Effect of tender coconut water on systolic and diastolic blood pressure in prehypertensive women

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Abstrak

Latar belakang: *Insiden prehipertensi di Indonesia dimulai sejak usia dewasa muda. Salah satu faktor risiko prehipertensi adalah asupan kalium rendah. Asupan makanan kalium tinggi akan menurunkan tekanan darah (TD). Air kelapa muda segar adalah khas minuman tinggi kalium. Penelitian ini bertujuan untuk mengetahui pengaruh air kelapa muda segar terhadap tekanan darah prehipertensi wanita.*

Metode: *Penelitian ini merupakan penelitian acak tersamar tunggal di antara 32 subjek perempuan berusia 25-44 tahun. Subjek dibagi menjadi dua kelompak masing-masing terdiri dari 16 subjek. Kelompok perlakuan diberi air kelapa muda segar 300 ml dua kali sehari selama 14 hari dan konseling gizi, sedangkan kelompok kontrol diberi air 300 ml dua kali sehari selama 14 hari dan konseling gizi. Penilaian tekanan darah dilakukan pada hari 0, hari ke-8, dan hari ke-15. Analisis statistik menggunakan t-test dan test Mann-Whitney.*

Hasil: *Rerata asupan kalium sebanyak 1420,28 ± 405,54 mg / hari atau 30,22 ± 8,63% dibandingkan dengan Recomendasi Diet Indonesia 2004. Selama masa penelitian, asupan kalium meningkat secara signifikan pada kelompok perlakuan. Di samping itu terdapat penurunan tekanan darah pada kedua kelompok, dan yang lebih besar terjadi pada kelompok perlakuan tetapi tidak signifikan secara statistik (P > 0,05). Rata-rata penurunan yang signifikan terhadap tekanan darah sistolik pada kelompok perlakuan (P = 0,031), sementara penurunan tekanan diastolik tidak menunjukkan perubahan yang signifikan (P=0.134)*

Kesimpulan: *Air kelapa muda segar 300 ml dua kali sehari selama 14 hari berturut-turut cenderung menurunkan tekanan darah sistolik, tetapi tidak terhadap tekanan darah diastolik.* ***(Health Science Indones 2013;2:64-8)***

Kata kunci: *air kelapa muda segar, tekanan darah, sistolik dan diastolik*

Abstract

Background: The incident of prehypertension in Indonesia has started since young adulthood. One of the risk factors of prehypertension is low potassium intake. Dietary intakes of high potassium will decrease blood pressure (BP). Tender coconut water (TCW) is a typical drink high in potassium. This study aimed to investigate the effect of TCW on BP in female teachers and employees prehypertension.

Methods: The research was a parallel single blind randomized clinical trial. A total of 32 female prehypertension subjects aged 25-44 years. The subjects were selected using certain criteria and randomly allocated to one of two groups using block randomized, 16 subjects each. The treatment group received TCW 300 ml twice daily for 14 days and nutritional counseling, and the control group received water 300 ml twice daily for 14 days and nutritional counseling. Assessment of BP was done on day 0, day 8, and day 15. Statistical analysis were done using t-test and Mann-Whitney test.

Results: Mean dietary intakes of potassium were 1420.28±405.54 mg/day or 30.22±8.63% compared to Recommended Dietary Allowance (RDA). During treatment period, potassium intake increased significantly in the treatment group. There were decreased BP in both groups, which were greater in the treatment group, but not statistically significant different (P > 0.05). The mean decrease of systolic BP was significant in treatment group (P = 0.031), meanwhile the mean decrease of diastolic BP was not significant (P=0.134).

