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The effect of chocolate consumption (*Theobroma cacao* L.) on level of blood cholesterol and triglyceride in hypertension patients at Jatiroto Health Center, Indonesia

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ABSTRACT

Background: Hypertension is influenced by lifestyle factors such as high fat intake which has the potential for high blood cholesterol level. Cocoa products, which are rich sources of flavonoids, have been shown to reduce blood pressure and the risk of cardiovascular disease.
Aims: The purpose of this research is to examine the dark chocolate consumption in decreasing the level of blood cholesterol and triglyceride in hypertension patients.
Methods: This research is a quasi-experiment study with pre and post and control group design. There were thirty two (32) hypertensive patients selected from Jatiroto Health Center in June-July 2018 using a random sampling technique. The respondents were then divided to (1) a control group where patients were prescribed to a popular non-pharmacological therapy Simvastatin and (2) an intervention group where the respondents were prescribed with Simvastatin and also received an additional dark chocolate 60gr/day (given twice a day, each 30gr) for 15 days. A spectrophotometer glycerol phosphate oxidase (GPO-POD) with 546 nm wavelength was employed to measure the levels of blood cholesterol and triglyceride. The significant mean difference between pre and posttest, and the changes between control and intervention group were defined by statistical analysis *T*-test.
Results: This study acknowledged that the prescribed simvastatin alone presents a significant contribution to decrease the cholesterol level at 14.40 point (p value = 0.041), however, the generic is not enough to deliver a significant effect to the decrease of triglyceride level in the hypertension patients (p value = 0.361). A great contribution to the depression of cholesterol and triglyceride level in the hypertensive respondent was observed if simvastatin prescription was combined with a provision of 60 gram dark chocolate, respectively to the level of 57.06 and 38.41 mg/dL with p value = 0.001. The addition of dark chocolate in the simvastatin prescription will significantly reduce the blood cholesterol level (p value = 0.020), but not really effective to reduce the triglyceride (p value = 0.560).
Conclusion: The findings suggest that giving dark chocolate to the hypertensive patients who receive simvastatin prescription will decrease the cholesterol and triglyceride levels greater than the consumption of simvastatin drugs alone.

INTRODUCTION

Hypertension is a non-communicable disease and is indicated by the increasing of systole blood pressure ≥140 mmHg and diastole blood pressure ≥90 mmHg. World health organization (WHO) estimated 24% of male and 20.5% of female adults worldwide suffered from hypertension [1]. Unhealthy life style such as poor diet and lack of physical activity has been identified as the risk factors of NCDs [2-4]. High unsaturated fat intake affects the development of elevated blood cholesterol levels as the benchmark for the incidence of

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clinical cardiovascular disease. The buildup of cholesterol in the blood results in thickening of the walls of the arteries and reduced elasticity of blood vessels. As a consequence, blood flow requires high pressure in passing through narrow blood vessels. The impact that occurs if this condition is not addressed immediately will result in cardiovascular disorders [5].

Studies have documented the behavioral intervention as the most cost-effective treatment for NCDs instead of medicine [6-8]. Dietary modifications that increase the intake of vegetables, fruit, and grains and decrease the intake of saturated fats and refined sugars are recommended for hypertensive patients with high blood cholesterol levels [9] beside physical activity [10, 11].

Cocoa products, which are rich sources of flavonoids, have been shown to reduce blood pressure and the risk of cardiovascular disease. Regular consumption of cocoa flavanol-containing chocolate bars can significantly lower serum total and LDL cholesterol levels [12] as dark chocolate contains saturated fat and is a source of dietary calories [13]. The mechanism of how dark chocolate may reduce cholesterol are lacking in clinical settings, but several studies have shown that flavones have been shown to stimulate the production of endothelial nitric oxide, causing blood vessels to dilate and thus lowering blood pressure [9]. Dark chocolate consumption has also been suggested to have lipid modifying effects, decreasing total and low density lipoprotein cholesterol levels and increasing high density lipoprotein cholesterol levels. This study aims to compare the effect of drug combined chocolate treatment to chocolate treatment only in reducing blood cholesterol level among hypertension patients.

