risk of hypertension (high blood pressure) (Simamora, 2021).

In addition, potassium content plays a role in regulating the body's fluid balance, including fluids that are stored and excreted through urine. When the body retains water, blood pressure will increase because there is more fluid in the blood. The kidneys will remove excess fluid from the blood, but this process requires a good balance of sodium and potassium. Potassium helps the kidneys remove excess sodium, so that blood pressure can decrease (Munawassalmiah et al., 2018). Martadila's research (2024) stated that the results of this study using the Wilcoxon test showed that there was a significant effect between the pretest and posttest, a significance value of 0.000 or  $<0.05$  was obtained, so the hypothesis was accepted, or it was interpreted that there was a difference in the average pretest and posttest values in the classification of hypertension. There is a significant effect between the Effect of Giving *Sechium edule* (chayote) Decoction On Blood Pressure of Pregnant Women with Hypertension before and after intervention for 14 days.

Researchers assume that both *Punica Granatum L* and *Sechium Edule* interventions are equally effective in lowering blood pressure, but *Punica Granatum L* is more effective than *sechium edule*. This can occur in the process of consuming *Sechium Edule* intervention at the level of maturity and duration of boiling, so that it affects the vitamin content in *Sechium Edule* which causes reduced effectiveness in lowering blood pressure in prehypertensive pregnant women. In addition, the content of *Punica Granatum L* is natural nitrate and polyphenols, both of which are useful for dilating blood vessels and helping to lower blood pressure and are not found in *sechium edule*.

*Differences in the Effectiveness of Giving Solanum Lycopersicum (Tomato) and Brassica Oleracea L (Broccoli) on Reducing Systolic and Diastolic Blood Pressure in Prehypertensive Pregnant Women*

On the research results, it was found that there was a decrease in systolic and diastolic blood pressure before and after being given *Solanum Lycopersicum* and *Brassica Oleracea L.* in prehypertensive pregnant women. In the Wilcoxon test, the p-value was obtained = 0.000  $<0.05$ ,  $H_0$  was rejected, meaning that there was an effect of giving *Solanum Lycopersicum* and *Brassica Oleracea L.* on the decrease in systolic and diastolic blood pressure in prehypertensive pregnant women. Based on the Mann Whitney test, the systolic significance value  $p\ value = 0.647 > 0.05$  and diastolic  $p\ value = 0.339 > 0.05$  then  $H_0$  is rejected, meaning there is no difference in the effectiveness of administering *Solanum Lycopersicum* and *Brassica Oleracea L* on

reducing systolic and diastolic blood pressure in prehypertensive pregnant women.

*Solanum lycopersicum* contains fiber, vitamin C, potassium, vitamin K1, vitamin B9, beta carotene, flavonoids, chlorogenic acid and lycopene. The lycopene content in *Solanum Lycopersicum* is the most powerful antioxidant among other antioxidants. Lycopene is insoluble in water and is strongly bound in fiber. The lycopene content of red *Solanum Lycopersicum* fruit is 4,600  $\mu\text{g} / 100\text{g}$ . The anti-inflammatory effect of antioxidants in lycopene can reduce cell damage that can trigger atherosclerosis which causes increased blood pressure (Nugroho et al., 2020). The Vitamin C content in *Solanum Lycopersicum* supports the function of the endothelium, the layer of cells that lines the blood vessels. Healthy endothelium produces nitric oxide (NO), which is a natural vasodilator. Nitric oxide helps dilate blood vessels, reduce tension in the vessels, and lower blood pressure (Dia et al., 2024). *Solanum Lycopersicum* also contains a lot of potassium, potassium can also affect the renin-angiotensin system as an inhibitor of secretion. Renin works to convert angiotensinogen into angiotensin I, but the presence of a block in the system causes blood vessels to experience vasodilation, which can cause blood pressure to decrease, another function of potassium can also reduce the membrane potential of blood vessel walls, causing relaxation of the blood vessel walls and ultimately can reduce blood pressure in hypertensive patients (Hidayah et al., 2021).

In addition to tomatoes (*Solanum Lycopersicum*), broccoli (*Brassica Oleracea L.*) is one type of vegetable that belongs to the *Brassicaceae* family, which also includes other plants such as cabbage, cauliflower, and kale. Broccoli is known for its very high nutritional content, including protein, carbohydrates, fiber, calcium, iron, magnesium, nitrate and vitamins A, B, C & K sulforaphane content and bioactive compounds that have various health benefits and can help lower blood pressure (Dalimartha, 2020). The sulforaphane content found in broccoli can stimulate the production of antioxidant enzymes in the body, such as glutathione and other phase II enzymes involving Nrf2 (Nuclear factor erythroid 2-related factor 2).

