

<https://doi.org/10.33472/AFJBS.6.7.2024.427-436>

African Journal of Biological Sciences

Journal homepage: <http://www.afjbs.com>

Research Paper

Open Access

Effect of Beet Root Juice on Blood Pressure Level among Clients with Hypertension

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Article Info

Volume 6, Issue 7, 2024

Received: 03 March 2024

Accepted: 11 April 2024

Published: 08 May 2024

doi: [10.33472/AFJBS.6.7.2024.427-436](https://doi.org/10.33472/AFJBS.6.7.2024.427-436)

ABSTRACT:

Background: Hypertension is the major global risk factor for mortality, accounting for 13% of all deaths. Worldwide, though, hypertension identification, awareness, treatment, and control are poor. A healthy lifestyle can lower blood pressure without causing any negative side effects and can also enhance cardiovascular health in general. According to the World Health Organization (WHO), cardiovascular disease accounts for 17.5 million (31%) of all annual fatalities, placing a considerable burden on the global health system. Almost 10 million of these fatalities are thought to be specifically related to hypertension, which is currently thought to be the main risk factor for the burden of disease worldwide.

Materials and methodology Quantitative research approach and a quasi-experimental control group pre and post-test research design was adopted for this study. The study was conducted in selected community area at Sangli- Miraj- Kupwad Corporation area. The sample size for the study was 50 (25 in experimental and control group) using G power analysis with non- probability purposive sampling technique. Data collection was done by using demographic variables, clinical variables and observational table for assessment. The data was analysed using descriptive and inferential statistics.

Results In the present study, it was found that after intervention of beet root juice in experimental group, there was significant difference in post interventional parameters of blood pressure level i.e., p value was 0.0001. The result shows that there was significant difference between pretest and post test scores between experimental and control group. The obtained 't' value of systolic and diastolic blood pressure was 21.82 and 6.26 respectively and p value was 0.0001 (< 0.05), null hypothesis was rejected. It was evident that the systolic and diastolic blood pressure reduced significantly after administration of beet root juice in experimental group.

Conclusion The study finding concludes that beet root juice administration was effective in reducing blood pressure among hypertensive clients. It was also found that people had experienced less fatigue, were more energized and well hydrated with consumption of beet root juice. Hypertension cannot be cured but managed, controlled effectively with beet root juice along with routine treatment.

Key words- Beet root juice, Blood pressure level, Hypertension.

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1. Introduction

Hypertension is the major global risk factor for mortality, accounting for 13% of all deaths. Worldwide, though, hypertension identification, awareness, treatment, and control are poor. Controlling hypertension at the population level requires a number of steps. Identification of persons at risk is necessary first [awareness]. Second, people with hypertension need to receive the proper care, whether that involves medication, a change in lifestyle, or a mix of the two. Finally, they need to be monitored to make sure they're following their treatment plan and keeping their blood pressure under control.^{1,2}

A rising burden of NCDs (Non-Communicable Diseases) is causing major morbidity and mortality in both rural and urban populations in India, as well as a large loss of years of life that could have been spent being productive (between the ages of 35 and 64). According to World Health Organization (WHO, 2002), adopting healthy behaviours including quitting smoking, eating a balanced diet, keeping a healthy weight and exercising regularly can cut the risk of coronary heart disease, stroke and diabetes by roughly 75 percent and that of malignancies by 30 percent.³

In India, cardiovascular illnesses contributed to 2.3 million fatalities in 1990; by 2030, this number is expected to treble. In India, 57% of deaths from stroke and 24% from coronary heart disease are directly attributable to hypertension. Although there has been a continuous rise over time in this demographic as well, the prevalence of hypertension is lower in rural Indians. Urban individuals have a high prevalence of hypertension, according to recent research utilizing improved criteria (BP 140 and/or 90 mmHg). Combining epidemiological data reveals that 10% of subjects in India's rural areas and 25% of urban ones have hypertension. There are 31.5 million hypertensives in rural areas and 34 million in urban areas, per estimate. 70% of them would have Stage I hypertension (systolic blood pressure of 140 to 159 and/or diastolic blood pressure of 90 to 99 mmHg).⁴

