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CELERY LEAF BOILED WATER EXTRACT TO LOWER BLOOD PRESSURE IN ELDERLY WITH HYPERTENSION

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ABSTRACT

Introduction: Hypertension is a major risk factor that contributes to early cardiovascular morbidity and mortality worldwide. Management of hypertension is necessary to include pharmacological and non-pharmacological interventions. An alternative non-pharmacological therapy to minimizing the burden of the patients, the families, and also the government. Innovation by Evidence-based which is the use of celery leaf extract aimed at blood pressure management in hypertensive patients. the purpose of the community services has integrated community nursing practice and apply celery leaf boiled water for lowering blood pressure.

Methods: The implementation method involves carrying out a pre-treatment examination in the form of checking blood pressure and filling out a form, then a demonstration of making boiled celery leaf extract. Participants were given instructions to make the extract at home and consume it 2 times per day after eating for 7 days. During implementation, participants were directed to fill out a form to schedule their routine consumption of boiled celery leaf extract. Post-treatment data was collected after 7 days of implementation.

Results: The results showed that there was a difference in pre- and post-treatment systolic pressure p-value 0.0001, there was a difference in pre- and post-treatment diastolic pressure p-value 0.001.

Conclusion: The number of categories of pre and post treatment blood pressure measurements showed positive results. The boiled celery leaf extract has shown positive results for lowering blood pressure in elderly participants. Furthermore, this innovation program requires optimization of comprehensive support from various part or stakeholders, so that the benefits can be felt by the wider community.

KEYWORDS

celery leaf; elderly; hypertension; non-pharmacological therapy

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1. INTRODUCTION

High blood pressure (HTN) is a major global risk factor for cardiovascular disease and chronic kidney disease ("Cardiovascular Disease, Chronic Kidney Disease, and Diabetes Mortality Burden of Cardiometabolic Risk Factors from 1980 to 2010," 2014). One of the global targets for non-communicable diseases (NCDs) set by the World Health Assembly in 2013 is to reduce the prevalence of high blood pressure, defined as a systolic blood pressure of 140 mm Hg or higher or a diastolic blood pressure of 90 mm Hg or higher, by 25% compared

with its 2010 level by 2025. Prevalence estimate of hypertension in 2025 has also increased and affects one third of the world's population (Oliveros et al., 2020).

More than a billion adults worldwide suffer from hypertension, up to 45% of the adult population affected by this disease (Zhou et al., 2017). Like many other conditions, HTN increases by age, its prevalence increasing from 27% in patients under 60 years of age to 74% in those older than 80 years (Lloyd-Jones et al., 2005). A high prevalence of hypertension occurs across all socioeconomic and income strata, and prevalence increases with age, covering up to 60% of the population over 60 years of age (Zhou et al., 2017).

Hypertension is diagnosed by performing careful and repeated blood pressure measurements (Kodela et al., 2023). Untreated high blood pressure can increase the risk of myocardial infarction, stroke, and other serious complications (Kodela et al., 2023). the important steps to manage HTN is lifestyle modification such as exercise, weight loss, dietary intervention, low-sodium diet, alcohol restriction, smoking cessation, and stress management to help control blood pressure (Kodela et al., 2023).

Historically, treatment of hypertension has tended to position patients as passive recipients of care (Lewanczuk, 2008). HTN treatment is based on specific characteristics such as disease stage, compliance, and comorbid conditions. For proper management of HTN, it is necessary to include both pharmacological and non-pharmacological interventions (Mahmood et al., 2019a).

Despite advances in treatment and treatment options, the global burden of HTN has increased due to aging of the population and increasing prevalence of obesity (Kodela et al., 2023). Increasing physical activity, limiting salt intake, minimizing alcohol consumption, smoking cessation, and stress management together support the management of patients with HTN and as preventive measures in the general population (Maniero et al., 2023). However, it is important to note that lifestyle modification is a process that requires patients to adhere to continuously (Mahmood et al., 2019b). The modification approach and management of blood pressure in hypertension are important to be implemented, which is also needed to minimize the burden on sufferers, families and also the government. Furthermore, this activity can optimize innovations based on scientific evidence that can be implemented by community nurses and health service providers to the community.

