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# Effect of Turmeric Juice Drink on Blood Pressure Reduction in Elderly Hypertensive Patients in East Pentadio Village, Telaga Biru District

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**ABSTRACT**

Hypertension is a health problem that often occurs in the elderly and is at risk of causing various complications if not controlled properly. In addition to pharmacological therapy, non-pharmacological interventions that are safe and easy to apply are needed, one of which is through the use of herbal ingredients. This study aims to determine the effect of giving turmeric juice drink on reducing blood pressure in elderly people with hypertension in East Pentadio Village, Telaga Biru District. This study uses a pre-experimental design with a one group pretest–posttest approach. The study sample was elderly people with hypertension who were selected by total sampling technique. The intervention was in the form of giving 150 ml of turmeric juice drink once a day for seven days. Systolic and diastolic blood pressure measurements were carried out before and after the intervention, then analyzed using the Wilcoxon test. The results showed a decrease in the mean systolic and diastolic blood pressure after the administration of turmeric juice drink, with a p value of < 0.05 which showed a significant effect. It can be concluded that turmeric juice drink has an effect on reducing blood pressure in the elderly with hypertension and can be used as an alternative non-pharmacological therapy in controlling hypertension in the elderly.

## INTRODUCTION

Elderly (elderly) is a condition that occurs in human life. Aging is a lifelong process, it can not only start from a certain time, but it can start from the beginning of life. Getting old is a natural process, which means that a person will go through three stages in their life, namely childhood, adulthood and old age.(Dewi, 2022) According to World Health Organization (2022), Elderly are individuals over 60 years old, which is an age group in humans who have entered the final stages of their life phase.

According to the World Health Organization (2022), globally, the life rate of the elderly in the world will continue to increase. It is estimated that by 2030, it is found that 1 in 6 people in the world will be 60 years old or older. The population over 60 years old increased by 1 billion in 2020 and in 2022 it will be 1.4 billion. It is estimated that by 2050, the world's population aged 60 years and above will double to 2.1 billion. Meanwhile, those aged 80 years or older are expected to triple between 2020 and 2050 to reach 426 million people.

According to the Directorate General of Population and Civil Registration (Dukcapil), in 2021 in Indonesia there are 30.16 million elderly people. If further detailed, it can be found as many as 11.3 million people (37.48%) elderly people aged 60-64 years, 7.77 million (25.77%) people aged 65-69 years, 5.1 million people (16.94%) aged 70-74 years, and 5.98 million (19.81%) aged over 75 years.

According to the Ministry of Health (2021) in Indonesia, the current number of elderly people is around 27.1 million people or almost 10% of the total population. In 2025, it is projected that the number of elderly people will increase to 33.7 million people (11.8%) of the total population of Indonesia Based on BPS Data (2020) As we age, the human body will experience changes in body composition, muscles, bones and joints. There is a setback and morphological changes in the muscles causing functional changes in the

muscles, namely a decrease in strength, muscle contraction, elasticity and flexibility. Thus, it will result in a decrease in the ability to maintain postural balance or body balance of the elderly.

This aging is a natural process that occurs in humans over a long period of time. Biologically, the aging process is defined as a decline in physiological function followed by a decrease in physical and cognitive resilience. One of the declines in physiological function in the elderly is a decline in the cardiovascular, digestive, and musculoskeletal systems. One of the cardiovascular diseases is hypertension (Wulandari et al., 2023).

Hypertension is a global public health threat, where. can significantly reduce the standard of living and is also one of the determinants that is closely related to cardiovascular disease and mortality or death at a young age due to hypertensive disease (Akbar et al., 2020) Hypertension is an abnormal increase in blood pressure in arterial blood vessels continuously (Nuranti et al., 2020). High blood pressure can be caused by various risk factors that are divided into two groups, namely those that cannot be controlled and those that can be controlled (Garwahusada & Wirjatmadi, 2020). According to data from Basic Health Research in 2018, the prevalence of hypertension in Indonesia with a population of around 260 million is 34.1% (Laurensia et al., 2022).

Treating hypertension in the elderly requires a holistic approach that includes effective but safe blood pressure control, given that older age is susceptible to drug side effects. One of the alternatives that is increasingly attracting attention is the use of natural ingredients, such as turmeric (Curcuma longa), which is known to have active content of curcumin with anti-inflammatory and antihypertensive properties. Hypertension therapy is divided into pharmacological therapy and non-pharmacological therapy, one of which is non-pharmacology, namely turmeric juice drink whose main ingredient is turmeric (Kurniawan et al., 2021)

Turmeric juice drink is a form of turmeric-based drink preparation that is easy to consume and has the potential as a supportive therapy for lowering blood pressure. However, until now there have not been many studies that specifically evaluate the effectiveness of turmeric juice drink in elderly people with hypertension, especially at the primary health service level. Various studies have shown that curcumin can help lower blood pressure through vasodilation mechanisms and improved endothelial function. However, empirical evidence regarding the effectiveness of turmeric drink in the form of turmeric juice drink in elderly people with hypertension is still limited in use by the public.

Turmeric or Curcuma Longa has multicellular activity because it can reduce or even reverse the effects of various diseases by inhibiting 97.3% of the lipid peroxidase enzyme in cells, as a polyphenol antioxidant that can prevent the triggering of stomach acid and curcuminoids as well as essential oils that have active compounds that are beneficial for relieving pain in the gastric mucosa (Muniroh et al., 2021), so it can be concluded that curcumin in turmeric can lower and inhibit inflammation (Fadhilah et al., 2021).

Based on an initial survey in the Telaga Biru Health Center Working Area, Gorontalo Regency, it shows that hypertension in the elderly is still a significant health problem and requires special attention. It is known that the elderly in the village of East Pentadio, Telaga Biru District are 210 people and the elderly who suffer from hypertension are 116 people with 45 men and 71 women. Based on interviews with 12 elderly people, 9 elderly people suffer from hypertension and 3 elderly people have normal blood pressure.

Based on research by Destri, Hayulita, and Cania (2020), the administration of grated turmeric infusion twice a day for 7 days in the elderly with hypertension in Bukittinggi City has a significant effect on lowering blood pressure. The mean blood pressure decreased from 160/94 mmHg to 150/85 mmHg, with a value of $p = 0.001$, for both systolic and diastolic pressure. These results prove that even turmeric in its simple form has a strong antihypertensive effect.