Indeed, high blood pressure is a risk factor that can be changed. According to estimates, approximately one billion individuals globally (or about 26% of the adult population) had hypertension in 2000. Every year, more people are diagnosed with hypertension, which is predicted to affect 29% of the population by 2025. Indicable secondary hypertension affects 5–10% of patients with hypertension. Since this type of hypertension is treated differently from essential hypertension, the underlying cause of the elevated blood pressure, it is crucial to identify it. Because it causes no early symptoms and is the single biggest risk factor for heart disease, including myocardial infarction, left ventricular hypertrophy, etc., hypertension is frequently referred to as "the silent killer."⁵

The most significant public health issue in modern nations is elevated arterial pressure, which is prevalent, asymptomatic, easily detectable, and typically treatable and frequently results in fatal complications if left untreated. The risk of stroke, heart attack, congestive heart failure, hypertensive retinopathy and nephropathy can all be decreased with effective hypertension management. Reducing blood pressure is the aim of hypertension treatment. The risk of severe hypertension consequences is decreased by hypertension treatment and appropriate lifestyle adjustments.⁵

According to disability-adjusted life, hypertension is the third-highest risk factor for losing healthy years of life to illness or premature death. Hypertension is the main cause of death worldwide. Major cardiovascular disease risk factors, in particular ischemic heart disease and stroke, include hypertension. The prevalence of hypertension has significantly increased in low- and middle-income nations over the past few years, and in South Asia, it now ranks as the third most significant risk factor for disease burden. Hypertension is a severe public health concern in the Asian region where it affects more than 35% of the adult population. By 2025, it is anticipated that the burden of hypertension will increase in India and China. The

risk of severe hypertension consequences is decreased with adequate lifestyle adjustments and hypertension treatment. The risk of hypertension and other harmful health issues is increased by obesity, being overweight and leading a sedentary lifestyle.⁶

The primary cause of death, cardiovascular diseases, stroke, and end-stage renal diseases have all been linked to uncontrolled blood pressure (BP).⁶ However high blood pressure can be efficiently controlled with antihypertensive drugs and lifestyle changes such limiting sodium in the diet, drinking in moderation, and exercising frequently. A healthy lifestyle can lower blood pressure without causing any negative side effects and can also enhance cardiovascular health in general. Those who are still at risk of developing hypertension but have not yet reached the point where clinical care is necessary, as well as those who have already been given a hypertension diagnosis, have both shown to benefit from decreased blood pressure. Hence, lifestyle change is definitely recommended for hypertension patients regardless if they are on regular treatment of anti-hypertensive medications as well as normotensive patients.⁷

Green leafy vegetables high in nitrates have demonstrated positive results in decreasing blood pressure and improving endothelial function in healthy persons, while garnering less attention than beetroot juice. Green leafy vegetables including lettuce and spinach, as well as fennel, rocket, radishes, Chinese cabbage, and parsley, are particularly high in nitrates. Green leafy vegetables also include nitrates, as well as vitamins C, E, and K, carotenoids like lutein and beta-carotene, folate, iron, zinc, calcium, and magnesium.⁸

The primary risk factor for cardiovascular disease, hypertension, is a result of a combination of genetic, environmental, and social variables. Environmental causes include being overweight or obese, eating a poor diet, getting too much sodium or potassium in your diet, not doing enough exercise, and drinking alcohol. Targeted and/or population-based methods can be used to prevent and control hypertension. The focused strategy for controlling hypertension entails actions to improve individual awareness, treatment, and control.⁹

