The Effect of Chayote Extract (Sechium edule) On Blood Pressure in Pregnant Women with Hypertension

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ABSTRACT

Background: Increased blood pressure of pregnant women during pregnancy is one of the high risks during pregnancy which can lead to preeclampsia, eclampsia to maternal and infant mortality. One of the treatments recommended by pregnant women is to consume foods containing potassium and flavonoids, namely squash. This study aimed to determine the effect of squash pumpkin on changes in blood pressure of hypertensive mothers in pregnancy in the health center in Semarang City area.

Subjects and Methods: This was an experimental study. The study was conducted at community health centers in Semarang, Central Java, from March to May 2018. A sample of 20 pregnant women who experienced hypertension in pregnancy was divided into two groups, control and treatment groups. The dependent variable was blood pressure. The independent variable was the extract of chayote. The data were analyzed by a multiple linear regression.

Results: There were differences in systolic blood pressure before and after the administration of squash extract (p<0.001). There are differences in Diastolic blood pressure before and after the administration of squash extract (p <0.001).

Conclusion: Consuming chayote can make an effort to help lower blood pressure in pregnant women with hypertension.

Keywords: flavonoids, hypertension in pregnancy, potassium, squash, blood pressure.

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by routine blood pressure checks at the time of pregnancy examination. Pregnancy checks are routinely carried out so that the risk of preeclampsia can be detected immediately so that no more fatal complications occur (Rukiyah, 2012).

Hypertension is the second cause of maternal death, which occurs in 5-10% of all pregnancies (Malik, 2016; Vest and Cho 2014). The causes of death of pregnant women include bleeding (25%), hypertension (12%), congestion (8%), abortion (13%) and other causes (7%) (World Health Organization 2013). According to WHO (World Health Organization) data in 2013 cardiovascular disease accounted for around 17 million deaths per year, almost one third of the total population. Of these, hypertension complications reached 0.4 million deaths worldwide every year. Hypertension is responsible for at least 45% of deaths from heart disease (World Health Organization 2013).

Data from the Central Java Provincial Health Office in 2015 the highest cases of maternal mortality due to hypertension as much as 26.34% and bleeding as much as 21.14%. The number of maternal deaths in 2016 was 32 cases with a number of live births of 26,337 cases or 121.5 per 100,000 live births (Health Service Offices of Central Java Province, 2015). Data from the Semarang District Health Office in 2015, because preeclampsia was 34% and bleeding was 28%. Whereas in 2016 due to preeclampsia as much as 21% and as much as 12% (Health Service Offices of Semarang City, 2016).

Handling of hypertension cases in pregnant women has been carried out by giving anti-hypertensive drugs. Treatment of hypertension to date is non-pharmacological (herbal) and pharmacological therapy. No pharmacological therapy is a complement to pharmacological therapy to get a better treatment effect (Dalimartha, 2008).

Non-pharmacological therapy (herbal) has various benefits for those who consume it, including more affordable prices, easily obtained, does not cause side effects, increase endurance because it contains many vitamins that are useful for health. Taking herbs has been done by our ancestors in ancient times (Pereira et al., 2016). After science develops, research on herbs that can cure various diseases is carried out. It turns out that herbs contain substances that can cure disease (Nisa, 2012).

Non-pharmacological (herbal) treatment of hypertension, including fruits, vegetables, leaves, and roots containing potassium, calcium and other important substances. Patients with hypertension are generally deficient in potassium and calcium which is the right way to reduce blood pressure, one of which is chayote (Sechium edule) (Luh et al, 2012; Nisa, 2012; Jayani, 2016).

Siam squash (Sechium edule) is efficacious as an antipyretic, anti-inflammatory and contains potassium so it can lower blood pressure (Lombardo-earl et al, 2014). Conjoined squash (Sechium edule) is easily available, at an affordable price, and there are no side effects. Besides folic acid, chayote also contains potassium, energy, protein, fat, carbohydrates, fiber, sugar, calcium, zinc, copper, manganese, selenium, vitamin C, thiamine, riboflavin, niacin, vitamin B6, and vitamin E. Vitamin K very beneficial for the body (Tjoawirawan, 2012; Luh et al., 2012).