Public acceptance of alternative medicine and herbal plants is increasing, especially in developing countries (G.-Y. Tang et al., 2017). About 80% of people accept this treatment approach because it is safer and cheaper, has fewer side effects, and is more compatible with the human body (Keylani et al., 2023). So far, several studies have been presented on several evidence-based innovations with the aim of supporting blood pressure management in hypertensive patients.

These innovations refer to the use of easily obtained and processed vegetation such as celery leaves. Celery leaves have been planted for medicinal purposes before being consumed as food ingredients (Hedayati et al., 2019a). Celery is rich in vitamins, minerals, phthalates, and flavonoids such as apigenin and luteolin, which have powerful anti-inflammatory and antitumor properties. In addition, celery contains silica, chlorophyll, and high fiber content and contains about 95% water (Hedayati et al., 2019a).

Due to its antioxidant properties and anti-inflammatory potential, its various parts (seeds, leaves, stems, and roots) have been used in traditional medicine to treat arthritis, urinary tract diseases, and high blood pressure. In addition, celery has protective effects against CVD, high lipid profiles, increased blood sugar levels in type 2 diabetes patients, and obesity (Rupdi Lumban Siantar, 2021).

The active components of celery, including 3-n-butylphthalide (NBP) and apigenin, may help lower blood pressure by acting as a diuretic and vasodilator. Additionally, its effectiveness is similar to that of calcium channel blocker drugs (Oktarina & Rahmawaty, 2022).

They may also lower cholesterol levels and arterial plaque formation, contributing to lower blood pressure. Unlike ordinary diuretic drugs, NBP and apigenin do not disturb the balance between sodium and potassium levels in the blood (Illes, 2021). Celery has been used to treat and control high blood pressure in China and Indonesia with effective results due to its safety and affordability, without side effects (Oktarina & Rahmawaty, 2022). Boiled celery leaves provide benefits and are effective in reducing systolic and diastolic pressure in elderly hypertension sufferers in Indonesia (Simamora et al., 2022). Boiled celery leaves have also been applied in many research in other groups of elderly people with hypertension which provide positive value in reducing blood pressure continuously (Tifany Desty Erisandi, 2021).

Therefore, hypertension management can be achieved pharmaceutically and non-pharmaceutically by using herbal plants such as celery (Y. Tang & Chen, 2010). Thus, the aim of this research is to assess the impact of celery in lowering blood pressure in individuals with hypertension and also as a form of innovation in community service as a lecturer and nurse.

The development of this innovation is by modifying previous research, that is, if in the previous research, celery leaf extract was made by crushing it, then in this study a celery leaf extract was boiled with water, which was then consumed by the participants (Simamora et al., 2021). This activity for community empowerment involves the development and evaluation of innovative approaches essential for hypertension control, including: community involvement, integrated health post cadres (kader posyandu) and first-level health facilities, namely Puskesmas Sedayu 1.

2. MATERIAL AND METHODS

Procedure

The activity of community service included community involvement integrated to health post cadres (kader posyandu) in puskesmas Sedayu. The research was also conducted to determine the effectiveness of boiled celery leaf extract on reducing blood pressure and the data was analyzed using Wilcoxon Test . The design used a pre-post experimental design involving one group of research. The sample was selected using a purposive sampling technique, and followed by 17 elderly people with hypertension without a control group. The sample selection criteria were: elderly with hypertension without comorbidities, elderly with hypertension grades 1 and 2 and able to be research samples. The location of this activity was carried out in Padukuhan Sengon Karang, Sedayu District.