A possible intervention for improving blood pressure and vascular function in hypertension is dietary nitrate (nitrate). As a result, rather than the use of antihypertensive medications, the effectiveness of nitrate to lower blood pressure and enhance vascular function in hypertension appears to depend on the degree of vascular dysfunction and blood pressure elevation. Individuals with uncontrolled hypertension (defined as >140/90 mmHg) are more sensitive to the effects of nitrate supplementation, most likely as a result of their improved capacity to convert nitrite to NO. Patients with uncontrolled hypertension who were either drug-naïve or receiving subpar antihypertensive medication treatment benefited from nitrate supplementation in terms of both blood pressure and vascular function. Almost half of all individuals with hypertension who are receiving treatment still have excessive blood pressure. Nitrate supplementation has the ability to reduce blood pressure, making it a desirable non-pharmaceutical supplementary treatment for hypertension.¹⁰

Beetroot juice and its health benefits

- i. Lowers blood pressure: Consuming beet juice increases perfusions, or blood flow, to the brain. This is due to beets' abundant nitrate content, which promotes free blood flow in blood vessels.
- ii. Anemia and low blood haemoglobin: Due to the high iron content of beet juice, anemia and low blood hemoglobin can be treated. Thus, it is also helpful for pre-menstrual symptoms.
- iii. Cancer: Beets have been discovered to boost the number of CD8 cells, which are cells that fight cancer, in the colon.
- iv. Aging: Beets make a great anti-aging food because of their anti-oxidants, polyphenols, vitamins, and minerals for healthy body development.

- v. Brain function: Beetroot juice's advantages penetrated the perplexing blood-brain barrier with ease and improved blood flow to crucial regions of the brain associated with executive function.
- vi. Antioxidant qualities that decrease LDL cholesterol oxidation has folic acid, which is necessary for healthy body growth.
- vii. Osteoporosis: Decreases the incidence of osteoporosis due to its silica concentration, which aids the body in utilizing calcium.¹⁰

2. Methods

The research approach adopted for the present study was quantitative research approach. The research design used for the present study was quasi experimental control group pre and posttest design. In present study, the independent variable was beet root juice and dependent variable was level of blood pressure.

The present study setting was selected as per need and criteria. The research study was done in selected areas of Sangli- Miraj- Kupwad Corporation area. Population of the study consisted of patients diagnosed with hypertension. The target population of the study consisted of patients diagnosed with hypertension at Sangli- Miraj Kupwad Corporation area. The accessible population of the study consisted of patients diagnosed with hypertension in selected community areas at Sangli- Miraj Kupwad Corporation area. The samples were patients diagnosed with hypertension in selected community areas at Sangli- Miraj- Kupwad Corporation area.

The inclusion criteria were the hypertensive clients who are willing to participate in the study, who can read and write Marathi, Hindi, English, clients whose blood pressure levels was in range 140-159 mm of hg (systolic) and 90-99 mm of hg (diastolic). The exclusion criteria were hypertensive clients with other co-morbidities like diabetes mellitus, chronic renal failure, renal calculi etc, pregnancy induced hypertensive clients and those who are allergic to beetroot. The sample size was determined using G power software. The sample size comprised of 50 out of which 25 were in experimental group and 25 were in control group. Non-probability purposive sampling technique was used in this study.

The data collection tool included development of tool along with observational table. Development of tool was done based on the study objectives. Data collection tool was prepared by doing extensive review of literature. After an extensive review of literature, referring the books and journals, abstracts, research articles, discussion with guide and expert opinions the tool was developed for the data collection. The tool was divided into 3 sections.

Section-I: Demographic data

Section-II: Clinical variables

Section III: Observational table

To ensure the content validity of the tool, the tool was submitted to experts. With suggested corrections needed changes were done after the discussion with guide and final tool was prepared. Along with that, B P Apparatus (Sphygmomanometer) was also calibrated for its accuracy from bio- medical department of Bharati Hospital, Sangli.

