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Research Article
Influence of Nutrition Education and Provision of Instant Chayote to Change in Blood Pressure

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Abstract

Background and Objective: Current efforts to overcome hypertension have been predominantly based on medical treatment. Nutritional education and local food use are still limited in efforts to lower blood pressure. This study was conducted to analyze the effect of nutritional education intervention and the provision of chayote on changes in blood pressure of pre-diabetic high school teachers. **Methodology:** This research study is an experiment consisting of a sample of high school teachers (SMA) with pre-diabetes in Palu city. The number of subjects per group was 25 people and they were categorized as the following: Group I = Intervention of instant chayote, Group II = Nutrition education intervention and Group III = Nutrition education intervention and provision of chayote. Systolic and diastolic blood pressure was measured before and after intervention. Data analysis were performed using pairwise t-test and Wallis crucial test and significance was considered at $p<0.05$. **Results:** Change in the mean and standard deviation of systolic blood pressure after intervention with instant infusion of chayote was 15.24±10.54 mm Hg ($p = 0.00$), after nutrition education intervention was 3.12±12.34 mm Hg ($p = 0.190$) and intervention in combination of nutrition education and instant chayote were 14.48±12.00 ($p = 0.00$). The change in diastolic blood pressure after intervention with the administration of siam gourd was 11.24±8.29 mm Hg ($p = 0.00$), nutritional education intervention was 1.88±10.33 mm Hg ($p = 0.253$) and intervention in combination of nutritional education and chayote was 6.84±11.76 mm Hg ($p = 0.005$). **Conclusion:** Instant chayote interventions combined with nutritional education may significantly decrease systolic and diastolic blood pressures in pre-diabetic high school teachers.

Key words: Nutrition education, chayote, blood pressure, pre-diabetes

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Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

High blood pressure (hypertension) needs to be controlled because it is a silent killer that does not cause symptoms like a disease[1]. The prevalence of hypertension in Indonesia is 32.2% and as many as 75.8% of cases have not been diagnosed and are affordable with regards to its health services[2]. Worldwide, approximately one billion people are at risk of heart failure, heart attacks, kidney failure and blindness due to hypertension. Hypertension occurs when blood volume increases and blood vessels narrow, causing the heart to contract more strongly to supply oxygen and nutrients to every cell in the body[3].

Previous research studies have shown that chayote (*Sechium edule*, Jacq. Swartz.) can grow in subtropics. This species is used as food and medicine[4]. Chayote is easily available and is relatively inexpensive and thus it can be an option to meet the needs of society[5]. Many people are fond of the fruit of chayote because it tastes good and is cold. According to Siciliano *et al.*[6], there are eight flavonoids consisting of three C-glycosyl compounds and five O-glycosyl flavone compounds in chayote. The leaves and fruits of chayote are known to have anti-inflammatory properties and can also lower blood pressure. The leaves can be used for treatment such as atherosclerosis and hypertension, can even destroy kidney stones[3].

Chayote has a diuretic (urine emetic) alkaloid content, which can also open blood vessels that are blocked[7]. Therefore, chayote can lower blood pressure. It is well known that the effects of chayote are wasted through urination due to the diuretic properties of chayote and the salt content is reduced in blood. Reduced absorption levels of salt or water retention will lighten the physiological burden on the heart in pumping blood and thus blood pressure will decrease[8].

The decrease in blood pressure in hypertensive patients due to chayote occur due to high potassium content, which binds to sodium exiting through sweat and other secretory channels[9]. Reduced sodium in blood decreases the fluid volume in the blood causing a decrease in blood pressure[10,11]. Chayote has been reported to exhibit antihypertensive properties as dichloromethane extracts of cauliflower produce cinnamic acid and α-linolenic acid, which exhibit antimicrobial properties and act as antihypertensives[7]. This study aimed to demonstrate that the intervention of instant chayote and nutritional education can reduce systolic and diastolic blood pressure in adults.

MATERIALS AND METHODS

Research type: The type of study was pre-experiment with three groups of pretest post-test without control group.

Population and sample: The population consisted of high school teachers who are civil servants in Palu city. The determination results of the sample using the Lameshow formula[12] were obtained from 22 subjects and to avoid the sample loss 3 more subjects were added resulting in 25 pre-diabetic teachers for each group. In total, for the three groups 75 pre-diabetes teachers were recruited.

Making and packing chayote flour

Flour processing: The cauliflower was washed with running water, crushed into small pieces and placed in the oven for 2×24 h (until dry). Next, the sample was ground and sieved using a 80-mesh sieve size. Chayote flour was placed into a plastic package of 15 mg per pack. The flour was served and consumed by the addition of warm water to taste. The chayote was consumed for 30 days each morning and evening.