Yanti’s study on 2017 reported that there was an influence between squash squeeze to decrease blood pressure in hypertensive patients with an average reduction in systolic blood pressure of 15.50 mmHg and Diastolic 9.0 mmHg (Yanti, 2017). A study by Nadila in 2014 reported that one of the plants used as antihypertensive was chayote fruit (Sechium edule). The active compound in the squash fruit that func-
ctions as an antihypertensive is flavonoids, saponins, and alkaloids that can inhibit angiotensin I converting enzyme (ACE) and as a diuretic.

The use of chayote is usually consumed in the form of steamed or juice and juice, extracts can now be made in capsule form according to certain concentrations and procedures. In addition to being more practical, the use of chayote extract in capsule form can also be stored for a longer period than consumed in the form of steamed or juice (Paramawati, 2016). For that use chayote as a treatment with natural ingredients that are economical and have minimal negative effects to be a good solution to overcome health problems, especially hypertension. Based on the description, the researcher was interested in conducting research entitled "Effect of blood pressure reduction on hypertensive mothers in pregnancy with squash extract (Sechium edule)".

**SUBJECTS AND METHOD**

1. **Study Design**
This was a quasi-experimental study with the design of Non equivalent control group design. The study was conducted at the Semarang City Community Health Center (Tlogosari Wetan Health Center, Tlogosari Kulon Health Center, Bangetayu Health Center and Srondol Health Center) from March to May 2018.

2. **Population and sample**
The population in this study were pregnant women who experienced hypertension in pregnancy at the Semarang City Health Center on March to May 2018. Samples of 20 pregnant women with sampling according to inclusion criteria.

3. **Study Variables**
The dependent variable was blood pressure. The independent variable was the extract of chayote.

4. **Operational Definition of Variables**
Pumpkin extract made into powder and then put into capsules and given to respondents (treatment) 1x500 mg for 11 days after 2 hours of antihypertensive drug administration.

5. **Study Instruments**
The data collected by observation sheet. The measurement scale is categorical. Blood pressure is the value of systolic and Diastolic blood pressure that changes after the intervention after 2 hours of giving the pumpkin extract. Data collected with observation sheets and digital sphygmomanometer. The measurement scale is numerical.

6. **Data analysis**
Univariate analysis was carried out to see the frequency distribution and characteristics of the study subjects, while the bivariate analysis was carried out using the general linear model repeated measure test because the measurement was more than twice and Post Hoc to see differences in blood pressure before and after intervention in one group and between groups research.

7. **Research Ethics**
Research ethics including informed consent, anonymity, confidentiality, and ethical permission. Ethical permits in this study were conducted at the Semarang Health Ministry Polytechnic and declared ethically feasible based on the decision letter number: 131/KEPK /Poltekkes-Smg/EC/2018.

**RESULTS**

1. **Sample Characteristics**
Distribution of the characteristics of respondents in this study included the age, parity, past pregnancy / childbirth / childbirth history and family history that will be explained in table 1.
Table 1. Sample Characteristics