Complete research proposal along with data collection tool was presented in front of research committee for approval. Approval was given by Institutional ethics committee of Bharati Vidyapeeth (Deemed to be) university, College of Nursing, Sangli. Permission was obtained to conduct pilot study and main study. Informed written consent was obtained from each study participants prior to conducting the study. Data was collected from 50 hypertensive

clients who met the study criteria. The collected data was encrypted, organized, analyzed, and explained using explanatory statistics. Tables and graphs are used to illustrate results.

3. Results and Discussion

Based on the objectives of the study, analysis and explanation of the results were presented in following sections:

Section I –

A) Frequency and percentage distribution of demographic variables.

B) Frequency and percentage distribution of clinical variables.

Section II – C) Level of blood pressure before administration of beet root juice among experimental and control group

Section III - D) Level of blood pressure after administration of beet root juice among experimental and control group

Section IV – E) Comparison of level of blood pressure after administration of beet root juice between experimental and control group

A) Frequency and percentage distribution of demographic variables

In this study, in experimental group, 60% of samples were in the age group 41-60 years. In control group, 72% of them were in the age group 41-60 years. In experimental group, 52% of them were males. In control group, 56% of them were males. In experimental group, 40% of them did not have any formal education. In control group, 40% of them had completed primary education. In experimental group, 76% of them were married. In control group, 84% of them were married. In experimental group, 40% of them were labourers. In control group, 36% of them were housewives. In experimental group, 76% of them had moderate work. In control group, 84% of them had moderate work. In experimental group, 76% of them had monthly income between Rs.15001-30000. In control group, 84% of them had monthly income between Rs.15001-30000. In experimental group, 56% of them were from joint family. In control group, 52% of them had joint family. In experimental group, 36% of them had family history of hypertension. 4% of their fathers had hypertension, 24% of their mothers had hypertension and 8% of their fathers and mothers both had hypertension. In control group, 24% of them had family history of hypertension. 4% of their fathers had hypertension, 16% of their mothers had hypertension and 4% of their fathers and mothers both had hypertension. In experimental group, 56% of them had mixed food habits. In control group, 68% of them had mixed food habits.

B) Frequency and percentage distribution of clinical variables.

In experimental group, 28% of them had the duration of illness and treatment for 1 to 3 years, 28% of them had for 3 to 5 years and 28% of them had for more than 5 years. In control group, 32% of them had for more than 5 years. In experimental group, 64% of them had a habit of regularly checking the BP. In control group, 80% of them had a habit of regularly checking the BP. In experimental group, 68% of them never missed anti-hypertensive dose. In control group, 80% of them never missed anti-hypertensive dose. In experimental group, 56% of them had a habit of exercising. In control group, 60% of them had a habit of exercising. In experimental group, 36% of them had normal weight BMI 18.5-24.9), 24% of them were overweight (BMI 25-29.9) and 32% of them were obese (BMI >30). In control group, 36% of them were overweight (BMI 25-29.9).

This study can be supported by previous findings published by JNC-8 Guidelines Recommendations (Updated) that the overall incidence of hypertension is comparable in men and women but it varies with age. High blood pressure is more prevalent in men than women

under the age of 45. Women are more affected than males by high blood pressure when they are 65 years of age or older. The age-related increase in level of blood pressure and the high prevalence of hypertension is observed among the elderly. For people over 55 years of age with normal blood pressure, the lifetime risk of getting hypertension is 90%. So the investigator felt the need to conduct such types of interventional studies which are intended to reduce blood pressure in elderly population or among women above age group of 65. Or the investigator suggests conducting descriptive study for assessing the prevalence of hypertension in males under age group of 45.¹²

C) Table no. 1: Level of blood pressure before administration of beet root juice in hypertensive patients

PARAMETER (IN MM OF HG)	EXPERIMENTAL GROUP		CONTROL GROUP	
	MEAN	SD	MEAN	SD
Systolic Blood pressure	151.2	4.1	152.5	4.9
Diastolic Blood pressure	90.2	3.8	90.0	5.6

It shows the analysis of data related to the level of blood pressure before administration of beet root juice in hypertensive patients among experimental and control group.