Conclusion: Tender coconut water 300 ml twice daily for 14 consecutive days has tendency to decrease systolic BP, but not diastolic blood pressure. ***(Health Science Indones 2013;2: 64-8)***

Key words: coconut water, systolic and diastolic blood pressure

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Cardiovascular disease (CVD) is the leading cause of deaths worldwide, and one of the risk factors of CVD is hypertension. Prehypertension (PHT) defined as systolic blood pressure (SBP) of 120-139 mm Hg and/or diastolic blood pressure (DBP) of 80-89 mm Hg, is associated with 3-fold greater risk likehood of developing hypertension, and roughly twice the number of CVD, than normotension.[1,2] The mean of blood pressure (BP) in Indonesia at 25-34 years are 124.7/79.9 mm Hg and increases with advancing age.[3]

One of the risk factors of PHT is low potassium intake while one of its causes is consumed less fruit and vegetables as recommended 4-5 servings per day and average of only eating one serving per day.[4,5] Nonpharmalogical strategies are the main recommended for PHT subjects. The Dietary Approaches to Stop Hypertension (DASH) diet showed that BP was significantly reduced in PHT by using a diet rich in vegetables and fruits (high potassium).[2]

A meta-analysis study have shown that increasing potassium intake will decrease BP.6 Mechanism of potassium in lowering BP are natriuresis, endhotelium-dependent vasodilatation, decreasing activity of the renin angiotensin aldosterone (RAA) and increasing neuronal Na pump resulting in decreasing sympathetic nerve activity.[7]

Lifestyle modification such as weight loss, exercise, and dietary alteration are important to reduce BP, and in Indonesia it has not been widely studied particularly the increase potassium intake in PHT. Tender coconut water is a typical drinks high in potassium, and coconut water 6-8 months age have the highest content of potassium.[8] Alleyne et al9 studied TCW 300 ml twice daily for two weeks in hypertensive subjects, showed significant decrease BP. This study aimed to investigate the effect of TCW 300 ml twice daily for 14 consecutive days on BP in PHT female teachers and employees aged 25-44 years.

METHODS

This study was a single blind randomized clinical trial. A total of 32 PHT female teachers and employees aged 25-44 years in five Islamic Education Foundation in Surabaya at April – Juni 2013 were selected using certain criteria and randomly allocated to one of two groups using block randomized, 16 subjects each. The treatment (T) group received TCW 300 ml twice daily for 14 days and nutritional counseling, and the control (C) group received water 300 ml twice daily for 14 days and nutritional counseling. Coconut water used comes from coconut hybrid varieties aged 6-8 months were taken directly from the coconut plantation in Lumajang with potassium content was 1789±116.7 mg/L.

Subjects were included in the study if they had a BMI within 18.5–29.9 kg/m2. Exclusion criteria were hypertension, consuming antihypertensive drugs and potassium supplement, consuming tobacco and alcohol, pregnant or nursing, menopause, diabetes mellitus or blood glucose level ≥200 mg/dL, and creatinine clearance test (CCT) < 60 mL/min.

Data collection in this study consisted of age, physical activity, body mass index, intake of energy and potassium, systolic and diastolic BP. The study personnel who obtained these measurements were blinded to intervention assignments. Data of age and physical activity index were obtained by interview. Body weight was measured in light indoor clothes without shoes to the nearest 0.1 kg using a high-quality digital scale and microtoise was used to measure body height.[10] Physical activity index was calculated by multiplication intensity, duration, and frequency of physical activity the subjects.[11]

Dietary intake of energy and potassium were assessed by collecting a two-day food record during run in, week 1 and 2 periods of data collection. The individual energy requirement was calculated using Harris-Benedict Equation.[12] Mean potassium intake was compared with the recommended daily intake which is 4700 mg/day.[13]

Blood pressure was measured in the seated position in the right arm after a 10 min rest using mercury sphygmomanometer “Riester” and stetoscope “Litman”. Two readings were taken at 5 min intervals then averaged.[10] BP was assessed at approximately the same time of the day (morning) by the same observer using the same instruments throughout the study and were assessed in day 0, 8, and 15.

All data were checked for normality using the Saphiro-Wilk test. The unpired t-test and Mann-Whitney were used to assess the significance of differences between two groups with the level of significance was 5%.