The community activity was conducted over 7 days with 10 female and 7 male participants. Pre-treatment was implemented on May 10 2024 before a demonstration of making boiled water from celery leaves. The demonstration on making boiled celery leaf extract took place at the Padukuhan Sengon Karang, Elderly Posyandu, Argomulyo Village, Sedayu District. Before the demonstration, participants were asked to collect pre-treatment data by recording them using an observation form, which was used to record the results of blood pressure measurements before and after administering the boiled celery leaf water. Measurement of blood pressure used an Omron 7130 digital sphygmomanometer, a chair with a backrest, a table to support the arms and form. During the 7 days of treatment, participants were asked to fill out a checklist when they had consumed the boiled celery leaf extract. At the end, post-test data collection was carried out 7 days after the pre-test, at May 18 2024. During pre-treatment/test and post-treatment/test

blood pressure measurements, participants were given instructions as preparation;

1. Do not smoke, consume food or drinks with caffeine or exercise within 30 minutes before measurement,
2. Instruct participants to relaxed, and not to talk during the measurement,
3. Keep the arms open and relaxed,
4. Position the participant sitting on a chair with their backs leaning and legs uncrossed.
5. Place the arm that will be measured on the table with the palm facing up and at heart level (Rehman & Hashmi, 2025).

Procedure For Making Celery Leaf Boiled Water

The community service activity involves the preparation of boiled extract of celery leaves is composed using 100 ml of water, 100 grams of celery leaves are added and boiled up to 100oC. The procedure was demonstrated at the Elderly Posyandu on May 10, 2024. Boiled extract were consumed by participants after eat and were done twice a day, for 7 days.

3. RESULTS

Table 1 shows distribution data on the characteristics of participants, in terms of the majority aged over 65 years, 13 people (76.5%), with the number of female participants being more than 10 people (58.8%). Most of the participants have last education of Elementary School as many as 7 people (41.2%) and Junior High School 7 people (41.2%). The majority of participants who attended were housewives as many as 7 people (41.2%), however, most of the participants were still productive to work as entrepreneurs and farmers. The history of hypertension in participants was calculated by months, where blood pressure control was carried out every month at the Elderly Posyandu and at the Community Health Center with data from participants who had a history of hypertension of 1-12 months 15 people (88.2%) and a history of hypertension of 13-24 months 2 people (11.8%). As for several participants who had a history of hypertension, there was also a history of taking antihypertensive drugs as many as 8 people (47.1%) and 9 people (52.9%) did not take antihypertensive drugs.

Hypertension classification is based on JNC 7 (Seventh report of the Joint National Committee on Prevention on Detection, Evaluation, and Treatment of High Blood Pressure). The number of hypertension category scores before treatment was carried out in participants who consumed boiled celery leaf extract; 9 people were categorized as stage 1 hypertension, and 8 people were categorized as stage 2 hypertension. The participants' hypertension category after consuming boiled celery leaf extract was 12 people categorized as pre-hypertension and 5 people in stage 1 hypertension. This total value shows that there is an increase in the number of hypertension categories in a positive direction.

Table 3 presents the average blood pressure results of 17 participants, along with their minimum and maximum values. A noticeable difference is observed in the average systolic pressure before and after treatment. Before consuming boiled celery leaf water, the average systolic pressure was 157.12 mmHg, which decreased to an average of 136 mmHg afterward. The systolic pressure range before treatment was 145–168 mmHg, which reduced to 129–146 mmHg after treatment.

Similarly, diastolic pressure showed a measurable difference. The average diastolic pressure before consuming boiled celery leaf water was 86.24 mmHg, which dropped to 79.88 mmHg afterward. The diastolic pressure range before treatment was 78–94 mmHg, decreasing to 78–83 mmHg post-treatment.

These findings, based on average values as well as minimum and maximum measurements of systolic-diastolic blood pressure, indicate that consuming boiled celery leaf water has a generally measurable effect. From table 4 can be concluded that there is a difference in systolic values before and after

Table 1. Participant Characteristics (n = 17)

Characteristics	f	%
Age		
56-65	4	23.5
>65	13	76.5
Gender		
Male	7	41.2
Female	10	58.8
Education		
Elementary school	7	41.2
Middle school	7	41.2
High school	3	17.6
Occupation		
Housewife	7	41.2
Self-employed	6	35.3
Farmer	4	23.5
History of hypertension in months		
1-12 months	15	88.2
13-24 months	2	11.8
Take antihypertensive drugs		
Yes	8	47.1
No Consumption	9	52.9