In pretest, in experimental group, average systolic blood pressure was 151.2 with standard deviation of 4.1 whereas average diastolic blood pressure was 90.2 with standard deviation of 3.8. In control group, average systolic blood pressure was 152.5 with standard deviation of 4.9 whereas average diastolic blood pressure was 90 with standard deviation of 5.6.

The results shown mean and standard deviation of systolic and diastolic blood pressure among experimental and control group.

Similar study corresponds to our study: The study findings were consistent with the similar study conducted by Mrs. Soumya M., Snehaleeza V. L. in Ambalappuzha, Kerala, India from College of nursing institute of paramedical sciences, Coimbatore, Tamil nadu and Govt. College of nursing, Alappuzha, Kerala assessed Effectiveness of Beetroot Juice as Adjuvant Therapy on Blood Pressure among Patients with Hypertension.. Research approach was quantitative in nature. Quasi experimental one group pre-test post-test design was adopted. A sample of 35 patients with hypertension was selected consecutively. The study findings revealed that the systolic blood pressure was reduced by 8.84 ± 0.14 mm Hg and diastolic blood pressure was reduced by 4.13 ± 0.49 mm Hg after adjuvant therapy with 200 ml of beetroot juice for 14 consecutive days which is supporting present study.¹³

D) Table no.2: Level of blood pressure after administration of beet root juice in hypertensive patients.

GROUP	PARAMETER (IN MM OF HG)	TIMEPOINT	MEAN	SD	T	DF	P-VALUE	INFERENCE
Experimental	Systolic Blood pressure	Pretest	151.2	4.1				
		Day5	138.0	7.7	9.39	24	0.000	Significant

		Day8	125.1	3.7	26.60	24	0.000	Significant
	Diastolic Blood pressure	Pretest	90.2	3.8				
		Day5	84.1	4.5	6.04	24	0.000	Significant
		Day8	79.8	4.6	10.23	24	0.000	Significant
Control	Systolic Blood pressure	Pretest	152.5	4.9				
		Day5	149.4	5.2	3.58	24	0.001	Not Significant
		Day8	151.8	4.9	0.63	24	0.267	Not Significant
	Diastolic Blood pressure	Pretest	90.0	5.6				
		Day5	88.6	4.4	1.32	24	0.100	Not Significant
		Day8	88.6	5.3	1.30	24	0.103	Not Significant

It shows the analysis of data related to the level of blood pressure after administration of beet root juice in hypertensive patients among experimental and control group

Researcher applied paired t-test for comparing pretest and posttest blood pressure among hypertensive patients On 5th day, the obtained T value of systolic blood pressure and diastolic blood pressure was 9.39 and 6.04 respectively and on 8th day it was 26.60 and 10.23 respectively in experimental group. The corresponding p- values obtained was 0.0001 which is less than 0.05, hence null hypothesis was rejected. It is evident that the systolic and diastolic blood pressure reduced significantly after administration of beet root juice among hypertensive patients.

On 5th day, the obtained T value of systolic blood pressure and diastolic blood pressure was 3.58 and 1.32 respectively and on 8th day it was 0.63 and 1.30 respectively in control group. The corresponding p- values obtained was large (greater than 0.05), hence null hypothesis was accepted. It is evident that the systolic and diastolic blood pressure did not reduced significantly after administration of beet root juice among hypertensive patients.

E) Table no. 3: Comparison of average reduction in level of blood pressure after administration of beet root juice between experimental and control group.

