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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 Diastoleic 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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BACKGROUND

Hypertension (high blood pressure) in pregnancy is hypertension that occurs after 20 weeks of pregnancy, with blood pressure reaching 140/90 mmHg without proteinuria (Pisani et al. 2017; Nzelu et al. 2017; Cudihy and Lee 2009). Hypertension can occur before pregnancy and during pregnancy. There are 2 pregnancy hypertension disorders, namely gestational hypertension (GH) and preeclampsia (PE) (Roberts et al. 2017; Ogle and Korda 2015). Hypertension results in blood vessels experiencing vasoconstriction (constriction), resulting in reduced blood supply to the body's tissues, so that loss of nutrient and oxygen intake gradually results in the organ not functioning even death (Cudihy and Lee 2009). Hypertension in pregnancy can also progress to mild preeclampsia and eventually increase to severe preeclampsia followed by subjective complaints of headache, epigastria pain, blurred vision, nausea, vomiting, and disturbance of consciousness (Nugroho, 2012).

Preeclampsia often occurs suddenly, it is necessary to detect it as early as possible during pregnancy. Early detection is done

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 9.4 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 Diastoleic 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 fun-

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 quasy-experimental study with the design of Non eqiuvalent 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 Diastoleic 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	%	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	50	6	60	11	55	
> 35 year	5	50	4	40	9	45	
Parity							
Primipara	5	50	1	10	6	30	1.000
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	0.207
Yes	7	20	5	50	12	65	
Family History							
No	8	80	9	90	17	85	0.232
Yes	2	20	1	10	3	15	

2. Univariate Analysis

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

Table 2. Measurement of systolic and Diastoleic 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 3	142	170	150.60	7.73
Post Systole 5	136	165	151.00	7.60
Post Systole 7	142	163	150.80	5.33
Post Systole 9	146	158	151.70	4.27
Post Systole 11	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 3	93	110	99.40	4.57
Post Diastole 5	90	107	98.00	5.18
Post Diastole 7	90	105	95.80	4.26
Post Diastole 9	90	103	95.40	4.67
Post Diastole 11	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:

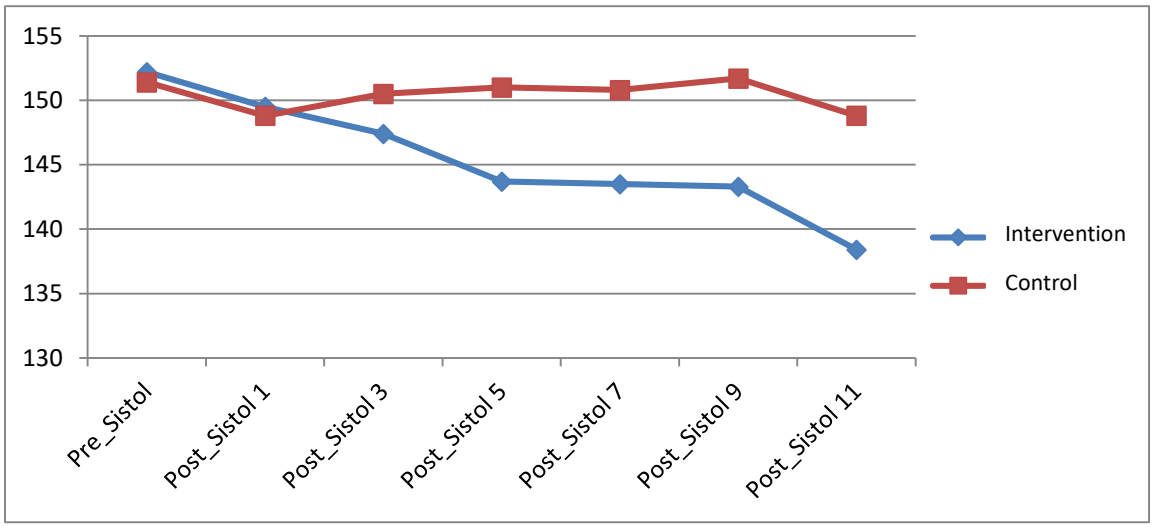

Figure 1. Changes in the mean systolic blood pressure in the treatment and control groups