Intervention: The first group was the instant chayote intervention, in which each respondent was provided with instant chayote of 15 mg in the morning and 15 mg in the afternoon every day for 30 days. The second group was the nutrition education intervention, in which each respondent was provided with training and knowledge about food intake of pre-diabetics patients. Educational information was provided in the following manner:

Classical meetings for 2×60 min, for 3 meetings with an interval of 14 days (first meeting at the beginning of the intervention, second meeting on day 15 of intervening meetings and third meeting at the end of the intervention).

Face-to-face meetings of researchers and respondents performed at a specific time, according to the agreement by the researchers and respondents within 30-60 min.

Meetings between school groups where the respondent teaches, which was performed 1×60 min.

The third group consisted of nutrition education intervention and instant chayote feeding, in which each respondent was provided with instant chayote as well as training and knowledge about food intake of pre-diabetic consumption of instant chayote.

Blood pressure measurement: Blood pressure measurements (systolic and diastolic) were performed by laboratory personnel from the PRODIA Clinical Laboratory in Palu city.

Research ethics: This study received a recommendation of ethical agreement with Number: 440/H4.8.4.5.31/PP36-KOMETIK/2017 issued by Health Research Ethics Committee of Faculty of Medicine, RSPTN University of Hasanuddin, RSUP Dr. Wahidin Soedirohoesodo Makassar on June 21, 2017.

Statistical analysis: Univariate analysis was performed to examine blood pressure data (systolic and diastolic) in all three intervention groups. Normality tests were performed for variables with numerical using the Shapiro-Wilk test. Bivariate analysis for blood pressure (systolic and diastolic) before and after intervention, i.e., paired t-test and Wilcoxon Signed Ranks Test. The Wallis crucial test was performed to analyze the effect of intervention on blood pressure of all three groups (systolic and diastolic).

RESULTS

The participants in Group I and Group III showed a significant decrease in systolic blood pressure (SBP) after the intervention ($p<0.05$). The participants in Group I showed the greatest decrease in SBP compared with Groups II and III, with a mean D SBP of 15.24 points and Group II had the smallest change (3.12 points, Table 1).

The participants in Group I and Group III also showed a significant decrease in diastolic blood pressure (DBP) after the intervention ($p<0.05$). Group I showed the greatest decrease in SBP compared with Groups II and III, with a mean D DBP of 8.293 points, while Group II had the smallest change (1.88 points, Table 2).

Table 3 shows that there was no significant difference in the reduction of systolic blood pressure and diastolic blood pressure between Group I and Group III ($p>0.05$). Group I and Group II showed significant differences in the change in systolic blood pressure and diastolic blood pressure ($p<0.05$). Group II and Group III showed significant differences in systolic blood pressure ($p<0.05$), while diastolic blood pressure showed no significant difference ($p>0.05$). Thus, the Group I intervention was more effective than the other interventions for reducing systolic and diastolic blood pressure.

DISCUSSION

The results showed that the interventions in Group I and Group III significantly decreased systolic blood pressure (SBP) and diastolic blood pressure (DBP) ($p<0.05$) after 30 days in pre-diabetic participants. The greatest decrease in SBP occurred in Group I, with 15.24 points, followed by Group III,

Table 1: Systolic blood pressure (SBP) in each group

	Intervention groups			
Variables	Provision of instant chayote	Nutrition education	Training of nutrition education and provision of instant chayote	p-value
SBP before intervention				
Minimum	120.000	110.000	107.000	0.586*
Maximum	160.000	171.000	165.000	
Mean (average)	133.240	131.320	130.080	
SD (standard deviation)	10.146	16.943	16.755	
SBP after intervention				
Minimum	90.000	100.000	90.000	0.036*
Maximum	150.000	180.000	160.000	
Mean (average)	118.000	128.200	115.600	
SD (standard deviation)	14.720	19.088	17.578	
p-value	0.000**	0.190**	0.000***	
ΔSBP				
Minimum	0.000	-20.000	-10.000	0.003*
Maximum	40.000	23.000	40.000	
Mean (average)	15.240	3.120	14.480	
SD (standard deviation)	10.541	12.340	12.000	

Source: Primary data 2017. *Kruskal Wallis Test, **Wilcoxon signed ranks test, ***Paired t-test

Table 2: Systolic blood pressure (SBP) changes among the three intervention groups

Comparison between types of interventions	p-value
Provision of instant chayote with the training of nutrition education	0.001*
Provision of instant chayote with instant nutrition training and instant chayote provision	1.000
Nutrition education training with nutrition education training and instant chayote provision	0.003*

*p<0.05

Table 3: Diastolic blood pressure (DBP) in each group

Variables	Intervention groups: Instant chayote provision	Nutrition education	Training of nutrition education and provision of instant chayote	p-value
DBP before intervention				
Minimum	70.000	65.000	70.000	0.097*
Maximum	100.000	104.000	100.000	
Mean (average)	88.360	83.480	83.960	
SD (standard deviation)	8.190	10.104	10.031	
DBP after intervention				
Minimum	60.000	70.000	60.000	0.213*
Maximum	90.000	110.000	100.000	
Mean (average)	77.120	81.600	77.120	
SD (standard deviation)	8.890	10.279	8.890	
p-value	0.000**	0.253**	0.005**	
ΔDBP				
Minimum	-10.000	-20.000	-20.000	0.007*
Maximum	20.000	20.000	30.000	
Mean (average)	11.240	1.880	6.840	
SD (standard deviation)	8.293	10.337	11.760	