| Characteristics                  | Control group (n=10) | Treatment group (n=10) | Total | p      |
|----------------------------------|----------------------|------------------------|-------|--------|
| N                                | %                    | N                      | %     |        |
| **Age (mean±SD)**                | 34.30±3.71           | 34.40±4.12             | 34.35±3.82 |       |
| Min-Max                          | 27-41                | 29-42                  | 27-42 |        |
| < 20 year                        | -                    | -                      | -     | 0.548  |
| 20-35 year                       | 5                    | 60                     | 11    | 55     |
| > 35 year                        | 5                    | 40                     | 9     | 45     |
| **Parity**                       | 1.000                |                        |       |        |
| Primipara                        | 5                    | 50                     | 1     | 10     | 6      | 30     |
| Multipara                        | 4                    | 40                     | 4     | 40     | 8      | 40     |
| Grandemultipara                  | 1                    | 10                     | 5     | 50     | 6      | 30     |
| **Past Pregnancy / Childbirth / Postpartum History** |                     |                        |       |        |
| No                               | 3                    | 80                     | 5     | 50     | 8      | 35     |
| Yes                              | 7                    | 20                     | 5     | 50     | 12     | 65     |
| **Family History**               |                      |                        |       |        |
| No                               | 8                    | 80                     | 9     | 90     | 17     | 85     |
| Yes                              | 2                    | 20                     | 1     | 10     | 3      | 15     |

2. Univariate Analysis

The results of measurements of systolic and Diastolic blood pressure values before and after the administration of antihypertensive drugs are shown in Table 2.

Table 2. Measurement of systolic and Diastolic blood pressure values in the control group (antihypertensive drugs)

| Control group | Minimum value | Maximum value | Mean   | SD    |
|---------------|---------------|---------------|--------|-------|
| **Systolic**  |               |               |        |       |
| Pre Systole   | 145           | 158           | 151.40 | 3.92  |
| Post Systole 1| 145           | 154           | 148.80 | 2.66  |
| Post Systole 2| 142           | 170           | 150.60 | 7.73  |
| Post Systole 3| 136           | 165           | 151.00 | 7.60  |
| Post Systole 4| 142           | 163           | 150.80 | 5.33  |
| Post Systole 5| 146           | 158           | 151.70 | 4.27  |
| Post Systole 6| 140           | 159           | 148.80 | 5.11  |
| **Diastolic** |               |               |        |       |
| Pre Diastole  | 92            | 110           | 100.40 | 5.40  |
| Post Diastole 1| 95           | 109           | 99.90  | 4.04  |
| Post Diastole 2| 93            | 110           | 99.40  | 4.57  |
| Post Diastole 3| 90            | 107           | 98.00  | 5.18  |
| Post Diastole 4| 90            | 105           | 95.80  | 4.26  |
| Post Diastole 5| 90            | 103           | 95.40  | 4.67  |
| Post Diastole 6| 85            | 102           | 94.30  | 5.58  |

From table 2 above, it is explained that from all measurements of systolic and Diastolic blood pressure in the control group, there was a decrease in each measurement.

Changes in the average measurement of systolic blood pressure in the treatment and control groups measured every two days for 11 days can be seen in the graph below:
Figure 1 above shows that the average change in systolic blood pressure on the first day to the 11th day for the treatment group and control group with an average value decreased. It can be concluded that blood pressure in the treatment group was better than the control group.

The results of measurements of systolic and diastolic blood pressure values before and after the administration of antihypertensive drugs and chayote extracts are shown in Table 3.

### Table 3. Measurement of systolic and Diastolic blood pressure values in the treatment group (antihypertensive drugs and chayote extracts)

| Systolic group | Minimum value | Maximum value | Mean   | Standard deviation |
|----------------|---------------|---------------|--------|--------------------|
| Pre Systole    | 140           | 171           | 152.20 | 9.57               |
| Post Systole 1 | 140           | 160           | 149.50 | 7.50               |
| Post Systole 3 | 136           | 162           | 147.40 | 8.58               |
| Post Systole 5 | 135           | 159           | 143.70 | 8.26               |
| Post Systole 7 | 134           | 155           | 143.50 | 6.15               |
| Post Systole 9 | 127           | 157           | 143.30 | 8.55               |
| Post Systole 11| 128           | 150           | 138.40 | 7.63               |