Table 2. Univariate Results of Blood Pressure Data of Participants Before and After Consuming Celery Leaf Boiled Extract

Hypertension category	Pre treatment		Post trestment	
	f	%	f	%
Pre-hypertension	0	0	12	70.6
Stage 1 hypertension	9	52.9	5	29.4
Stage 2 hypertension	8	47.1	0	0
Total	17	100	17	100

Table 3. Average Blood Pressure of Participants Before and After Being Given Boiled Celery Leaf Water

Variable	n	Mean	SD	Minimum-Maximum
Pre-treatment				
Systole	17	157.12 mmHg	8.77	145-168 mmHg
Diastole		86.24 mmHg	5.39	78-94 mmHg
Post-treatment				
Systole	17	136 mmHg	5.73	129-146 mmHg
Diastole		79.88 mmHg	1.36	78-83 mmHg

Table 4. Results of Analysis Showing the Effectiveness of Boiled Celery Leaf Extract on Blood Pressure in Participants

Category	P-value
Pre-post systole after consumption of boiled celery extract	0.0001
Diastole pre-post after consumption of boiled celery extract	0.001

consuming boiled celery leaf extract with a p-value of 0.0001<0.05. There is a difference in diastolic values before and after consuming boiled celery leaf extract with p-value of 0.001<0.05.

4. DISCUSSION

Hypertension is defined as systolic blood pressure ≥ 140 mmHg and diastolic blood pressure ≥ 90 mmHg with several risk factors that can influence it such as age, race, family history, obesity, lifestyle (lack of physical activity, stress, and smoking behavior), dietary factors (Janelle M. Guirguis-Blake, MD, Corinne V. Evans, MPP, Elizabeth M. Webber, MS, Erin L. Coppola, MPH, Leslie A. Perdue, MPH, and Meghan Soulsby Weyrich, MPH., 2021). Hypertension is one of the most common non-communicable diseases treated in primary care and if not treated properly can cause various serious complications such as myocardial infarction, stroke, kidney failure and death (Whelton, 2002).

Figure 1. Opening of Community Service and Health Education

Figure 2. Implementation of Community Service and Blood Pressure Measurement

The alternative of seeking additional, more economical innovations that provide little or no side effects has made non-pharmacological hypertension management an attractive approach to managing hypertension, both in developed and developing countries (Verma et al., 2021). Acceptance of non-pharmacological complementary therapy innovations for hypertension such as herbal and vegetable preparations is increasing, especially in developing countries (Tan et al., 2023).

Based on several epidemiological studies, it has been explained that vegetable consumption is negatively related to risk factors for cardiovascular disease (CVD) (Alonso et al., 2006). Furthermore, experimental studies show that some types of vegetables such as celery leaves are effective in preventing cardiovascular disease factors, namely hypertension (Alobaidi & Saleh, 2024).

The results of a study related to the consumption of celery leaf extract in elderly participants at the Sengon Karang Posyandu, Argomulyo, Sedayu District showed a significant effect in lowering blood pressure. Initial measurements before the demonstration of making boiled celery leaf extract showed that there were 9 participants with stage 1 hypertension and 8 participants with stage 2 hypertension.

Then, participants who had received a demonstration on making boiled celery leaf extract, continue to make the extract at home and consume it 2 times a day after breakfast and dinner for 7 days. Participants were asked to do a checklist after consuming the boiled celery leaf extract, with the note that participants who received antihypertensive drugs must consume the drugs correctly according to the previous pharmacological provisions.

Participants who were taking antihypertensive medication were given a 3 hour break before consuming the boiled celery leaf extract. After 7 days, post-treatment data was collected by measuring blood pressure at each participant's home.

The results of post-treatment data show that the number of elderly participants with hypertension experienced positive changes, namely, for 12 prehypertensive people with systolic pressure 120-139 mmHg and diastole 80-89 mmHg, 5 people with stage 1 hypertension with systolic pressure 140-159 mmHg and diastole 90-99 mmHg. This is the same as the results of testing the effectiveness of boiled celery leaf extract consumed by participants, which had positive scores. The systolic pressure value before and after consuming boiled celery leaf extract has a p-value of 0.0001, and the diastolic pressure test value before and after consuming boiled extract shows a p-value of 0.001.