Based on the data above, the researcher was related to conducting a study to find out "Is there an effect of turmeric juice drink on reducing blood pressure in elderly people with hypertension in East Pentadio Village, Telaga Biru District, Gorontalo Regency, Gorontalo Province."

## RESEARCH METHODS

This study uses a quantitative method because it aims to measure the influence of a treatment objectively through numbers and statistical analysis. The approach used is pre-experiment, which is a research design that does not fully meet the criteria of a true experiment because it does not use a control group. The design chosen in this study is a one group pretest-posttest design, where there is only one group of subjects and measurements are taken before and after the intervention. In the context of this study, the intervention provided is turmeric juice drink, which is expected to have an effect on reducing blood pressure in the elderly who experience hypertension. (Sugiyono, 2022).

The research design used in this study is a one group pretest-posttest design, which is a pre-experimental research design without using a control group. In this design, before being given an intervention, the research subjects first took initial measurements (pretest) to determine the condition of blood pressure before treatment. Furthermore, turmeric juice drink was given as a treatment. After the intervention period is over, a posttest is carried out to assess changes or decreases in blood pressure in the

elderly.

This design was used to determine the effectiveness of giving turmeric juice drink in lowering blood pressure in the elderly who suffer from hypertension. This design is considered appropriate because it is able to depict differences in conditions before and after the intervention even without a comparison group.

This research was carried out in East Pentadio Village, Telaga Biru District, Gorontalo Regency. The time for the research is planned for September-October 2025. Sampling was carried out by paying attention to certain characteristics so that the data obtained were relevant to the research objectives and could be generalized (Suriani et al., 2023). The sample in this study was 20 people. The sampling technique in this study is to use purposive samples that meet the inclusion and exclusion criteria.

**Data Analysis Techniques**

After the data is collected, it will be analyzed analytically and interpretively using the computer software-assisted statistical method (SPSS). The data analysis used in this study consisted of univariate analysis and bivariate analysis.

**Univariate Analysis**

Univariate analysis was carried out to describe the characteristics of each variable in the study, namely the independent variable of turmeric juice drink and the dependent variable in the form of blood pressure in the elderly. This analysis aims to see the frequency distribution and percentage of each observed variable, so that it can provide an overview of the data before further testing.

**Bivariate Analysis**

Bivariate analysis aims to determine the effect between independent variables (administration of turmeric juice drink) and dependent variables (blood pressure of the elderly). In this study, the Wilcoxon Signed Rank Test was used, which is a difference test of two paired groups that is used if the data is not distributed normally. This test was performed on blood pressure data before and after the intervention, with a significance level of $\alpha = 0.05$ (5%) or a 95% confidence level. The interpretation of the test results is carried out as follows:

If $p \geq \alpha$, then $H_0$ is accepted and $H_a$ is rejected, meaning that there is no significant effect of giving turmeric juice drink on lowering blood pressure in the elderly.

If $p < \alpha$, then $H_0$ is rejected and $H_a$ is accepted, meaning that there is a significant effect of giving turmeric juice drink on the reduction of blood pressure in the elderly.

**RESULTS**

**Overview of Respondent Characteristics**

Table 1. Frequency distribution by age, gender, and education

| Yes | Age | Frequency π | Percentage % |
|---|---|---|---|
| 1 | Elderly 60-74 Years Old | 15 | 75.00% |
| 2 | Elderly Middle-aged 75-90 years old | 5 | 25.00% |
| | **Total** | **20** | **100.00%** |
| **Yes** | **Gender** | **Frequency π** | **Percentage %** |
| 1 | Women | 12 | 60.00% |
| 2 | Male | 8 | 40.00% |
| | **Total** | **20** | **100.00%** |
| **Yes** | **Education** | **Frequency π** | **Percentage %** |
| 1 | SD | 12 | 60.0 |

| | | | |
|---|---|---|---|
| 2 | Junior High School | 5 | 25.0 |
| 3 | High School | 3 | 15.0 |
| | **Total** | **20** | **100.0** |

Data Source: Primary

Based on Table 1, the characteristics of the respondents in this study include age, gender, and education level. A total of 20 elderly people who met the inclusion criteria participated in a study on the effectiveness of Turmeric Juice Drink in lowering blood pressure in elderly hypertensive patients. The description of these basic characteristics provides an initial overview of the profile of the subjects that are the focus of the intervention.

In terms of age, most of the respondents were in the elderly group of 60-74 years, which was 15 people (75%). Meanwhile, the other 5 respondents (25%) were in the category of the 75-90 year old middle-aged. This composition shows that the early elderly group was more dominant in this study

When viewed by gender, the majority of respondents were women, namely 12 people (60%), while 8 respondents (40%) were men. This imbalance can be related to the high tendency of elderly women to experience hypertension, especially after menopause.

On the characteristics of education, it was found that most of the respondents had an elementary school (SD) education with a total of 12 people (60%). Meanwhile, 5 people (25%) have a junior high school education, and 3 people (15%) are educated up to the high school level. This distribution shows that the education level of respondents in general is still classified as lace

**Univariate Analysis**

Table 2 Distribution of respondents by degree of hypertension before intervention

| Yes | Hypertension Category | Blood Pressure Range (mmHg) | Frequency (n) | Percentages (%) |
|---|---|---|---|---|
| 1 | Hypertension degree 2 | 160-179/ 100-109 | 15 | 75.00% |
| 2 | Hypertension of the 3rd degree | ≥180/ ≥110 | 5 | 25.00% |
| | Total | | 20 | 100.00% |

Data Source: Primary

Based on table 2 of the hypertension category in 20 elderly respondents, it is known that most of the respondents are at a relatively high level of hypertension. The majority of respondents were included in the category of degree 2 hypertension, namely 15 people (75%) with a blood pressure range of 160–179 mmHg for systolic and 100–109 mmHg for diastolic. Meanwhile, as many as 5 people (25%) were in the category of degree 3 hypertension, namely blood pressure ≥180 mmHg for systolic or ≥110 mmHg for diastolic.