This Nrf2 activation increases the body's ability to fight oxidative stress. Excessive oxidative stress can damage blood vessels and increase resistance to blood flow, which ultimately increases blood pressure. By reducing oxidative stress, sulforaphane helps maintain blood vessel health and reduce blood pressure. The potassium and vitamin C content in broccoli can play an important role in lowering blood pressure through several mechanisms, namely by helping to regulate sodium balance, reducing tension in blood vessels, and

supporting healthy kidney function. Folate content plays a role in the production of nitric oxide (NO) in the body. Nitric oxide has a vasodilating effect, which is to widen blood vessels, which helps lower blood pressure by reducing resistance to blood flow. Increased nitric oxide can help improve endothelial function (the inner lining of blood vessels), which in turn helps maintain normal blood pressure (Ministry of Health, 2020).

Researchers assume that both interventions *Solanum Lycopersicum* and *Brassica Oleracea L* are equally effective in lowering blood pressure because they have almost the same content and effectiveness so that there is no significant difference between the two interventions, meaning that both interventions are very suitable for prehypertensive pregnant women because both interventions contain high vitamin C and other contents, including the content found in tomatoes, namely natural nitrates, flavonoids and lycopene and broccoli also contains potassium, folate and sulforaphane. Although the way the substances work and the mechanisms are different, when compared there is no significant difference between *Solanum Lycopersicum* and *Brassica Oleracea L* in reducing blood pressure in prehypertensive pregnant women.

#### *Differences in the Effectiveness of Giving Persea Americana (Avocado) and Cucumis Melo L (Melon) on Reducing Systolic and Diastolic Blood Pressure in Prehypertensive Pregnant Women*

Based on the results of the study, it was found that there was a decrease in systolic and diastolic blood pressure before and after being given *Persea Americana* and *Cucumis Melo L* in prehypertensive pregnant women. The *Wilcoxon test* obtained a  $p\text{-value} = 0.000 < 0.05$ ,  $H_0$  was rejected, meaning that there was an effect of giving *Persea Americana* and *Cucumis Melo L* on reducing systolic and diastolic blood pressure in prehypertensive pregnant women. Based on the *Mann-Whitney test*, the systolic significance value was obtained  $p\text{ value} = 0.708 > 0.05$  and the diastolic significance value  $p\text{ value} = 0.212 > 0.05$ , so  $H_0$  was rejected, meaning that there was no difference in the effectiveness of giving *Persea Americana* and *Cucumis Melo L* on reducing systolic and diastolic blood pressure in pregnant women.

Therapy that can lower blood pressure is *Persea Americana* (avocado fruit). *Persea Americana* is one type of healthy fruit with a soft texture, delicious taste is easy to get. The content of *Persea Americana* is potassium, flavonoids, anthocyanins, condensed tannins, alkaloids and triterpenes in methanol extract. *Persea Americana* contains a source of potassium that can help control blood pressure, Potassium can reduce circular tension by expanding sodium release, inhibiting

renin emanation which causes arteriole dilation and reducing endogenous vasoconstrictor responses. Meanwhile, flavonoids act as inhibitors of *Angiotensin Changing Over Enzyme* (Pro) by inhibiting the progress of angiotensin II from angiotensin I, with a decrease in the amount of angiotensin II, the vasoconstriction effect and the arrival of aldosterone are reduced for sodium and water reabsorption (Nurrahmani, 2017). *Persea americana* contains potassium which can stabilize blood pressure (Ohorela et al., 2024). In addition, *Persea americana* also contains betasitosterol which can reduce the amount of cholesterol absorbed from food. The combination of betasitosterol and monounsaturated fats makes *Persea Americana* a good food for breaking down cholesterol. Increasing HDL levels and decreasing LDL levels will be able to prevent high blood pressure, stroke, and heart disease (Ohorela et al., 2024). In addition, the Vitamin C content in *Persea Americana* can act as a diuretic that can help the kidneys excrete more water, helping to relax the walls of blood vessels, thereby lowering blood pressure.

The folate content also has a beneficial effect on blood pressure by increasing nitric oxide synthesis in endothelial cells or by reducing plasma homocysteine, which in itself can cause endothelial cell injury, thereby lowering blood pressure (Forman, 2020). This is in line with the research of Salsabil (2022) which was conducted in the Rajapolah Tasikmalaya Health Center work area in 2022, which stated that the average initial blood pressure of the case was 148.6/90 mmHg with the final blood pressure of the case being 128.67/80 mmHg, this can be proven by the value ( $p = 0.000 < 0.05$ ). Consuming *Persea Americana* juice in the morning after eating as much as 250 ml for 7 days can lower blood pressure (Nurrahmani, 2017).