The effectiveness test results were positive in reducing blood pressure, which was confirmed by previous findings where celery leaf extract and celery seeds packaged in capsule form were able to reduce blood pressure. Apart from that, other findings which

were also carried out on elderly participants who experienced hypertension in Mamasa Regency, produced positive values for reducing systolic and diastolic pressure.

According to several studies, celery leaf content is an important phytochemical component such as phenolic acid, flavones, flavonols, and antioxidants such as vitamin C, beta-carotene (Provitamin A), and manganese. These components act as antioxidants to reduce oxidation and cardiovascular inflammation (Hedayati et al., 2019b). Celery's active components, including 3-n-butylphthalide (NBP) and apigenin, may help lower blood pressure by acting as a diuretic and vasodilator (Khairullah et al., 2021). The benefits of celery leaves that have been stated in this study and several supporting research, can be applied as an alternative in non-pharmacological therapeutic innovations that are economical and easily available. Through community service activities that include demonstrations on making boiled celery leaf extract, the observed benefits extend beyond a decrease in blood pressure. These activities also enhance community knowledge and skills in properly processing boiled celery leaf extract.

However, this study will continue to be developed by addressing several limitations that were not considered in previous research. One key aspect for future improvement is expanding the coverage area to support better mapping of the number of elderly participants with hypertension. Additionally, increasing the number of participants will enhance the validity of the research, allowing for the allocation of participants into treatment and control groups. Extending the study duration will also help to ensure the positive effectiveness of celery leaf decoction extract as a treatment.

5. CONCLUSION

The benefits of celery leaves have successfully provided a positive effect in reducing blood pressure in people with hypertension, especially in the elderly population. In addition to getting celery leaves easily and being able to be planted in climates and environments in general, the method of processing it into an extract is also easy for the community. Through this community service activity, people in especially elderly participants, will gain the ability and skills to prepare boiled celery leaf extract, understand the proper way to consume it, and recognize its potential benefits in lowering blood pressure. Futhermore, Application this innovation in blood pressure management in hypertension sufferers by using boiled celery leaf extract can be applied to nursing interventions by community nurses. Optimizing the implementation of this innovation then requires comprehensive support from various stakeholders so that the benefits can be felt by the wider community.

6. REFERENCES

Alobaidi, S., & Saleh, E. (2024). Antihypertensive Property of Celery: A Narrative Review on Current Knowledge. *International Journal of Food Science*, *2024*, 1–8. https://doi.org/10.1155/2024/9792556

Alonso, A., Beunza, J. J., Bes-Rastrollo, M., Pajares, R. M., & Martínez-González, M. Á. (2006). Vegetable Protein and Fiber from Cereal Are Inversely Associated with the Risk of Hypertension in a Spanish Cohort. *Archives of Medical Research*, *37*(6), Article 6. https://doi.org/10.1016/j.arcmed.2006.01.007

Cardiovascular disease, chronic kidney disease, and diabetes mortality burden of cardiometabolic risk factors from 1980 to 2010: A comparative risk assessment. (2014). *The Lancet Diabetes & Endocrinology*, *2*(8), 634–647. https://doi.org/10.1016/S2213-8587(14)70102-0

Hedayati, N., Bemani Naeini, M., Mohammadinejad, A., & Mohajeri, S. A. (2019a). Beneficial effects of celery (*APIUM GRAVEOLENS*) on metabolic syndrome: A review of the existing evidences. *Phytotherapy Research*, *33*(12), 3040–3053. https://doi.org/10.1002/ptr.6492

Hedayati, N., Bemani Naeini, M., Mohammadinejad, A., & Mohajeri, S. A. (2019b). Beneficial effects of celery on metabolic syndrome: A review of the existing evidences. *Phytotherapy Research*, *33*(12), Article 12. https://doi.org/10.1002/ptr.6492