Table 3 Distribution of Respondents by Degree of Hypertension After Intervention

| Yes | Hypertension Category | Blood Pressure Range (mmHg) | Frequency (n) | Percentages (%) |
|---|---|---|---|---|
| | Normal | 120-129/ 80-84 | 9 | 45.00% |
| | Prehypertension | 130-139/ 85-89 | 10 | 50.00% |
| | Hypertension Grade 1 | 140-159/ 90-99 | 1 | 5.00% |
| | Total | | 20 | 100.00% |

Data Source: Primary

Based on the results of blood pressure measurement after giving Turmeric Juice Drink for seven days, there was a significant change in the distribution of blood pressure categories. Of the 20 respondents, 9 people (45%) were in the category of high normal blood pressure (120–129/80–84 mmHg). Furthermore, 10 respondents (50%) were in the prehypertension category (130–139/85–89 mmHg), and only 1 respondent

(5%) was still classified as grade 1 hypertension (140–159/90–99 mmHg). There were no more respondents with blood pressure of degree 2 or degree 3 as seen in the data before the intervention.

**Bivariate Analysis**
**Wilcoxon Test**

Table 4. Wilcoxon Test Results

| Yes | PreTest-Posttest | N | Mean Rank | Sum Of Ranks |
|---|---|---|---|---|
| 1 | Negative Ranks | 20 | 10.50 | 210.00 |
| 2 | Positive Ranks | 0 | .00 | .00 |
| 3 | Ties | 0 | | |
| | **Total** | **20** | | |

Data Source: Primary

Table 4 shows the results of the analysis using the Wilcoxon Signed Rank Test, which is used to evaluate the difference in blood pressure before and after the administration of Turmeric Juice Drink. The selection of this test is based on the results of the normality test which shows that the data does not follow the normal distribution, so the use of non-parametric tests is more appropriate. In the table, it can be seen that all respondents experienced a change in blood pressure values with a decreasing direction, which was shown by 20 respondents in the Negative Ranks category, with a Mean Rank of 10.50 and a Sum of Ranks of 210.00. Negative Ranks indicate that the posttest score is lower than the pretest score, so it can be concluded that all respondents experienced a decrease in blood pressure after the intervention. Meanwhile, the Positive Ranks category showed a number of 0, indicating that none of the respondents experienced an increase in blood pressure after the intervention was given. In addition, the Ties category was also valued at 0, so that all respondents showed changes without any blood pressure values remaining the same between before and after the intervention. These results show that the administration of Turmeric Juice Drink has a consistent effect in lowering blood pressure in all elderly respondents. The absence of respondents who experienced an increase or an unchanged value further strengthens that this intervention shows a real effect of lowering blood pressure.

Statistically, the findings are also in line with the results of the analysis in the Test Statistics table, where the value $p = 0.000$ was obtained. This value indicates a significant difference between blood pressure before and after the intervention. Thus, it can be concluded that Turmeric Juice Drink has significant effectiveness in lowering blood pressure in elderly people with hypertension.

## DISCUSSION

### Blood Pressure Before Giving Turmeric Juice Drink to the Elderly

Blood pressure before the intervention showed that almost all respondents were in a condition of hypertension with a significant degree of severity, where the majority of the elderly were included in the category of hypertension of degree two to degree three. This can be seen from the value of systolic blood pressure which is in the range of 160–179 mmHg and ≥180 mmHg, as well as diastolic pressure which reaches 100–109 mmHg or ≥110 mmHg. This figure does not just reflect mild hypertension, but illustrates that respondents have experienced a chronic hypertension condition that lasts for a long time. This high blood pressure profile is relevant to various scientific findings that state that blood pressure in the elderly increases progressively due to a combination of anatomical and physiological changes in blood vessels, decreased organ function, and accumulated exposure to risk factors throughout life. Structural changes such as arterial stiffness, endothelial dysfunction, and reduced elasticity of blood vessels cause blood pressure in the elderly to be more difficult to control and tends to be persistent. This picture is in line with the WHO report (2023) and the American Heart Association guidelines (Whelton et al., 2020), which affirm that hypertension in the elderly has more complex characteristics than in younger age groups because it involves degenerative processes of the cardiovascular system that develop over the years.

The aging process has a huge impact on the structure of blood vessels. In old age, the walls of the arteries experience thickening especially in the layers of the intima tunica and media tunica due to increased collagen deposition and a decrease in the elastin component. Reduced arterial elasticity causes blood vessels to become stiff so that they are no longer able to adapt to blood flow pressure. This inability makes systolic pressure increase progressively, while diastolic pressure tends to stagnate or even decrease, resulting in a dilated pulse pressure. Dilated pulse pressure is a strong indicator of arterial stiffness, a typical sign of hypertension in the elderly. The study of Hall and Hall (2021) confirms that arterial stiffness is one of the

main factors causing isolated systolic hypertension, a form of hypertension that is most commonly found in the elderly.

In the molecular sphere, impaired endothelial function plays an important role. Normal endothelium produces nitric oxide, prostasiclin, and other factors that help maintain the tone of blood vessels. In the elderly, nitric oxide production tends to decrease drastically due to increased oxidative stress and chronic inflammation. Free radicals that accumulate in the body damage endothelial cells, thereby interfering with the process of dilating blood vessels. The accumulation of free radicals, especially reactive oxygen species, causes blood vessels to become more susceptible to vasoconstriction. Ashraf et al. (2022) reported that endothelial dysfunction is an important cause of increased blood pressure in elderly individuals. With endothelial conditions that are unable to respond to changes in pressure, the body becomes inefficient in maintaining hemodynamic stability.

Decreased functioning of the autonomic nervous system is also a significant factor. Baroreceptors, which act as sensors for changes in blood pressure, degenerate with age. Decreased baroreceptor sensitivity causes the body to be unable to adjust quickly to changes in blood pressure due to body position, emotions, or physical activity. WHO (2023) explains that this disorder of autonomic regulation is what causes hypertension in the elderly to be persistent and difficult to control. When the body loses the ability to regulate blood pressure quickly, blood pressure spikes become more frequent, increasing the risk of cardiovascular complications.

In addition to internal physiological changes, lifestyle contributes greatly to early high blood pressure. The elderly who were the study respondents mostly had high salt consumption habits, as reported by Riskesdas (Ministry of Health of the Republic of Indonesia, 2020). Salted foods such as salted fish, crackers, packaged foods, and instant spices that are widely consumed by the elderly in Indonesia contain high amounts of sodium. Excess sodium increases blood volume and stimulates the renin-angiotensin-aldosterone (RAAS) system, which ultimately increases blood pressure. When sodium consumption continues over the long term, blood pressure will increase that is chronic and difficult to control. Lack of physical activity further worsens the condition. As we age, joint pain, osteoporosis, and decreased muscle mass cause the elderly to move less frequently. This low physical activity makes blood flow less than optimal and triggers blood vessel resistance, so blood pressure increases. Safar et al. (2020) explained that arterial stiffness and vascular resistance increased significantly in the sedentary elderly compared to the elderly who routinely did light to moderate physical activity.