In addition, *Cucumis Melo L* (melon fruit) is also a non-pharmacological therapy that can lower blood pressure. *Cucumis Melo L* is a fruit plant that belongs to the *Cucurbitaceae* Family. Its content is protein, calcium, potassium and phosphorus. Potassium content is useful for lowering blood pressure and plays a role in muscle contractions, heart rate and the transmission of nerve impulses throughout the body, because potassium has an important role in preventing stroke, hypertension, and stress. So it can be used for therapy in preventing hypertension (Kusumawaty et al., 2021).

According to Mariani (2019) consumption of *Cucumis Melo L* can lower blood pressure, this is because of the potassium content which is useful for lowering blood pressure and plays a role in muscle contractions, blood vessels experience vasodilation, heart rate and delivery of nerve impulses throughout the body, because potassium has an important role in preventing stroke, hypertension, and stress. So it can be

used for therapy in preventing hypertension. Vitamin C in *Cucumis Melo L* can act as a diuretic which can help the kidneys excrete more water, help relax the walls of blood vessels thereby lowering blood pressure. Folate content also has a beneficial effect on blood pressure by increasing nitric oxide synthesis in endothelial cells or by reducing plasma homocysteine, which in itself can cause endothelial cell injury, so that blood pressure drops (Marliani, 2019).

Researchers assume that there is no difference between the interventions of *Persea Americana* and *Cucumis Melo L* because both interventions are equally able to significantly lower blood pressure, so both interventions are very good to be given to pregnant women with prehypertension. *Persea Americana* and *Cucumis Melo L* both contain ingredients that affect blood pressure reduction, namely the content of *Persea Americana* between potassium: makes blood vessels experience vasodilation, Vitamin C: helps relax blood vessel walls, Folate can increase nitric oxide synthesis in endothelial cells or by reducing plasma homocysteine and magnesium can help in blood vessel relaxation by affecting the process of contraction and relaxation of smooth muscles in the walls of blood vessels.

While in *Cucumis Melo L*, among others, also contains Potassium which helps blood vessels experience vasodilation, Vitamin C: helps relax blood vessel walls, Folate can increase nitric oxide synthesis in endothelial cells or by reducing plasma homocysteine and Riboflavin which relaxes blood vessel walls. The content of both interventions is almost the same so there is no significant difference between *Persea Americana* and *Cucumis Melo L*, both of these contents have the same function to lower blood pressure.

*Differences in the Effectiveness of Giving Moringa Oleifera (Moringa Leaves) and Apium Graveolens L. (Celery Leaves) On Reducing Systolic And Diastolic Blood Pressure In Prehypertensive Pregnant Women*

On the research results, it was found that there was a decrease in systolic and diastolic blood pressure before and after being given *Moringa Oleifera* and *Apium Graveolens L.* in prehypertensive pregnant women. In the Wilcoxon test, the p-value was obtained =  $0.000 < 0.05$ ,  $H_0$  was rejected, meaning that there was an effect of giving *Moringa Oleifera* and *Apium Graveolens L.* on the decrease in systolic and diastolic blood pressure in prehypertensive pregnant women. Based on the *Mann Whitney* test, the systolic significance value p value =  $0.023 < 0.05$  then  $H_0$  is accepted meaning there is a difference in the effectiveness of giving *Moringa Oleifera* and *Apium Graveolens L.* to reduce systolic blood pressure in

prehypertensive pregnant women. While in diastolic blood pressure, a significant diastolic value of  $p$  was obtained value =  $0.277 > 0.05$ , then  $H_0$  is rejected, meaning that there is no difference in the effectiveness of administering *Moringa Oleifera* and *Apium Graveolens L* in reducing diastolic blood pressure in prehypertensive pregnant women, so it is concluded that *Moringa Oleifera* is more effective in reducing systolic blood pressure than administering *Apium Graveolens L*, but both are equally effective in reducing diastolic blood pressure.