Illes, J. D. (2021). Blood Pressure Change After Celery Juice Ingestion in a Hypertensive Elderly Male. *Journal of Chiropractic Medicine*, *20*(2), 90–94. https://doi.org/10.1016/j.jcm.2021.04.001

Janelle M. Guirguis-Blake, MD, Corinne V. Evans, MPP, Elizabeth M. Webber, MS, Erin L. Coppola, MPH, Leslie A. Perdue, MPH, and Meghan Soulsby Weyrich, MPH. (2021). *Screening for Hypertension in Adults: An Updated Systematic Evidence Review for the U.S. Preventive Services Task Force*. Agency for Healthcare Research and Quality U.S. Department of Health and Human Services 5600 Fishers Lane Rockville, MD 20857. https://www.ncbi.nlm.nih.gov/books/NBK570230/pdf/Bookshelf_NBK570230.pdf

Keylani, K., Arbab Mojeni, F., Khalaji, A., Rasouli, A., Aminzade, D., Karimi, M. A., Sanaye, P. M., Khajevand, N., Nemayandeh, N., Poudineh, M., Azizabadi Farahani, M., Esfandiari, M. A., Haghshoar, S., Kheirandish, A., Amouei, E., Abdi, A., Azizinezhad, A., Khani, A., & Deravi, N. (2023). Endoplasmic reticulum as a target in cardiovascular diseases: Is there a role for flavonoids? *Frontiers in Pharmacology*, *13*, 1027633. https://doi.org/10.3389/fphar.2022.1027633

Khairullah, A. R., Solikhah, T. I., Ansori, A. N. M., Hidayatullah, A. R., Hartadi, B., Ramandinianto, S. C., & Fadholly, A. (2021). Review on the Pharmacological and Health Aspects of Apium Graveolens or Celery: An Update. *Systematic Reviews in Pharmacy*, *12*(1), Article 1. https://doi.org/10.31838/srp.2021.1.87

Kodela, P., Okeke, M., Guntuku, S., Lingamsetty, S. S. P., & Slonovschi, E. (2023). Management of Hypertension With Non-pharmacological Interventions: A Narrative Review. *Cureus*. https://doi.org/10.7759/cureus.43022

Lewanczuk, R. (2008). Hypertension as a chronic disease: What can be done at a regional level? *Canadian Journal of Cardiology*, *24*(6), 483–484. https://doi.org/10.1016/S0828-282X(08)70622-6

Lloyd-Jones, D. M., Evans, J. C., & Levy, D. (2005). Hypertension in Adults Across the Age Spectrum: Current Outcomes and Control in the Community. *JAMA*, *294*(4), 466. https://doi.org/10.1001/jama.294.4.466

Mahmood, S., Shah, K. U., Khan, T. M., Nawaz, S., Rashid, H., Baqar, S. W. A., & Kamran, S. (2019a). Non-pharmacological management of hypertension: In the light of current research. *Irish Journal of Medical Science (1971 -)*, *188*(2), 437–452. https://doi.org/10.1007/s11845-018-1889-8

Mahmood, S., Shah, K. U., Khan, T. M., Nawaz, S., Rashid, H., Baqar, S. W. A., & Kamran, S. (2019b). Non-pharmacological management of hypertension: In the light of current research. *Irish Journal of Medical Science (1971 -)*, *188*(2), 437–452. https://doi.org/10.1007/s11845-018-1889-8

Maniero, C., Lopuszko, A., Papalois, K.-B., Gupta, A., Kapil, V., & Khanji, M. Y. (2023). Non-pharmacological factors for hypertension management: A systematic review of international guidelines. *European Journal of Preventive Cardiology*, *30*(1), 17–33. https://doi.org/10.1093/eurjpc/zwac163

Oktarina, R., & Rahmawaty, S. (2022). *The Use of Celery (* Apium Graveolens *L.) for Reducing Blood Pressure in Individual with Hypertension in Indonesia: A Review Paper:* 4th International Conference Current Breakthrough in Pharmacy (ICB-Pharma 2022), Sukoharjo, Indonesia. https://doi.org/10.2991/978-94-6463-050-3_22