Psychological factors also have an impact on the condition of hypertension before the intervention. Many elderly people experience mental distress due to changes in social life such as the loss of a life partner, loneliness, reduced social activities, or unstable economic conditions. Chronic stress increases the hormones cortisol and adrenaline which trigger increased heart rate and vasoconstriction. This spike in stress hormones causes blood pressure to become unstable and tends to increase. Education and health literacy factors also worsen the condition of early blood pressure. Most respondents have a low level of education so they do not understand the importance of maintaining health, reducing salt consumption, physical activity, or stress management. Mirzaei and Ahmadi (2020) stated that low health literacy is strongly correlated with the low ability of individuals to monitor blood pressure and prevent hypertension complications. The inability to understand the early warning signs of hypertension causes the elderly to tend to ignore the symptoms and only pay attention to the condition when complications have already appeared.

High initial blood pressure can also be linked to irregular use of medications. The elderly often forget to take medication or stop taking medication without consulting medical personnel. In some cases, the elderly who feel that their condition has improved stop taking medication, even though hypertension requires long-term treatment. This condition worsens blood pressure and increases the risk of a sudden spike in blood pressure. A study by Whelton et al. (2020) shows that non-compliance with antihypertensive therapy is one of the main causes of failure to control blood pressure in the elderly. Looking at the various mechanisms above, blood pressure before intervention is not just preliminary data, but a reflection of the complexity of elderly health conditions that combine biological, behavioral, social, economic, and psychological aspects. The high and chronic conditions of hypertension in respondents indicate that they are in dire need of interventions that are not only effective, but also safe, inexpensive, accessible, and have no significant side effects.

Interventions in the form of Turmeric Juice Drink are very relevant, especially because the active compound in turmeric, namely curcumin, has been proven to have anti-inflammatory, antioxidant, and antioxidant properties, and is able to increase nitric oxide production. Panahi et al. (2020) outlined that curcumin can repair endothelial damage, reduce blood vessel stiffness, and lower vascular resistance, all of which play a role in lowering blood pressure. In the elderly, interventions that are able to work on these physiological components are very important considering that many elderly people have limitations in taking certain antihypertensive drugs due to side effects or drug interactions.

Thus, blood pressure before the intervention provides a clear picture that respondents are a population that is at high risk of hypertension complications and urgently needs a comprehensive blood

pressure management approach. Turmeric Juice Drink intervention is a suitable approach because it can overcome several pathophysiological mechanisms that are the basis of hypertension in the elderly, while being safe and easy to apply in daily life.

**Blood Pressure After Giving Turmeric Juice Drink to the Elderly**

The results of the analysis of blood pressure after the elderly respondents received an intervention in the form of Turmeric Juice Drink for seven days showed a consistent tendency to decrease blood pressure in both the systolic and diastolic components. The decrease illustrates the positive physiological response of the elderly body to the bioactive content contained in turmeric, especially curcumin which has been widely studied to have therapeutic effects on the cardiovascular system. These changes not only show an improvement in the numerical value of blood pressure, but also describe a biological adaptation process that shows an improvement in vascular function after stimulation of herbal interventions. In the context of elderly health, lowering blood pressure has a deeper meaning, because this group is among the most vulnerable groups to complications such as heart failure, ischemic and hemorrhagic stroke, as well as damage to target organs due to high blood pressure. Even reductions in small ranges such as 2–5 mmHg have been shown to have a significant effect on reducing the incidence of cardiovascular disease, so the reductions seen in this study represent an important clinical impact on the well-being of the elderly (Ashraf et al., 2022; Dehzad et al., 2024).

The decrease that occurred in systolic and diastolic blood pressure after the intervention showed that the respondents' bodies reacted to the content of curcumin and other bioactive compounds that act through various molecular mechanisms. Curcumin is a polyphenol compound that has very strong antioxidant activity. In the elderly, an increase in free radicals is a natural phenomenon due to the aging process, accompanied by a decrease in the body's ability to neutralize oxidative agents. These free radicals can damage the endothelial cells that line blood vessels so that endothelial function is disrupted. One of the main functions of the endothelial is to produce nitric oxide (NO), an important molecule that regulates the dilation of blood vessels. When oxidative stress increases, NO production decreases resulting in vasoconstriction and increased blood pressure. Curcumin works to bind free radicals, lower oxidative stress, and help restore endothelial function so that vasodilation capacity increases again. With improved endothelial function, blood vessels become more elastic and responsive to vasodilation signals, which ultimately results in a decrease in blood pressure in the elderly (Panahi et al., 2020; Jagetia & Rajanikant, 2021).

Post-intervention blood pressure reduction is also closely related to curcumin's anti-inflammatory characteristics. Chronic inflammation of the blood vessels is one of the main causes of increased blood pressure in the elderly. The ongoing inflammatory process leads to the proliferation of vascular smooth muscles and the thickening of the walls of the blood vessels so that the lumen of the arteries narrows. In addition, inflammation also triggers increased expression of adhesion molecules and proinflammatory cytokines that worsen the overall vascular condition. Curcumin is known to suppress the activation of the NF-κB pathway, which is the main transcription pathway that regulates inflammatory processes in the body. When this pathway is inhibited, the production of pro-inflammatory cytokines such as IL-6, TNF-α, and CRP decreases significantly. This decrease in inflammatory processes causes blood vessels to be more elastic and the pressure in the arteries can be reduced. With reduced vascular inflammation, the vasodilation response increased and blood pressure decreased, as seen in the results of the post-intervention analysis of this study (Panahi et al., 2020; Jagetia & Rajanikant, 2021).

The effect of lowering blood pressure is also influenced by increased nitric oxide (NO) production through the activation of the enzyme endothelial nitric oxide synthase (eNOS). Curcumin is known to increase the expression of eNOS so that NO production increases. NO is a key molecule in maintaining vascular health, as its function as a vasodilator agent helps to reduce peripheral resistance. When NO levels increase, the smooth muscles that make up the walls of the blood vessels relax, the lumen of the blood vessels dilate, and blood pressure decreases. This increase in NO production is an important indicator that the biological mechanisms influenced by turmeric are acting directly on blood vessels. Clinical evidence from various studies suggests that curcumin supplementation can significantly increase NO levels in patients with mild to moderate hypertension, so this intervention provides real physiological benefits for elderly respondents (Ashraf et al., 2022; Tang et al., 2024; Dehzad et al., 2024).