METHODS

This was a quasi-experimental study with pre-test and post-test design with a control group design. The population in this study was all hypertensive patients who were treated at the Jatiroto Health Center, Indonesia. Random sampling technique was practiced to assign patients into 2 groups with criteria of inclusion as follows: 1) having hypertension with systole ≥130 mmHg, and diastole ≥85 mmHg; 2) total cholesterol level above 200 mg/dl; 3) were not under other treatment; and 4) willing to participate in the study. Hypertension patients with obesity, diabetes mellitus, and arthrosclerosis and kidney disorders were excluded from the study. Patients in the intervention group were administered with simvastatin with an additional dark chocolate 60gr/day (given twice a day, each 30gr) for 15 days, while patients in the control group only received Simvastatin as the prescription.

Blood cholesterol level was measured by trained health officers where the patients were asked to not taken any food (fasting) 8 hours before blood sample taken. The day before any medication taken by the respondents, counted as Pretest. After the measurement for the Pretest data, the patients were asked to take their medication as prescribed by doctor which at the intervention group they were asked to consume 60gr/day dark chocolate twice a day. At the Day 15, patients at the control and the intervention group were invited for blood lipid profile determination (cholesterol and triglyceride), counted as Posttest. A spectrophotometer glycerol phosphate oxidase (GPO-POD) with 546 nm wavelength was employed to measure the levels of blood cholesterol and triglyceride where the interpretation of lipid status was following the classification from National Cholesterol Education Program Adult Panel III (NCEP-ATP III): cholesterol and triglyceride levels were considered high if measured more than 239 and 199 mg/dL [14].

Dependent *T*-test was employed to analyze the mean difference level of the blood lipid profile before and after treatment, while independent *T*-test was practiced to observe the results between groups. The procedures, research design and the study preparations have been approved prior the sampling and measurement, by the Health Research Ethics Commission of Semarang Health Polytechnic on June 21st, 2018, with number 463/KEPK/Poltekkes-Smg/EC/2018.

Table 1. Frequency distribution of respondent's characteristics

Characteristics	Intervention (N=17)		Control (N=15)		*p* value
	f	%	f	%	
Age					
26-45	3	17.6	2	13.3	0.791
46-65	11	64.7	11	73.3	
>65	3	17.6	2	13.3	
Sex					
Male	7	41.2	7	46.7	0.592
Female	10	58.8	8	53.3	
Hypertension history					
Yes	7	41.2	8	53.3	0.592
No	10	58.8	7	46.7	
BMI					
Underweight	2	11.8	-	-	0.041
Normal	6	35.3	12	80.0	
Pre obese	8	47.1	3	20.0	
Obese	1	5.9	-	-	
Severe obese	-		-	-	

RESULTS

There is no significance difference in the respondents' age between the intervention and a control group. Most of the respondents in both groups are adult aged between 46-65 years old, with a very low proportion of younger and oldest adult. There is a slight difference in the proportion of male/female where female respondents are slightly higher than their male counterparts. More respondents in the control group had hypertension history (53 versus 41 percent) compared to the intervention group. The Body Mass Index (BMI) was categorized into 5 groups; underweight (≤ 18.4), normal (18.5-24.9), Pre obese (25-29.9), Obese (30-39.9) and Severe obese (>40). While most respondents in control group are categorized normal, only 35 percent in intervention group had a normal Body Mass Index (BMI). With 47 percent of respondents in the intervention group was categorized as pre-obese, the interpretation of the results should be made with cautions.

Table 2. Cholesterol level (mg/dL) in the intervention and control group

Variable	Intervention (N=17)		Control group (N=15)	
	Mean ± SD	Range	Mean ± SD	Range
Pre	250.18±31.08	204-298	236.00±24.2	207-271
Post	193.12±43.55	98-260	222.40±30.5	178-278

Table 2 shows the cholesterol levels of patients in both group. Prior to the intervention, blood cholesterol level of respondents in the intervention group was higher compared to their counterparts in the control group (250 versus 236 mg/dL), which means, all patients are above the normal level (200 mg/dL). After the provision of simvastatin with an additional dark chocolate 60gr/day (given twice a day each 30gr) for 15 days, the blood cholesterol level of respondents in the intervention group decreased significantly to 193 mg/dL whereas respondents in the intervention group who did not received dark chocolate treatment slightly decreased into 222 mg/dL.