*Moringa oleifera* (Moringa leaves) contain a lot of flavonoids, potassium, calcium and antioxidants, good for consumption by pregnant women at risk of hypertension because it can lower blood pressure. The effect of potassium and potassium content can relax blood vessels so that the burden on the heart to pump and flow blood throughout the body will decrease so that the results obtained are that blood pressure decreases (Yanti et al., 2022). *Moringa Oleifera* (Moringa Leaves) contains all the nutrients needed to balance blood pressure. Calcium is needed for smooth muscle reactions and contractions, increased calcium consumption can have a direct effect on blood vessels, thereby widening blood vessels and lowering blood pressure. The potassium content in *Moringa Oleifera* works by increasing sodium excretion in the urine, which helps widen blood vessels, and changes the interaction of hormones that affect blood pressure (Wahyudi et al., 2020). Magnesium contained in *Moringa Oleifera* is very beneficial for people with hypertension by contributing to smooth muscle reactions to widen blood vessels. *Moringa Oleifera* also contains vitamin C which plays a role in reducing blood pressure along with other nutrients. Moringa is rich in potassium so that sodium levels in the blood can be controlled which has implications for lowering blood pressure.

*Apium Graveolens L* is one of the types of herbal therapy to treat hypertension. *Apigenin*, which is found in celery is very useful for preventing narrowing of blood vessels, namely by increasing vasodilation and reducing blood pressure and helping to widen blood vessels (vasodilation), which allows blood to flow more smoothly and reduces pressure on the walls of blood vessels. This can help lower overall blood pressure. Vitamin C is an antioxidant and can lower blood pressure by about 5 mmHg, through its role in repairing arterial damage due to hypertension. Vitamin C helps maintain normal blood pressure by increasing the excretion of lead from the body. Chronic exposure to lead can increase blood pressure. So, by removing lead from the body, blood pressure will also drop.

Vitamin C restores the elasticity of blood vessels (Simamora, 2021).

Researchers assume that both interventions of *Moringa Oleifera* and *Apium Graveolens L* are equally effective in lowering systolic and diastolic blood pressure in respondents in this study, however *Moringa Oleifera* is more effective in lowering systolic blood pressure than *Apium Graveolens L* and in diastolic blood pressure both interventions are equally effective in lowering blood pressure. This can happen because calcium content is useful for smooth muscle reactions and contractions, increased calcium consumption can have a direct effect on blood vessels, thus widening blood vessels and lowering blood pressure. While vitamin C is useful for maintaining normal blood pressure by increasing the excretion of tin from the body chronic exposure to tin can increase blood pressure. So, by removing tin from the body, blood pressure will also decrease. Vitamin C restores the elasticity of blood vessels.

## Conclusion

Hypertension is a condition when blood pressure is  $\geq 140/90$  mmHg. Prehypertension is a condition where systolic blood pressure is 120-139 mmHg and diastolic is 80-89 mmHg. If left untreated, hypertension can lead to more severe conditions such as heart complications, stroke, and even more serious problems, namely death. This study seeks to explore the various impacts of non-pharmacological treatment on reducing blood pressure in prehypertensive pregnant women by administering *Amaranthus Caudatus* and *Cocos Nucifera L*, *Punica Granatum L* and *Sechium Edule*, *Solanum Lycopersicum* and *Brassica Oleracea L*, *Moringa Oleifera* and *Apium Graveolens L*, *Persea Americana* and *Cucumis Melo L*. This therapy or treatment was chosen based on the efficacy of the content that can lower blood pressure such as folic acid, vitamin C, calcium, potassium, riboflavin, magnesium, potassium. This study used a quasi-experimental quantitative design with total sampling which aims to evaluate the effectiveness of non-pharmacological treatment. The results were analyzed statistically using the Wilcoxon test, it was found that there was an effect of giving *Amaranthus Caudatus*, *Cocos Nucifera L*, *Punica Granatum L*, *Sechium Edule*, *Solanum Lycopersicum*, *Brassica Oleracea L*, *Moringa Oleifera*, *Apium Graveolens L*, *Persea Americana* and *Cucumis Melo* on reducing blood pressure in prehypertensive pregnant women, and based on the analysis of differences with the *Mann-Whitney statistical test*, a significant difference was obtained in reducing blood pressure in the intervention of *Punica Granatum L* (pomegranate) and *Sechium edule* (chayote) with a

systolic significance value of  $p$  value = 0.001 and diastolic significance value  $p$  value = 0.000, and there is a difference in the intervention of *Moringa Oleifera* and *Apium Graveolens L* on reducing systolic blood pressure in prehypertensive pregnant women with a systolic significance value of  $p$  value = 0.023. The use of non-pharmacological treatments is very beneficial especially for pregnant women who experience prehypertension in situations where advanced medical treatment is limited or where patients prefer natural treatment options. Ultimately, this study contributes to the growing body of evidence supporting the use of natural substances in the management of blood pressure reduction in prehypertensive pregnant women so that it can prevent further complications such as hypertension and even preeclampsia.

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#### Author Contributions

S., N., A contributed in conceptualizing the research idea, developing the product, analyzing data and writing the article, reviewing, editing the article and collecting data.

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#### Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this article.

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