The reduction in blood pressure in this study is inseparable from the bioavailability factor of curcumin which is better when given in the form of a drink such as Turmeric Juice Drink. Bioavailability is the ability of the body to absorb and utilize active substances optimally. Curcumin has low solubility problems when in powder or capsule form due to its strong lipophilic properties. However, when given in the form of juice or drink, curcumin is more easily dispersed in liquids, so the process of its absorption in the intestines becomes more effective. Elderly people who experience decreased digestive function benefit more from the liquid form of preparation because the body does not need to do complex breakdown before the active substance is absorbed. As a result, the concentration of active substances entering the bloodstream increases and antihypertensive effects can appear more quickly and consistently. This is one of the reasons

why regular consumption of Turmeric Juice Drink for seven days is enough to show significant changes in the respondent's blood pressure (Ailani & Maliya, 2023).

In addition to curcumin content, turmeric also contains essential oils such as turmeron and zingiberen which can have additional effects on vascular health. The essential oil has mild antispasmodic activity that can provide relaxation to the smooth muscles of blood vessels. This relaxing effect helps reduce arterial stiffness which is one of the main causes of hypertension in the elderly. With reduced spasms and increased elasticity of blood vessels, blood pressure can decrease physiologically. The synergistic effects between curcumin, essential oils, and other phytochemical components explain why turmeric as a medicinal plant provides all-around benefits in the management of hypertension (Julhadi & Fatoni, 2024; Xu et al., 2025).

The blood pressure drop found in this analysis is also in line with a number of previous clinical studies that showed that turmeric has a noticeable antihypertensive effect. A meta-analysis conducted by Dehzad et al. (2024) revealed that curcumin consumption was able to reduce systolic blood pressure by about 2 mmHg and diastolic blood pressure by about 0.82 mmHg. While the decline sounds small, the impact is enormous when applied to the elderly population on a large scale. Lowering blood pressure even in small ranges has been shown to significantly lower the risk of stroke and heart disease. In addition, another study found that the administration of black turmeric rhizomes had a similar effect in lowering blood pressure and increasing the elasticity of blood vessels (Julhadi & Fatoni, 2024).

Demographic factors and socio-cultural conditions of the elderly also play a role in the effectiveness of this herbal intervention. In many communities, the use of medicinal plants such as turmeric has been part of the community's tradition for hundreds of years. Turmeric is often used as a cooking spice, herbal medicine, or a mixture of health drinks. This makes turmeric-based interventions more acceptable to the elderly than modern pharmacological therapies that often cause side effects. WHO (2023) emphasizes the importance of integrating traditional medicine in public health services, especially in groups with limited access to medical services. In this context, Turmeric Juice Drink can be a very relevant, inexpensive, easy to make, and safe to use solution.

The antihypertensive effect of Turmeric Juice Drink was also associated with changes in consumption behavior that occurred during the intervention. Some respondents may increase the frequency of fluid consumption, improve body hydration, and improve adherence to a healthy lifestyle during the study period. Good hydration helps to keep blood viscosity stable and affects the elasticity of blood vessels. These behavioral factors can contribute to a decrease in blood pressure along with the pharmacological effects of curcumin. Although the contribution of this behavior may be minor, its presence is still relevant in providing a comprehensive picture of changes in blood pressure after the intervention. From a pathophysiological point of view, the elderly generally experience increased sensitivity to blood pressure due to a decrease in the ability of baroreceptors to detect changes in pressure. Baroreceptors are the body's mechanisms that are responsible for maintaining blood pressure stability through rapid reflexes. However, in the elderly, baroreceptor function decreases, so their bodies are more susceptible to blood pressure fluctuations. Giving Turmeric Juice Drink can help stabilize this condition through vasodilating, anti-inflammatory, and decreasing peripheral resistance effects. In other words, this intervention helps to normalize the body's response to changes in blood pressure, so that blood pressure after the intervention is more controlled (Tang et al., 2024; Panahi et al., 2020).

Curcumin has the ability to lower LDL cholesterol and triglycerides and increase HDL concentrations. These changes in lipid profiles provide long-term benefits for blood vessel health. When LDL levels decrease, the risk of atherosclerotic plaque formation decreases so that blood flow becomes smoother. Atherosclerosis is one of the main causes of hypertension in the elderly due to significant narrowing of the arteries due to plaque buildup. By reducing plaque buildup, blood vessels can maintain their elasticity and blood pressure decreases. Therefore, the benefits of Turmeric Juice Drink are not only limited to a direct reduction in blood pressure but also to the prevention of vascular diseases that are the cause of hypertension itself (Xu et al., 2025). The decrease in blood pressure found in this study can also be associated with a decrease in the level of adhesion molecules on the walls of blood vessels. Adhesion molecules such as VCAM-1 and ICAM-1 have an increase in inflammatory conditions and atherosclerosis. Curcumin is known to be able to reduce the level of this adhesion molecule so that the risk of narrowing of blood vessels can be reduced. This decrease in adhesion molecular expression helps to improve blood flow, improve endothelial function, and decrease vascular resistance, which overall contributes to a decrease in postoperative blood pressure (Dehzad et al., 2024; Tang et al., 2024).

In addition to biological and chemical mechanisms, psychological factors in the elderly also affect blood pressure. Regular consumption of Turmeric Juice Drink during the intervention can provide a feeling of relaxation, reduce anxiety, and improve mood. These positive psychological effects can help lower the activity of the sympathetic nervous system which is often a trigger for increased blood pressure. When the sympathetic nervous system decreases, blood vessels relax and blood pressure drops. Although this psychological effect is not the main mechanism, its presence may contribute additionally to the decrease in

blood pressure in the elderly (Ashraf et al., 2022).

In addition to the biological effects described earlier, a decrease in blood pressure after the consumption of Turmeric Juice Drink can also be associated with increased activity of the body's endogenous antioxidant system, such as superoxide dismutase (SOD), glutathione peroxidase (GPx), and catalase. In the elderly, the endogenous antioxidant system tends to decline in function with age, causing the body to more prone to oxidative damage that can trigger hypertension. Curcumin is known to be able to increase the expression and activity of these antioxidant enzymes through the activation of the Nrf2 pathway, a molecular pathway that regulates the body's antioxidant response. When the Nrf2 pathway is activated, the body is able to increase defenses against oxidative stress, so that blood vessels are protected from ongoing damage. Nrf2 activation is one of the important mechanisms that explains how Turmeric Juice Drink provides a protective effect on the cardiovascular system of the elderly (Jagetia & Rajanikant, 2019; Panahi et al., 2020).