This study were approved by the ethics committee of Medical Faculty, Universitas Indonesia.

RESULTS

From a total of 58 persons who were provided written informed consent to participate in the study, 37 individuals met the criteria. Simple random sampling done to get 32 subjects. At H+12 days, one subject of the T group got chikungunya illness and was drop out.

A total of 31 subjects completed the study. Average of age was 36.58±5.39 years, had a BMI of 24.59±2.89 kg/m2, and 93.55% subjects have physical activity index below the average. The mean BP of 125.87±6.36 mm Hg/79.84±4.11 mm Hg. Table 1 demonstrates that the characteristic data of the two groups at base line were not significantly different or were closely matched at base line.

Mean potassium intake classified as low score (1420.28±405.54 mg/day) or only 30.22±8.63% compared to RDA. In treatment periode, potassium intake increased significantly within the T group. Percentage of energy intake compared to the total energy requirement at weeks 0, 1, 2 between two groups were not significantly different.

There were decreased systolic and diastolic BP in both groups, which were higher in the T group, but not statistically significantly different (table 3).

Table 1. Characteristic of base line data

Variabel	Treatment	Control	p
Age (years)	35.73±5.92	37.38±4.90	0.406*
Body mass index (kg/m^2)	24.73±2.74	24.45±3.12	0.792*
Physical activity	24.73 ±6.72	20.50 (16-42)	0.223†
Systolic blood pressure (mm Hg)	124.93±6.54	126.75±6.27	0.436*
Diastolic blood pressure (mm Hg)	80.20±4.35	79.50±3.98	0.643*
Blood glucose level (mg/dl)	93.67±32.44	89.19±29.64	0.691*
Creatinine clearance test (ml/minute)	95.67±22.69	85.81±14.98	0.162*

* = t-test; † = Mann-Whitney

Table 2. Potassium intake and percentage of energy intake to energy requirements (%)

Variabel	Treatment	Control	P*
Potassium intake (mg/ day)			
Pre treatment	1387.28±339.58	1451,21±117,04	0.669
First week	2743.68±540.05	1755.43±530.84	0.000
Second week	2871.10±587.59	1675.73±561.52	0.000
Percentage of energy intake to energy requirements (%)			
Pre treatment	89.88±20.80	95.64±16.21	0.286
First week	89.62±21.99	96.01±16.56	0.367
Second week	93.97±21.99	92.26±6.45	0.844*

* = t-test

Table 3. Systolic and diastolic blood pressure

Variabel	Treatment	Control	P*
Systolic (mm Hg)			
H0	124.93±6.54	126.75±6.27	0.436
H+8	122.40±5.55	125.62±7.20	0.175
H+15	121.80±5.39	125.38±7.55	0.142
Change	- 3.13 ± 2.31	- 1.37±1.99	0,031
Diastolic (mm Hg)			
H0	80.20±4.35	79.50±3.98	0.643
H+8	78.93±4.40	78.88±4.74	0.972
H+15	78.52±4.78	78.81±4.09	0.862
Change	- 1.67 ±1.98	- 0.69±1.54	0.134

* = t-test

DISCUSSION

The study was a single blind since the subjects aware of treatment (taste of coconut water differed from water). A total of 31 subjects (96.9%) completed the study, and one drop out subject.

Confounding variables in this study included age, sex, obesity, physical activity, smoking, alcohol intake, blood glucose level, kidney function (CCT) had been controlled by using exclusion criteria so the results were not bias. The characteristic data of the two groups at base line were not significantly different or closely matched (Table 1), so the difference of value was only caused by intervention.

Percentage of energy intake compared to the total energy requirement at weeks 0, 1, 2 between two groups were not significantly different. Coconut water contains only about 44 kcal/L8, so it did not affect the energy intake of the T group subjects. Moreover, counseling on nutrition balanced seems to also play a role in the observance of the subjects followed a diet balanced nutrition. Therefore, it was estimated energy intake did not affect changes in BP.