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)

Treatment group	Minimum value	Maximum value	Mean	Standard deviation
Systolic				
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				
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:

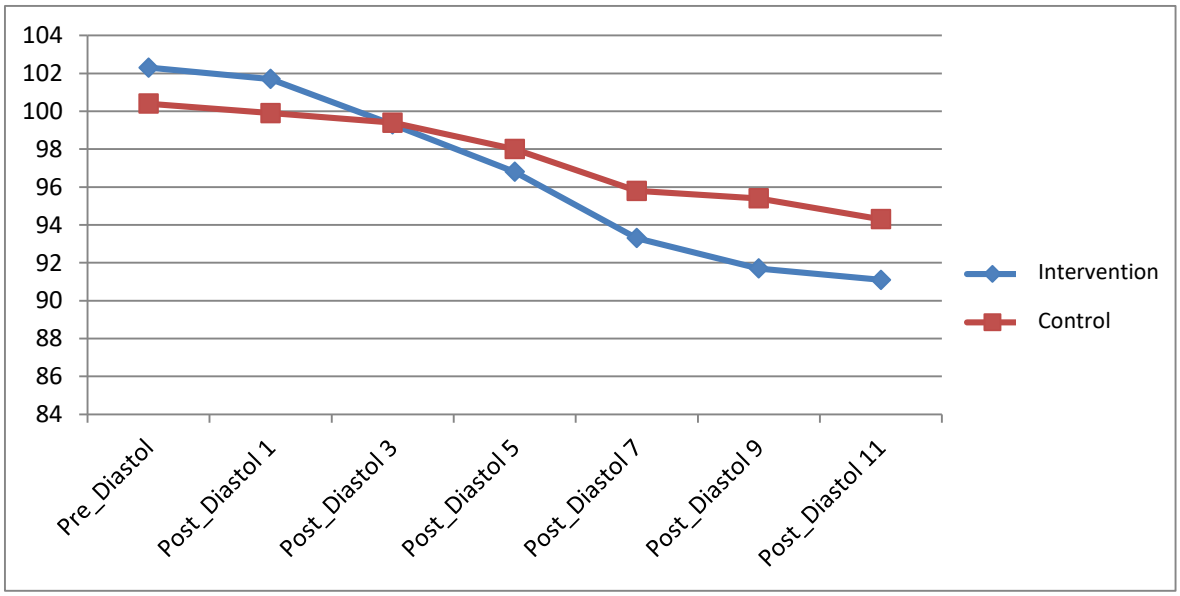

Figure 2. Changes in the mean diastolic blood pressure in the treatment and control groups

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

Table 4. Differences in Systolic blood pressure in the treatment group and control group.

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	<0.001
Pre	Post 1	2.60	0.757	Pre	Post 1	2.70	0.440
Post 1	Post 3	-1.80	1.000	Post 1	Post 3	1.20	1.000
Post 3	Post 5	-0.40	1.000	Post 3	Post 5	4.70	0.043
Post 5	Post 7	0.20	1.000	Post 5	Post 7	1.60	1.000
Post 7	Post 9	-0.90	1.000	Post 7	Post 9	2.80	0.366
Post 9	Post 11	2.90	1.000	Post 9	Post 11	5.00	0.002

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 paires wise 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			p
Systolic blood pressure	Group	Mean±SD	
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 reapeted measure 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	Systolic		Mean Difference	p
Pre	Post 11	6.10	0.017	Pre	Post 11	11.90	0.006
Pre	Post 1	0.50	1.000	Pre	Post 1	0.60	1.000
Post 1	Post 3	0.50	1.000	Post 1	Post 3	2.40	0.352
Post 3	Post 5	1.40	1.000	Post 3	Post 5	2.50	1.000
Post 5	Post 7	2.20	0.366	Post 5	Post 7	3.50	0.352
Post 7	Post 9	0.40	1.000	Post 7	Post 9	1.60	1.000
Post 9	Post 11	1.10	1.000	Post 9	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 paires wise comparison test meaning that there are differences in diastolic blood pressure in each treatment group and control group.

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

Variable			p
Systolic blood pressure	Group	Mean±SD	
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 antihypertensive 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 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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