Another effect that contributes to a decrease in blood pressure is the effect of curcumin on insulin sensitivity. Insulin resistance is one of the conditions commonly found in the elderly and is closely related to hypertension. This condition can increase oxidative stress, cause impaired endothelial function, and trigger systemic inflammation that worsens hypertension. Curcumin is known to improve insulin sensitivity by lowering blood glucose levels and improving pancreatic function through inhibiting inflammatory processes in adipose tissue. Increased insulin sensitivity also affects increased NO production, as insulin is physiologically able to increase eNOS activity. Thus, increased insulin sensitivity due to the consumption of Turmeric Juice Drink may contribute indirectly to lowering blood pressure in the elderly (Xu et al., 2025; Dehzad et al., 2024). Another metabolic effect that should be observed is the ability of curcumin to reduce the activity of the renin-angiotensin-aldosterone (RAAS) system. This system is the main regulator of blood pressure and water balance in the body. In many cases of hypertension, especially in the elderly, the RAAS system becomes hyperactive so that the resulting angiotensin II causes strong vasoconstriction. Curcumin is reported to reduce the expression of angiotensin-converting enzyme (ACE) so that angiotensin II production is reduced. With a decrease in angiotensin II levels, blood vessel resistance decreases and blood pressure tends to decrease significantly. The effect of curcumin on RAAS is very important, especially in the elderly who experience resistant hypertension (Panahi et al., 2020; Ashraf et al., 2022).

Regular consumption of Turmeric Juice Drink during the intervention period can affect blood volume and body fluid balance. Herbal drinks such as turmeric are usually consumed without added excess sugar and with sufficient volume of fluid for hydration. Good hydration can lower blood viscosity, reducing the workload of the heart and lowering intravascular pressure. In some studies, optimal hydration has been shown to help improve the function of baroreceptors that regulate blood pressure quickly. In the elderly at risk of dehydration, increasing fluid intake through the consumption of Turmeric Juice Drink can help keep plasma volume stable so that blood pressure becomes more controlled (WHO, 2023; Tang et al., 2024).

Another factor that plays a role in lowering blood pressure is the effect of curcumin on the modulation of the autonomic nervous system. Hypertension in the elderly is often influenced by the dominance of sympathetic nerve activity that triggers vasoconstriction and increased heart rate. Curcumin is thought to have the ability to decrease sympathetic activity indirectly through anti-inflammatory effects and increased levels of NO. Nitric oxide is a molecule that not only acts on blood vessels, but also affects the blood pressure regulation center in the brain. Increased levels of NO have a calming effect on the cardiovascular system by lowering an excess sympathetic response. Thus, Turmeric Juice Drink can provide a relaxation effect that physiologically helps lower blood pressure (Ashraf et al., 2022; Panahi et al., 2020).

In addition to direct biological mechanisms, there are also psychosocial factors that contribute to the reduction of blood pressure in the elderly. The activity of drinking herbal medicine or herbal drinks is often associated with relaxation rituals that provide a psychologically calming effect. The process of serving herbal drinks, the distinctive aroma of turmeric, and daily consumption routines can create a calmer environment for respondents. Older people who feel calm and relaxed will experience decreased levels of stress hormones such as cortisol, which physiologically triggers an increase in blood pressure. A decrease in cortisol not only lowers blood pressure but also improves mood and sleep quality, which in turn supports overall blood pressure stability (WHO, 2023; Xu et al., 2025).

In the context of this study, the daily consumption pattern of Turmeric Juice Drink was also likely to encourage respondents to pay more attention to their lifestyle in general. Elderly people who participated in the study tended to increase their attention to health, including reducing the consumption of high-salt foods, improving diet, and maintaining hydration. This habituation effect can improve adherence to the intervention and indirectly support a decrease in blood pressure. Although it cannot be concluded as the main factor, these behavioral changes can make a small but still meaningful contribution to the final results of the study (Dehzad et al., 2024).

Consumption of turmeric in the form of a drink also has the potential to affect lipid metabolism and prevent the formation of atherosclerotic plaques in blood vessels. These plaques are one of the main causes of hypertension in the elderly because they can narrow arteries and inhibit blood flow. Curcumin is known to

inhibit LDL oxidation, a process that plays a role in the formation of atherosclerotic plaques. By reducing oxidized LDL levels, Turmeric Juice Drink helps slow the progression of atherosclerosis and maintains smooth blood flow, which ultimately supports a decrease in blood pressure (Xu et al., 2025; Julhadi & Fatoni, 2024).

The influence of curcumin on kidney function should also not be ignored. The kidneys are important organs that regulate fluid balance and blood pressure. In the elderly, decreased kidney function can lead to sodium and fluid retention, which ultimately increases blood pressure significantly. Curcumin is known to have a nephroprotective effect, which is to protect the kidneys from oxidative and inflammatory stress. When kidney function improves, sodium excretion can increase and intravascular volume conditions can be stabilized. This has a positive impact on lowering blood pressure and explains why Turmeric Juice Drink interventions are effective in the elderly with a tendency to kidney disorders (Panahi et al., 2020; Ashraf et al., 2022).

Further analysis also showed that turmeric consumption can help balance the body's hormonal system related to blood pressure. Curcumin has reportedly affected levels of stress hormones such as adrenaline and cortisol which have a close relationship with vasoconstriction. The decrease in the activity of these hormones helps to increase the relaxation of blood vessels and lower blood pressure. This hormonal effect is especially beneficial for the elderly who often experience increased stress responses due to psychological and physical changes during the aging process (WHO, 2023; Xu et al., 2025). In addition, regular consumption of Turmeric Juice Drink can improve the gastrointestinal health of the elderly. A healthy digestive system contributes to better nutrient absorption, optimal metabolism, and electrolyte balance which affects blood pressure. Curcumin is known to increase the production of digestive enzymes, keep the intestinal flora healthy, and reduce inflammation in the gastrointestinal tract. A balanced gut microbiota can help with the production of metabolites that support cardiovascular function, including increased NO levels and decreased systemic inflammation. Thus, this intervention provides dual benefits for the elderly through improved digestive system and lowering blood pressure (Tang et al., 2024; Xu et al., 2025).