In similar to the results of other authors showing that mean dietary potassium intake of their subjects were lower than adequate intake of potassium (4700 mg/d).[15-18] Our study found mean dietary intakes of potassium were 1420.28±405.54 mg/day or only 30.22±8.63% compared to RDA. One causes of low potassium intake was the low intake of vegetables and fruits (high in potassium). Data National Socio Economic Survey in 2004 showed approximately 60-70% of Indonesian people consumed less fruit and vegetables as recommended 4-5 servings per day with average of only eating one serving per day.[5]

In treatment periode, potassium intake increased significantly within the T group (table 2) since the potassium level in coconut water (1800 mg/L) greater than water (4 mg/L). Coconut water used came from coconut hybrid varieties aged 6-8 months and were taken directly from the coconut plantation in Lumajang. It was observed that potassium was the highest in the coconut water of the 6-8 month old.[8] Hybrida variety had chosen because it had high potassium level (±5000 mg/L) based on prior study.19 Our study revealed that the potassium level in hybrid was only ±1800 mg/L. The difference was likely due to potassium contents of hybrid varieties, climate, soil conditions, and fertilization.[8]

There were decreasing either in systolic or diastolic BP in both groups, which was higher in the T group, but not statistically significantly different (Table 3).

Previous studies showed that the significant decreased systolic and diastolic BP with potassium intake or supplement happened in hypertensive subjects. 9,14-17 There were supported too by meta-analysis study that hypertensive and older subjects (> 45 years) have a greater response to potassium.[6] Our subjects were young adult healthy prehypertensive subjects and we did not find significant decrease of systolic and diastolic BP and it was similar to Braschi et al.18 Nutrition counseling appears to play a role in obedience subjects to follow the pattern of balanced nutrition. Hsieh et al[20] showed regularly nutrition counseling on prehypertensive and hypertensive subjects significantly lowered BP.

The addition of potassium intake in group P were higher than group K should impact a significant decrease in BP, but the potassium contents of coconut water in this study appears to have not been able to give a significant effect of BP changes. Low potassium intake subjects with the addition of coconut water had not been too able to meet the RDA of potassium (4700 mg/d). It is similar to Braschi et al18 (potassium intake 3000 mg+ KCl/K-cit 1180 mg), but contras to a another study (potassium intake 2700 mg + KCl 4700 mg),16 potassium intake 3200 mg + KCl/K-cit 3800 mg,[15] and diet DASH 4700 mg.14 Another study demonstrated that supplementation with KCl 40 mmol (1564 mg/d) for 16 weeks, significantly lowered BP in a normotensive subjects who reported low intakes of these minerals (2433 mg). It is the possibility of treatment given at longer time.[17]

The intervention in this study was similar to prior study9 giving tender coconut water 300 ml twice daily for two weeks, but the result in this study was not significant decreasing BP. The difference is likely due to blood pressure condition (hypertension), potassium contents of coconut water, and effect of antihypertensive drug consumpted Alleyne's subjects.

In this study (Table 3), TCW had tendency to decrease systolic BP (p= 0.142) with mean decrease significantly (p=0.031). The increase blood volume will increase stroke volume and cause high systolic BP.21 The natriuretic mechanism may have important role to decrease systolic BP but it was not proven in this study. On the other hand, laboratory finding of potassium level and sodium level in 24 hours urine is reliable measurement to assess intake, since the

close biological relationship between dietary intake and urinary excretion. The limitation in our study is we did not examine sodium and potassium urine because of difficult to perform, not comfortable, inadequate urine pooling, insufficient if performed over only 1 day, and thus measurement over several days is considered necessary.[22]

In conclusion, tender coconut water 300 ml twice daily for 14 days has tendency to decrease systolic BP, but not diastolic blood pressure.