| Diastolic      | Minimum value | Maximum value | Mean   | Standard deviation |
|----------------|---------------|---------------|--------|--------------------|
| Pre Diastole   | 98            | 107           | 102.30 | 2.83               |
| Post Diastole 1| 99            | 107           | 101.70 | 2.91               |
| Post Diastole 3| 97            | 102           | 99.30  | 1.77               |
| Post Diastole 5| 90            | 105           | 96.80  | 4.98               |
| Post Diastole 7| 88            | 103           | 93.30  | 4.71               |
| Post Diastole 9| 85            | 102           | 91.70  | 6.18               |
| Post Diastole 11| 83           | 99            | 91.10  | 4.82               |
From Table 3 above, it is explained that from all measurements of systolic and diastolic blood pressure in the treatment group, there was a decrease in each measurement. Changes in the average measurement of diastolic blood pressure in the treatment and control groups which were measured every two days for 11 days can be seen in the graph below:

**Figure 2. Changes in the mean diastolic blood pressure in the treatment and control groups**

Figure 2 above shows that the change in the average diastolic blood pressure on the first day to the 11th day for the treatment group and control group with an average value decreased. It can be concluded that blood pressure in the treatment group was better than the control group.

### 3. Bivariate analysis
Analysis of Differences in Systolic Pressure in the Treatment and Control Groups

| Source     | Type III Sum of Squares | df | Mean Square | F       | P value |
|------------|-------------------------|----|-------------|---------|---------|
| TD systole | 3037326.01              | 1  | 3037326.01  | 1.348E4 | <0.001  |

The Repeated Measure ANOVA (Test of Between-Subjects Effect) analysis in Table 4 shows that the p value <0.05 which means that there is a significant difference between systolic blood pressure in the treatment group and the control group.

Analysis of Differences in Systolic blood pressure before and after treatment groups and control groups.
Table 5. Differences in Systolic Blood Pressure Levels Before and After Treatment Groups and Control Groups

|                        | Control group |                        | Treatment group |                        |
|------------------------|---------------|------------------------|-----------------|------------------------|
|                        | Systolic Mean | Difference p          | Systolic Mean   | Difference p          |
| Pre Post 11            | 2.60          | 1.000                  | Pre Post 11     | 18.00                  |
| Pre Post 1             | 2.60          | 0.757                  | Pre Post 1      | 2.70                   |
| Post 1 Post 3          | -1.80         | 1.000                  | Post 1 Post 3   | 1.20                   |
| Post 3 Post 5          | -0.40         | 1.000                  | Post 3 Post 5   | 4.70                   |
| Post 5 Post 7          | 0.20          | 1.000                  | Post 5 Post 7   | 1.60                   |
| Post 7 Post 9          | -0.90         | 1.000                  | Post 7 Post 9   | 2.80                   |
| Post 9 Post 11         | 2.90          | 1.000                  | Post 9 Post 11  | 5.00                   |

The results of Test of Within-Subjects Effect obtained the value of [F (4.13, 74.41) = 14.32]; p<0.001. Table 5 illustrates the results of the post hoc pairwise comparison test meaning that there are differences in systolic blood pressure in each treatment group and control group. Analysis of differences in systolic blood pressure between the treatment group and the control group.

Table 6. Differences in systolic blood pressure between treatment and control groups

| Variable          | Systolic blood pressure | Group | Mean±SD | p     |
|-------------------|-------------------------|-------|---------|-------|
| Pre               | Control                 |       | 151.40±3.92 | 0.809 |
|                   | Treatment               |       | 152.20±9.57 |       |
| Post 1            | Control                 |       | 148.80±2.66 | 0.784 |
|                   | Treatment               |       | 149.50±7.50 |       |
| Post 3            | Control                 |       | 150.60±7.73 | 0.531 |
|                   | Treatment               |       | 147.40±8.58 |       |
| Post 5            | Control                 |       | 151.00±7.60 | 0.041 |
|                   | Treatment               |       | 143.70±8.26 |       |
| Post 7            | Control                 |       | 150.80±5.33 | 0.006 |
|                   | Treatment               |       | 143.50±6.15 |       |
| Post 9            | Control                 |       | 151.70±4.27 | <0.001|
|                   | Treatment               |       | 143.30±8.55 |       |
| Post 11           | Control                 |       | 148.80±5.12 | <0.001|
|                   | Treatment               |       | 138.40±7.63 |       |