In the context of pathophysiology, the blood vessels of the elderly generally undergo vascular remodeling characterized by thickening of arterial walls, increased collagen, decreased elastin, and changes in endothelial cell structure. This process causes the arteries to become less elastic so that blood pressure tends to increase. Curcumin is able to inhibit the vascular remodeling process through inhibition of the enzyme metalloproteinase (MMP) which plays a role in the degradation of the extracellular matrix. Thus, turmeric consumption helps prevent the hardening of arteries and supports the flexibility of blood vessels in the elderly, so that blood pressure can decrease significantly (Jagetia & Rajanikant, 2019; Panahi et al., 2020).

Research shows that curcumin has mild antithrombotic activity that can help smooth blood flow. In the elderly, the risk of microblood clots forming is higher due to decreased fibrinolytic activity and increased coagulation factors. Curcumin is known to inhibit platelet aggregation and increase fibrinolytic activity so that the risk of forming small blood clots can decrease. Although this effect is not the primary goal of the intervention, smoother blood flow directly helps lower intravascular pressure and prevents excessive blood pressure increases (Tang et al., 2024; Ashraf et al., 2022). When viewed from a broader perspective, turmeric-based interventions such as Turmeric Juice Drink have advantages over pharmacological therapies because they are multifactorial and do not work on just one receptor or biological pathway. This multimodal approach is particularly suitable for elderly populations that have a wide range of physiological changes. These interventions can be more flexible in adapting to the body's complex needs, in contrast to single antihypertensive drugs that work specifically and sometimes trigger side effects in the elderly. This advantage is one of the reasons why herbal drinks such as turmeric can be a relevant strategy in health care for the elderly (WHO, 2023; Dehzad et al., 2024).

A thorough analysis of the results of the study shows that Turmeric Juice Drink does not only work on a single mechanism, but on various complementary biological pathways. The complexity of this mechanism explains why a simple herbal intervention can have a significant effect on blood pressure. The advantage of turmeric-based interventions also lies in their safety, especially for the elderly who often have various comorbidities and use many medications. Curcumin as an active compound is relatively safe for short-term consumption and has a low risk of side effects when compared to pharmacological antihypertensive drugs (Panahi et al., 2020; WHO, 2023).

Overall, the data shows that Turmeric Juice Drink has a significant positive impact on lowering blood pressure in the elderly. These changes are the result of a combination of various mechanisms such as improved endothelial function, increased NO, decreased oxidative stress, inhibition of inflammation, and improvement of lipid profiles. This intervention can be an alternative or complementary to hypertension therapy in the elderly, especially in those living in areas with limited access to health facilities. With its easy-to-prepare, inexpensive, safe, and widely accepted properties in public culture, Turmeric Juice Drink has the potential to be applied in public health programs aimed at reducing the prevalence of hypertension and

supporting the welfare of the elderly in the long term (Dehzad et al., 2024; WHO, 2023; Ashraf et al., 2022).

**Effect of Turmeric Juice Drink on Systolic Blood Pressure**

The results showed a significant decrease in systolic blood pressure after Turmeric Juice Drink intervention. Before treatment, the average systolic blood pressure of the respondents was 160.4 mmHg, while after seven days of intervention it decreased to 144.7 mmHg. The decrease in systolic blood pressure of 15.7 mmHg seen after the Turmeric Juice Drink intervention not only reflects an increase in vasodilation ability, but also suggests that there is a change in the level of deeper blood pressure regulation. In the elderly, systolic blood pressure is often more difficult to lower than diastolic pressure due to the high level of arterial stiffness and decreased elasticity of blood vessels due to the aging process. Therefore, the findings in this study are very significant because they show that turmeric is able to modulate systolic pressure through a mechanism that not only focuses on the effects of acute vasodilation, but also improves the quality of vascular structures gradually. This ability has to do with curcumin properties that can affect arterial remodeling, reduce collagen deposition, and protect the elastin matrix from degradation. These three processes greatly determine the ability of the arteries to accommodate systolic blood flow at each heart rate (Muniroh et al., 2021; Rachmawati et al., 2020).

In addition to playing a role in the structure of blood vessels, curcumin also acts on blood pressure regulation pathways through modulation of hormones that play a role in systolic pressure. One of the most influential hormonal systems in the regulation of systolic pressure is the renin–angiotensin–aldosterone system (RAAS). In many cases of hypertension, especially the elderly group, the RAAS system becomes hyperactive resulting in excessive amounts of angiotensin II. Angiotensin II is a potent vasoconstrictor that causes a significant increase in systolic pressure. Curcumin is known to reduce the activity of angiotensin-converting enzyme (ACE), so that angiotensin II production decreases and causes arteries not to experience excessive vasoconstriction. With a decrease in the RAAS response, systolic pressure can decrease more stably. This shows that the effect of Turmeric Juice Drink does not only work on the surface, but also on the hormonal system that regulates blood pressure (Kurniawan, 2021; Muniroh et al., 2021).

The significant decrease in systolic pressure in this study can also be explained by its association with the heart's function as a pump. Systolic blood pressure is a reflection of the heart's ability to pump blood to arteries. If the blood vessels are less elastic or there is an increase in peripheral resistance, the heart must work harder to produce enough pressure to maintain blood flow. Consumption of Turmeric Juice Drink is suspected to have a positive effect on heart function by lowering vascular resistance through several mechanisms, such as increasing NO, decreasing inflammation, and improving vascular tone. When vascular resistance is reduced, the heart's work becomes lighter, so systolic pressure decreases. In addition, curcumin also has the ability to reduce oxidative stress in the heart muscle and increase the efficiency of myocardial contractions, so that less pressure is needed to pump blood (Rachmawati et al., 2020; Wulandari et al., 2023).

Another important thing that explains the effectiveness of Turmeric Juice Drink in reducing systolic pressure is the role of curcumin in improving mitochondrial health. Mitochondria are the main energy producers in cells, including the smooth muscle cells of blood vessels. When mitochondrial function is disrupted, blood vessels lose the ability to contract and relax optimally. Curcumin has been known to have a protective effect on mitochondria through antioxidant and anti-inflammatory mechanisms that suppress oxidative damage. The maintenance of this mitochondrial function is essential for maintaining vascular health, so that blood vessels can react better to changes in pressure. With the increase in the energy capacity of blood vessel cells, the elasticity of the vessels increases and systolic blood pressure can drop steadily (Muniroh et al., 2021; Destri et al., 2020).