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REFFERENCES

1. Papadopoulos DP, Makris TK, Papademetriou V. Is it time to treat prehypertension? Hypertens Res. 2008;31:1681–6.
2. Gupta P, Nagaraju SP, Gupta A, et al. Prehypertension-time to act. Saudi J Kidney Dis Transpl. 2012;23:223-33.
3. Agency for Health Research and Development, Department of Health, Republic of Indonesia. Household Health Survey (Survey). Jakarta. The Agency. 2004.
4. Drewnowski A, Maillot M, Rehm C. Reducing the sodium-potassium ratio in the US diet: a challenge for public health. Am J Clin Nutr. 2012;96:439–44.
5. Central Bureau of Statistics (BPS) of Indonesia. National socio-economic survey 2004. Jakarta: The Bureau; 2004.
6. Geleijnse JM, Kok FJ, Grobbee DE. Blood pressure response to changes in sodium and potassium intake: a metaregression analysis of randomised trials. J Hum Hypertens. 2003;17:471–80.
7. Adrogue HJ, Madias NE. Sodium and potassium in pathogenesis of hypertension. N Engl J Med. 2007;356:1966-78.
8. Rethinam P. Coconut water-nature's health drink. Asian and Pasific Coconut Comunity. 2006.
9. Alleyne T, Roache S, Thomas C, et al. The control of hypertension by use of coconut water and mauby: two tropical food drinks. West Indian Med J. 2005;54:3-9.
10. Chobanian AV, Bakris GL, Black HR, et al. Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure. Hypertension. 2003;42:1206-52.
11. Montoye HJ, Kemper HCG, Saris WHM, et al. Measuring physical activity and energy expenditure. Human Kinetics. 1996.
12. Butte NF, Caballero B. Energy needs: Assessment and requirements. In: Shils ME, Shike M, Ross AC, Caballero B, Cousin RJ, Editors. modern nutrition in health and disease. 10th edition. Philadelphia: Lippicott Williams & Wilkins; 2006. p. 136-48.
13. Proboprastowo SM, Dwiriani CM. Adequacy rate of water and electrolytes. In: National Food and Nutrition Widyakarya VIII. Food security and nutrition in the era of globalization and regional autonomy. Jakarta, May 17 to 19 2004. p :418-28
14. Lin PH, Allen JD, Li YL, et al. Blood pressure-lowering mechanisms of the DASH dietary pattern. J Nutr Metab. 2012:1-10.
15. He FJ, Markandu ND, Coltart R, et al. Effect of short-term supplementation of potassium chloride and potassium citrate on blood pressure in hypertensives. Hypertension. 2005;45:571-4.
16. Smith SR, Klotman PE, Svetkey LP. Potassium chloride lowers blood pressure and causes natriuresis in older patients with hypertension. J. Am. Soc. Nephrol. 1992;2:1302-9.
17. Sacks FM, Willett WC, Smith A, et al. Effect on blood pressure of potassium, calcium, and magnesium in women with low habitual intake. Hypertension. 1998;31:131-8.
18. Braschi A, Naismith DJ. The effect of a dietary supplement of potassium chloride or potassium citrate on blood pressure in predominantly normotensive volunteers. British J Nutr. 2008;99:1284-92.
19. Arsa M. The sodium and potassium contents of isotonic coconut water (cocos nucifera) eburnia. viridis and hybrid varieties [thesis]. Denpasar. Universitas Udayana. 2011.
20. Hsieh YC, Hung CT, Lien LM, et al. Significant decrease in blood pressure through a family-based nutrition health education programme among community residents in Taiwan. Public Health Nutr. 2009;12:570-7.
21. Goljan EF. Rapid review pathology. 3rd edition. Vascular disorder [cited 2012 Nov 15]. Available from: www. Active at studentconsult.com.
22. Kawano Y, Tsuchihashi T, Matsuura H, et al. Report of the working group for dietary salt reduction of the Japanese society of hypertension: assessment of salt intake in the management of hypertension. Hypertens Res. 2007;30:887–93.