In Table 6 the results of the repeated measurement showed the results of systolic measurements from pretest to posttest 11 for each group showed p value in measurement 5 <0.05, meaning that there was a difference in the decrease in systolic blood pressure between groups on day 5.
Table 7. Differences in diastolic blood pressure in the treatment and control groups

| Source   | Type III Sum of Squares | df | Mean Square | F      | P value |
|----------|-------------------------|----|-------------|--------|---------|
| TD Diastole | 1318618.35            | 1  | 1318618.35  | 1.196E4| <0.001  |

The Repeated Measure ANOVA (Test of Between-Subjects Effect) analysis in table 7 shows that the p value <0.05 which means that there is a significant difference between diastolic blood pressure in the treatment group and the control group.

Table 8. Differences in the value of diastolic blood pressure before and after treatment groups and control groups

|            | Control group | Treatment group |
|------------|---------------|-----------------|
| Systolic   | Mean Difference | p   | Mean Difference | p   |
| Pre        | 6.10          | 0.017          | Pre          | 11.90        | 0.006 |
| Post 1     | 0.50          | 1.000          | Post 1       | 0.60         | 1.000 |
| Post 3     | 0.50          | 1.000          | Post 3       | 2.40         | 0.352 |
| Post 5     | 1.40          | 1.000          | Post 5       | 2.50         | 1.000 |
| Post 7     | 2.20          | 0.366          | Post 7       | 3.50         | 0.352 |
| Post 9     | 0.40          | 1.000          | Post 9       | 1.60         | 1.000 |
| Post 11    | 1.10          | 1.000          | Post 11      | 1.30         | 1.000 |

The results of Test of Within-Subjects Effect obtained the value of \([F \ (3.334, 60.005) =4.28]\); \(p = 0.008\). Table 8 illustrates the results of the post hoc pairs wise comparison test meaning that there are differences in diastolic blood pressure in each treatment group and control group.

Table 9. Differences in Diastolic blood pressure between treatment and control groups

| Variable   | Systolic blood pressure | Group     | Mean±SD   | p  |
|------------|-------------------------|-----------|-----------|----|
| Pre        | Control                 | 100.40±5.40| 0.337     |
|            | Treatment               | 102.30±2.83|           |
| Post 1     | Control                 | 99.90±4.04| 0.268     |
|            | Treatment               | 101.70±2.91|          |
| Post 3     | Control                 | 99.40±4.57| 0.949     |
|            | Treatment               | 99.30±1.77|           |
| Post 5     | Control                 | 98.00±5.18| 0.604     |
|            | Treatment               | 96.80±4.98|           |
| Post 7     | Control                 | 95.80±4.26| 0.230     |
|            | Treatment               | 93.30±4.71|           |
| Post 9     | Control                 | 95.40±4.67| 0.148     |
|            | Treatment               | 91.70±6.18|           |
| Post 11    | Control                 | 94.30±5.58| 0.141     |
|            | Treatment               | 91.10±4.82|           |

In table 4.10 the results of the repeated measure showed the results of diastolic measurements from pretest to posttest 11 for each group showed p value> 0.05, meaning that there was no difference in Diastoleic blood pressure between groups, but betwe-
en the treatment group and the control group both experienced decrease.

**DISCUSSION**

Blood pressure is the amount of force given by blood in the interior of the artery when blood is pumped throughout the circulatory system. Every time the heart muscle contracts, blood is pressed against the blood vessel wall and calculated as systolic blood pressure. When the heart relaxes between pulses, the pressure on the blood vessel wall is calculated as diastolic blood pressure (Hernawati, 2011).