Oliveros, E., Patel, H., Kyung, S., Fugar, S., Goldberg, A., Madan, N., & Williams, K. A. (2020). Hypertension in older adults: Assessment, management, and challenges. *Clinical Cardiology*, *43*(2), 99–107. https://doi.org/10.1002/clc.23303

Rehman, S., & Hashmi, M. F. (2025). Blood Pressure Measurement. In *StatPearls*. StatPearls Publishing. http://www.ncbi.nlm.nih.gov/books/NBK482189/

Rupdi Lumban Siantar. (2021). Efectiveness of Celery (Apium Graveolens) on Hppertension in The Elderly. *Science Midwifery*, *Vol 9, No. 1, April 2021*, 360–365.

Simamora, L., Sembiring, N. M. P. Br., & Sinaga, A. (2022). The Effectiveness Of Celery Boiled Water On Lowering Blood Pressure in The Elderly With Hypertension in The Working Area Of The Simalingkar Public Health Center In 2020. *INTERNATIONAL JOURNAL OF MIDWIFERY RESEARCH*, *2*(1). https://doi.org/10.47710/ijmr.v2i1.26

Simamora, L., Srilina Br.Pinem, & Nurhamida Fithri. (2021). Efektifitas Jus Seledri Terhadap Penurunan Tekanan Darah Pada Lansia Penderita Hipertensi Di Wilayah Kerja Puskesmas Simalingkar. *Journal of Health (JoH)*, *8*(2), 67–74. https://doi.org/10.30590/joh.v8n2.p67-74.2021

Tan, T. Y. C., Lim, X. Y., Norahmad, N. A., Chanthira Kumar, H., Teh, B. P., Lai, N. M., & Syed Mohamed, A. F. (2023). Neurological Applications of Celery (Apium graveolens): A Scoping Review. *Molecules*,

28(15), Article 15. https://doi.org/10.3390/molecules28155824

Tang, G.-Y., Meng, X., Li, Y., Zhao, C.-N., Liu, Q., & Li, H.-B. (2017). Effects of Vegetables on Cardiovascular Diseases and Related Mechanisms. *Nutrients*, *9*(8), 857. https://doi.org/10.3390/nu9080857

Tang, Y., & Chen, A. (2010). Curcumin prevents leptin raising glucose levels in hepatic stellate cells by blocking translocation of glucose transporter-4 and increasing glucokinase. *British Journal of Pharmacology*, *161*(5), 1137–1149. https://doi.org/10.1111/j.1476-5381.2010.00956.x

Tifany Desty Erisandi, B. (2021). *The Difference of Celery Leaves And Bay Leaves Water to Decrease Blood Pressure among Pre-Elderly With Primary Hypertension in Public Health Center Cigugur Tengah*. https://doi.org/10.33755/jkk

Verma, N., Rastogi, S., Chia, Y., Siddique, S., Turana, Y., Cheng, H., Sogunuru, G. P., Tay, J. C., Teo, B. W., Wang, T., Tsoi, K. K. F., & Kario, K. (2021). Non-pharmacological management of hypertension. *The Journal of Clinical Hypertension*, *23*(7), Article 7. https://doi.org/10.1111/jch.14236

Whelton, P. K. (2002). Primary Prevention of HypertensionClinical and Public Health Advisory From the National High Blood Pressure Education Program. *JAMA*, *288*(15), Article 15. https://doi.org/10.1001/jama.288.15.1882

Zhou, B., Bentham, J., Di Cesare, M., Bixby, H., Danaei, G., Cowan, M. J., Paciorek, C. J., Singh, G., Hajifathalian, K., Bennett, J. E., Taddei, C., Bilano, V., Carrillo-Larco, R. M., Djalalinia, S., Khatibzadeh, S., Lugero, C., Peykari, N., Zhang, W. Z., Lu, Y., … Zuñiga Cisneros, J. (2017). Worldwide trends in blood pressure from 1975 to 2015: A pooled analysis of 1479 population-based measurement studies with 19·1 million participants. *The Lancet*, *389*(10064), 37–55. https://doi.org/10.1016/S0140-6736(16)31919-5