Parameter (in mm of hg)	Time Point	Experimental Group		Control Group		t	df	p-value	Inference
		Mean	SD	Mean	SD				
Systolic Blood pressure	Day5	13.16	7.0	3.1	4.4	6.08	48	0.000	Significant

	Day8	26.12	4.9	0.7	5.7	16.89	48	0.000	Significant
Diastolic Blood pressure	Day5	6.04	5.0	1.5	5.6	3.03	48	0.002	Significant
	Day8	10.36	5.1	1.5	5.7	5.83	48	0.000	Significant

Researcher applied two sample t-test for the comparison of average reduction in level of blood pressure after administration of beet root juice between experimental and control group. On 5th day, average reduction in systolic and diastolic blood pressure was 13.16 with SD 7 and 6.04 with SD 5 respectively and on 8th day it was 26.12 with SD 4.9 and 10.36 with SD 5.1 respectively in experimental group. Corresponding p-values were small (less than 0.05), the null hypothesis is rejected. Average reduction in systolic blood pressure was significantly more in experimental group than that compared in control group. It is evident that the systolic blood pressure reduced significantly after administration of beet root juice among hypertensive patients.

On 5th day, average reduction in systolic and diastolic blood pressure was 3.1 with SD 4.4 and 1.5 with SD 5.6 respectively and on 8th day it was 0.7 with SD 5.7 and 1.5 with SD 5.7 respectively in control group. Corresponding p-values were large (greater than 0.05), the null hypothesis is accepted. It is evident that the systolic blood pressure did not reduced significantly after administration of beet root juice among hypertensive patients.

A systematic review on 'Dietary Nitrate from Beetroot Juice for Hypertension' by Diego A and et.al, also focuses on current therapeutic approaches, a nitrate-dietary supplementation with beetroot juice (BRJ) is postulated as a nutritional strategy that might help to control arterial blood pressure in healthy subjects, pre-hypertensive population, and even patients diagnosed and treated with drugs.¹⁴

Table no. 4: Comparison of level of blood pressure on day 8 among hypertensive patients

PARAMETER (IN MM OF HG)	EXPERIMENTAL DAY 8		CONTROL DAY 8		t	D F	P-VALUE	INFERENCE
	MEAN	SD	MEAN	SD				
Systolic BP	125.1	3.7	151.8	4.9	21.82	48	0.000	Significant
Diastolic BP	79.8	4.6	88.6	5.3	6.26	48	0.000	Significant

Researcher applied two sample t-test for the comparison of the level of blood pressure on day 8 among hypertensive patients in experimental and control group.

In experimental group, average systolic blood pressure on day 8 was 125.1 with standard deviation 3.7 which was 151.8 in control group with standard deviation of 4.9 on day 8. T-

value for this test was 21.8 with 48 degrees of freedom. Corresponding p-value was small (less than 0.05), the null hypothesis is rejected. Average systolic blood pressure was significantly less in experimental group than that in control group.

In experimental group, average diastolic blood pressure on day 8 was 79.8 with standard deviation 4.6 which was 88.6 in control group with standard deviation of 5.3 on day 8. T-value for this test was 6.26 with 48 degrees of freedom. Corresponding p-value was small (less than 0.05), the null hypothesis is rejected. Average diastolic blood pressure was significantly less in experimental group than that in control group.

The investigator also wanted to find out any association between pretest and selected demographic variables, but due to categorical similarities of selecting hypertensive patients between certain fixed ranges also called as stage I hypertensive clients. It was found that such type of association cannot be done, and if done also there will be less or no possible chances of association with any of the selected demographic variables. It can be only be possible if we choose our subjects as per different categories of hypertension.

It was evident that the systolic and diastolic blood pressure reduced significantly after administration of beet root juice among hypertensive patients.

4. Conclusion

The study findings revealed that Beet root juice administration was effective in reducing blood pressure among hypertensive clients along with routine treatment and statistical findings highlighted that there was significant difference in level of blood pressure among experimental and control group on 8th day. It was also found that people had experienced less fatigue, were more energized and well hydrated with consumption of beet root juice. Hypertension cannot be cured but can be managed and controlled effectively with beet root juice along with routine treatment or regular medications. So, it can be used effectively in clinical practices. With the achievement of good control over this, one can maintain good control of blood pressure and improve the quality of life.