Table 3. Blood lipid profile (cholesterol and triglyceride) before and after treatment at the control and intervention group

Blood lipid profile	Pretest-post test		*p* value
	Control	Intervention	
Cholesterol (mg/dL)			
Difference	-14.40 ± 24.83	-57.06 ± 41.50	0.020
p value	0.041	0.001	
Triglyceride (mg/dL)			
Difference	-23.47 ± 96.10	-38.41 ± 38.98	0.560
p value	0.361	0.001	

From a paired *T*-test, as shown in Table 3, this study noticed that the prescribed simvastatin alone presents a significant contribution to decrease the cholesterol level at 14.40 point (*p* value = 0.041), however, the generic is not enough to deliver a significant effect to the decrease of triglyceride level in the hypertension patients (*p* value = 0.361). A great contribution to the depression of cholesterol and triglyceride level in the hypertensive respondent was observed if simvastatin prescription was combined with a provision of 60 gram dark chocolate, respectively to the level of 57.06 and 38.41 mg/dL with *p* value = 0.001. From an Independent *T*-test, it showed that there is a significant difference of blood cholesterol between intervention and control group with a *p* value of 0.020, however, the mean difference of triglyceride is not significant at the control group (*p* value > 0.05). It means that the addition of dark chocolate in the simvastatin prescription will significantly reduce the blood cholesterol level, but not really effective to reduce the triglyceride.

DISCUSSION

The present study found, the generic simvastatin prescribed to the hypertension patients slightly decreased the blood lipid profile. A higher depression of cholesterol and triglyceride level was observed at the intervention group where the patients received the simvastatin with the provision of dark chocolate. Although patients in the control group also experienced a slight decrease in the cholesterol level, however, the chocolate addition helped the reduction of cholesterol level of patients in the intervention group further. The results of this study corresponds with the previous studies in evaluating the intake of 50 grams of chocolate against the lipid profile in hypertension which showed a decrease in the average total cholesterol level [15]. Dark chocolate which contained flavonoids has been proven helpful in reducing levels of *3-hydroxy-3-methylglutaryl-CoA* (HMG CoA) *reductase* which later causes a decrease in cholesterol levels in the blood [16]. Dark chocolate with flavonoid-rich also improved endothelial function after regular consumption for 30 days [17].

The changes in triglyceride level will only be significant if the hypertensive patients who received simvastatin prescription also adding dark chocolate to their daily consumption. The findings in line with the previous study which acknowledged the popular non-pharmacological therapy, simvastatin, decreased the triglyceride level in blood, however the changes was not significant [18]. However, if compared to the level in control and intervention group, the 2-week additional consumption of 60 gram dark chocolate, doubled from the previous study

by Muniyappa *et. al.* [19], is still not effective to reduce the triglyceride.

Flavonoid compounds which are polyphenol derivatives capable of reducing plasma total cholesterol levels by inhibiting cholesterol absorption by the intestine and increasing the reaction of bile acid formation from cholesterol and then secreted through feces. Phenol and polyphenols play a role in reducing the secretion of lipoproteins found in the liver and intestines and reduce the process of cholesterol esterification resulting in a decrease in cholesterol ester levels where cholesterol esters are the main formation component of psychometric and VLDL [20]. The activity of lipoprotein lipase will also decrease the level of triglyceride. Antioxidants are able to dissolve in water and work very effectively as a deterrent to the process of lipid peroxidation in the plasma. In addition, it helps the hydroxylation reaction in the formation of bile acids thereby increasing cholesterol excretion and decreasing total cholesterol levels in the blood [20]. Polyphenol compounds affect the rate of increase in blood cholesterol levels by inhibiting the increase in total cholesterol levels by a mechanism to inhibit the activity of the *enzyme HMG CoA* reductase which plays an important role in the biosynthesis of cholesterol [21, 22].

CONCLUSION

This study concluded that the prescribed simvastatin alone presents a significant contribution to decrease the cholesterol level, however, the generic is not enough to deliver a significant effect to the decrease of triglyceride level in the hypertension patients. A significant contribution to the depression of cholesterol and triglyceride level in the hypertensive respondent was observed if simvastatin prescription was combined with a provision of 60 gram dark chocolate per day for 15 days. The findings recommend the provision of dark chocolate to the hypertensive patients who received simvastatin prescription in their medication to significantly reduce the blood cholesterol level, but not really effective to reduce the triglyceride.

CONFLICT OF INTERESTS

No conflict of interests involved in the study.

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