Source: Primary data 2017. *One-way ANOVA test, **Wilcoxon signed ranks test

Table 4: Diastolic blood pressure (DBP) change among the three intervention groups

Comparison between types of interventions	p-value
Provision of instant chayote with the training of nutrition education	0.006*
Provision of instant chayote with instant nutrition training and instant chayote provision	0.398
Nutrition education training with nutrition education training and instant chayote provision	0.272

*p<0.05

with 14.48 points and Group II with 3.12 points. The greatest decrease in DBP was observed in Group I with 11.24 points, followed by Group III with 6.84 points and Group II with 1.88 points.

Consistent with the results obtained by Yanti[11] in 128 respondents with hypertension, the mean systolic and diastolic blood pressure decrease was 15.500 and 9.000 mm Hg (p<0.00), respectively, after the participants were given chayote. Djaelani[13] found a difference in systolic and diastolic pressure before and after the administration of chayote. Without medicine, the blood pressure of hypertensive patients decreased after the consumption of chayote for 5 consecutive days. Chayote contains high levels of potassium, alkaloids and flavonoids. Adrogue and Madias[9] showed that hypertensive patients who ate foods containing potassium and adequate sodium demonstrated reductions of systolic blood pressure by 3.4 mm Hg and of diastolic pressure by 1.9 mm Hg. The flavonoids in the chayote play a role in inhibiting the regulation of the renin angiotensin aldosterone system and inhibit angiotensin I converting enzyme (ACE) and ACE inhibitors, which cause blood vessels to dilate, resulting in enhanced blood flow into the heart and a subsequent decrease in blood pressure[14].

A significant decrease in systolic blood pressure was observed in Group III (combination of nutrition education and chayote). Castro *et al.*[15] showed that nutritional education interventions can lead to an increase in physical activity in primary prevention, thereby positively affecting the prevention of cardiovascular risk factors, specifically blood pressure and blood lipid levels. The decrease in blood pressure in hypertensive patients who are given chayote is due to chayote's high levels of potassium, which binds to sodium and is excreted via sweat and other secretory channels. Reduced sodium in the blood results in a decreased fluid volume in the blood, causing a decrease in blood pressure[9,11]. Chayote has been reported to exhibit anti-hypertensive properties. Dichloromethane extracts of chayote produce cinnamic acid and α-linolenic acid, which exhibit antimicrobial properties and act as an antihypertensive[7].

Nutritional education programs for hypertensive patients are becoming increasingly important as non-pharmacological methods of treatment for hypertension. Andrade *et al.*[16] reported that nutrition education and lifestyle changes, i.e., 1: Reducing salt consumption, 2: Eliminating alcohol consumption, 3: Increasing consumption of vegetables, fruits and low-fat foods, 4: Reducing weight, 5: Increasing regular physical exercise and 6: Eliminating smoking, have been proven to lower blood pressure.

Epidemiological studies have shown that individuals with high-risk of hypertension have diabetes mellitus. In a prospective study of more than 12,000 adults, hypertensive patients were found to be 2.5 times more likely to develop diabetes mellitus compared with patients with normal blood pressure[16]. A study showed that impaired glucose tolerance and non-insulin-dependent diabetes mellitus placed females at a higher risk of hypertension compared with males[17–20].

These research implications should be considered for patients who suffer from hypertension and instant chayote consumption and nutritional education are recommended for hypertensive patients to obtain a healthy lifestyle. Results of the current study suggest that instant chayote may represent an alternative preventive treatment for hypertension.

This research study included a limited number of research subjects, i.e., 75 people and thus the results cannot be generalized to larger groups.

CONCLUSION

Systolic and diastolic blood pressure decreased after patients received the 3 types of interventions. The chayote intervention group showed significant blood pressure decreases of 15.24 mmHg (systolic) and 11.24 mmHg (diastolic). The nutritional education intervention group also showed a decrease, although it was not significant. Nutritional intervention was still necessary to improve the participants' knowledge regarding hypertension risk factors and diabetes mellitus. Thus, it is very important to provide chayote and nutrition education simultaneously to reduce blood pressure and prevent pre-diabetic complications.

SIGNIFICANCE STATEMENT

This study reports that chayote can be beneficial for controlling systolic and diastolic blood pressure in pre-diabetics. This study will help the researchers to uncover critical areas of efficacy chayote that many researchers have been unable to explore. Thus, a new theory on the provision of chayote are very important given that chayote can controlling blood pressure remained normal and prevent pre-diabetic complications .

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