Acknowledgement

The researcher acknowledges the institutional authorities of Bharati Vidyapeeth (Deemed to be) University College of Nursing, the study participants for the co-operation and all the stakeholders involved in completion of the research study.

Conflict of Interest

No conflict of interest involved.

Funding Source

The study was self-funded by the researcher and guide.

5. References

1. Khatib R, Schwalm JD, Yusuf S, Haynes RB, McKee M, Khan M, Nieuwlaat R. Patient and healthcare provider barriers to hypertension awareness, treatment and follow up: a systematic review and meta-analysis of qualitative and quantitative studies. *PloS one*. 2014 Jan 15; 9(1):e84238.
2. Khade, P. D., & Dhanawade, A. (2019). A Study to Assess the Effectiveness of Topical Application of Honey on Lscs Wound Healing among Postnatal Mothers from Selected Maternity Hospitals of Sangli, Miraj and Kupwad Corporation Area. *SCOPUS IJPHRD CITATION SCORE*, 10(7), 223.

3. Agarwal D, Shukla M, Shukla NK, Shukla R, Sidhu HP. Risk factors of non-communicable diseases in India: A systematic review. *Int J Med Res Prof.* 2016;2(5):6-10
4. Gupta R. Trends in hypertension epidemiology in India. *Journal of human hypertension.* 2004 Feb;18(2):73-8.
5. Sawicka K, Szczyrek M, Jastrzebska I, Prasal M, Zwolak A, Daniluk J. Hypertension–the silent killer. *Journal of Pre-Clinical and Clinical Research.* 2011;5(2).
6. Boro B, Banerjee S. Decomposing the rural–urban gap in the prevalence of undiagnosed, untreated and under-treated hypertension among older adults in India. *BMC Public Health.* 2022 Dec;22(1):1-6.
7. Ghorpade V, Salvi SN, Awate GG, Kamble SW. The Hurried Child Syndrome: An Overview. *Saudi J Nurs Health Care.* 2022;5(10):223-5
8. Shim JS, Heo JE, Kim HC. Factors associated with dietary adherence to the guidelines for prevention and treatment of hypertension among Korean adults with and without hypertension. *Clinical hypertension.* 2020 Dec;26(1):1-1.
9. Sweazea KL, Johnston CS, Miller B, Gumprich E. Nitrate-rich fruit and vegetable supplement reduces blood pressure in normotensive healthy young males without significantly altering flow-mediated vasodilation: a randomized, double-blinded, controlled trial. *Journal of nutrition and metabolism.* 2018 Sep 16;2018.
10. Carey RM, Muntner P, Bosworth HB, Whelton PK. Prevention and control of hypertension: JACC health promotion series. *Journal of the American College of Cardiology.* 2018 Sep 11;72(11):1278-93.
11. Broxterman RM, La Salle DT, Zhao J, Reese VR, Richardson RS, Trinity JD. Influence of dietary inorganic nitrate on blood pressure and vascular function in hypertension: prospective implications for adjunctive treatment. *Journal of Applied Physiology.* 2019 Oct 1;127(4):1085-94.
12. Rajalakshmi N. Effectiveness of beet root juice on blood pressure level among clients with Stage I hypertension residing at Samayanallur, Madurai (Doctoral dissertation, College of Nursing, Madurai Medical College, Madurai).
13. Soumya M.,Snehaleeza V.L. ‘Effectiveness of beetroot juice as Adjuvant therapy on blood pressure among patients with hypertension’ *International Journal of Cardiovascular Nursing*, ISSN; 2581-7051, Vol.6, Issue2, 01-09.
14. Bonilla Ocampo, D. A., Paipilla, A. F., Marín, E., Vargas-Molina, S., Petro, J. L., & Pérez-Idárraga, A. (2018). Dietary Nitrate from Beetroot Juice for Hypertension: A Systematic Review. *Biomolecules*, 8(4), 134. <https://doi.org/10.3390/biom8040134>
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