Siam squash is efficacious as antipyretic, anti-inflammatory and lowers high blood pressure. Siam squash is easy to get, at an affordable price, and there are no side effects. Chayote is good for pregnant women because it has a high amount of folic acid (Nisa, 2012).

Siamese Pumpkin fruit is rich in potassium, potassium is useful for the body to control blood pressure, as a high blood therapy, and cleanse carbon dioxide in the blood. Potassium is also useful to trigger the work of muscles and nerve nodes. High potassium will facilitate the delivery of oxygen to the brain and help maintain fluid balance, so the body becomes fresher. Patients with high blood pressure are recommended to consume squash regularly (Nisa, 2012).

Based on the results of this study showed that the administration of squash extract (Sechium edule) was proven to affect the decrease of systolic and diastolic blood pressure after being given 500 mg / day for 11 consecutive days in pregnant women with hypertension in pregnancy.

In statistical tests using Repeated Measure Generalized Linear Model (GLM) at systolic blood pressure showed that there was a difference between systolic blood pressure in the control group and the intervention group (p = 0.023) and in the statistical test diastolic blood pressure showed that there was a difference between pressure diastolic blood in the control group and intervention group (p = 0.021).

Several studies are in line with the results of this study, namely the results of Dire’s (2007) study that cloak has anti-hypertensive effects, according to Djaelani (2012), he found differences in systolic and diastolic pressure before and after the administration of chayote. Without medication, the blood pressure of hypertensive patients falls after consuming squash for five consecutive days. This occurs because chayote contains high potassium, and other compounds such as alkaloids and flavonoids (Hakim, 2015; Djaelani, 2015).

A study by Yuninda (2009) reported the effect of Sechium edule juice on blood pressure of adult women. The data measured were systolic and diastolic blood pressure for 3 days. The average results of systolic blood pressure on the first, second and third days after drinking squash juice decreased by 12.66 mmHg, 9.53 mmHg and 7.27 mmHg compared to before drinking chayote juice. While the average results of diastolic blood pressure on the first, second and third days after drinking squash juice decreased by 5.66 mmHg, 3.4 mmHg and 2.99 mmHg compared to before drinking chayote juice (Yuninda, 2009).

Hypertension that occurs in pregnancy is caused by a decrease in blood flow and uterine perfusion that stimulates excessive release of renin, this causes the renin released to flow along with the blood to the liver and react with angiotensinogen to convert angiotensin I to angiotensin II which when accumulated with thromboxane will cause vasoplasm which causes the anteriol lumen to narrow and the anteriol pressure increase. In addition angiotensin II also stimulates the adrenal cortex to produce the hormone aldosetrol which causes sodium
retention and raises blood volume and pressure (Kowalak, 2011)

To inhibit the formation of angiotensin II, flavonoids which are bioactive compounds with high antioxidants are needed, work directly on smooth muscle by activating endothelium derived relaxing factor (EDRF), causing vasodilation and inhibiting angiotensin-converting enzyme (ACE) so that angiotensin I cannot be converted to angiotensin II. Anthocyanin which are the most abundant compounds in flavonoids will accumulate into endothelial cells and protect from free radicals, so they can maintain Nitric Oxide Synthase (NOS) as a strong vasodilator (Won et al., 2010; June et al., 2018).

Reduction in blood pressure during pregnancy can also be affected by the production of the hormone progesterone. This hormone affects the muscles to become more relaxed. Then affecting the blood vessels tends to widen/vasodilation. This blood vessel dilation makes blood pressure decrease.

**AUTHOR CONTRIBUTIONS**
Nur Alfi Fauziah selected the study subjects, collected the data, measured quality of sleep, and wrote the manuscript. Kamilah Hidajati gave theoretical suggestion on the effect of chayote extract on hypertension. Ariawan Soejoenoes did the data analysis and interpreted the results of data analysis.

**CONFLICT OF INTEREST**
We declare that we do not have any conflict of interest.

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