In addition, it cannot be ignored that curcumin has an effect on decreased blood viscosity. Blood that is too thick causes the heart to work harder to push blood through the arterial system, resulting in increased systolic pressure. Regular consumption of turmeric has been shown to reduce blood viscosity through the mechanism of increasing fibrinolytic activity and decreasing the tendency of platelet aggregation. This makes blood flow smoother and reduces the resistance to the heart when pumping blood. The end result is a more controlled decrease in systolic pressure. Although the antiplatelet effect of curcumin is not as strong as that of medical drugs such as aspirin, it is sufficient to make a positive contribution without increasing the risk of bleeding in the elderly (Destri et al., 2020; Wulandari et al., 2023).

The findings of this study also indirectly indicate that Turmeric Juice Drink may have an impact on reducing physiological stress levels in the body. Stress plays a major role in the increase in systolic blood pressure because it causes the activation of the sympathetic nervous system which increases vasoconstriction and accelerates cardiac activity. Curcumin is known to have a modulating effect on neurotransmitters and stress hormones, including cortisol and epinephrine. When stress hormone levels decrease, blood vessels are no longer in a state of chronic vasoconstriction, so systolic pressure can decrease. This is especially relevant for the elderly who often experience emotional and physical stress due to health and environmental changes. Thus, Turmeric Juice Drink not only lowers blood pressure through physiological mechanisms, but also through psychological mechanisms related to the regulation of the autonomic nervous system (Rachmawati et

al., 2020; Wulandari et al., 2023).

The decrease in systolic pressure found also showed that respondents experienced improvements in the flexibility of large blood vessels such as the aorta, which is a major determinant factor in systolic pressure. The aorta is a blood vessel with the function of resisting shock pressure from the heart, and in the elderly it usually experiences thickening and decreased elasticity. Curcumin is able to reduce these degenerative processes through inhibition of the metalloproteinase enzyme responsible for the degradation of elastin. When large blood vessels such as the aorta are more elastic, systolic pressure can drop more easily even with minimal lifestyle changes. This process is an important part of turmeric's antihypertensive effects that are rarely highlighted, but are crucial in understanding the results of this study (Muniroh et al., 2021; Kurniawan, 2021).

From a nutritional point of view, Turmeric Juice Drink can be considered an intervention that not only provides direct benefits on blood pressure, but also supports the body's overall metabolism. Curcumin works synergistically with vitamins and minerals that may be present in the juice formulation thereby increasing the body's total antioxidant activity. High antioxidant activity helps prevent lipid peroxidation that can lead to atherosclerotic plaques. With reduced plaque, blood flow becomes smoother and peripheral resistance decreases so that systolic pressure can drop further. This mechanism reinforces the reason why the results show a considerable systolic decline in a relatively short time (Muniroh et al., 2021; Rachmawati et al., 2020).

Previous studies have also shown that turmeric consumption can improve sleep quality, reduce anxiety, and improve daily activity patterns. These factors affect the hormonal balance and nervous system which helps regulate systolic blood pressure. Elderly people who have better sleep quality experience decreased sympathetic nerve activity and increased parasympathetic tone, which ultimately leads to a decrease in systolic pressure. In other words, Turmeric Juice Drink can have a positive indirect impact through improving quality of life, which in turn has an impact on cardiovascular health (Destri et al., 2020; Wulandari et al., 2023).

By paying attention to all these mechanisms, the 15.7 mmHg decrease in systolic pressure that appeared in this study can be understood as the result of the cumulative effects of various biological, metabolic, hormonal, and psychological factors. The broad effects that curcumin has, coupled with its ability to work on a wide range of body systems, make Turmeric Juice Drink a very potential and relevant intervention to be used as a complementary therapy in elderly patients. With its safe, easy consumption, and minimal side effects, this intervention can be integrated into hypertension management programs in the community at large.

**Effect of Turmeric Juice Drink on Diastolic Blood Pressure**

In addition to systolic, diastolic blood pressure also experienced a significant decrease. Before treatment, the average diastolic blood pressure was 94.2 mmHg, while after the intervention it decreased to 85.3 mmHg. The decrease in diastolic blood pressure of 8.9 mmHg observed after the administration of Turmeric Juice Drink in the elderly indicates a very important physiological response to this herbal intervention. Diastolic pressure describes peripheral resistance in the relaxation phase of the heart; Therefore, the decrease indicates that the blood vessels become more flexible and do not experience excessive tension during the blood flow to the peripheral tissues. In the elderly group, diastolic values above 90 mmHg are often associated with a high risk of decreased renal perfusion and microvascular damage, so changes to close to normal limits (80–85 mmHg) reflect clinically significant improvement (Wahyuni & Rahayu, 2021). One of the main factors influencing this decrease in diastolic pressure is turmeric's ability to modulate the activity of the autonomic nervous system, specifically lowering the dominance of the sympathetic nervous system responsible for vasoconstriction. The sympathetic system in the elderly often experiences hyperactivity due to chronic stress, aging, and metabolic disorders. The essential oils in turmeric—such as zingiberen, turmeron, and ar-turmeron—are able to suppress these sympathetic responses so that vascular tone decreases. When blood vessels are in a more relaxed state, peripheral resistance is reduced and diastolic pressure can decrease gradually but consistently (Wahyuni & Rahayu, 2021).

In addition to inhibiting the sympathetic system, the curcumin content in turmeric also plays a role in reregulating the sensitivity of beta-adrenergic and alpha-adrenergic receptors in blood vessels. In the elderly with hypertension, these receptors tend to be overactivated so that blood vessels remain narrow even when the body does not need vasoconstriction. Curcumin can decrease the response of these receptors to stress hormones such as epinephrine and norepinephrine, resulting in a relaxation of the arteriole wall and a decrease in peripheral resistance. This effect explains why diastolic pressure decreased quite significantly after the seven-day intervention (Guasti et al., 2022). The diastolic decreasing effect is also amplified by turmeric's ability to increase the production of nitric oxide (NO) produced by endothelial cells. Nitric oxide has a central role in maintaining blood vessel relaxation through the mechanism of increasing the activity of the enzyme guanylate cyclase in vascular smooth muscle. The activation of such enzymes produces cyclic GMP which leads to smooth muscle relaxation and dilation of the arterial lumens. In the elderly, NO

production often decreases due to endothelial damage caused by oxidative stress. Curcumin acts as a powerful antioxidant that lowers free radicals and restores the endothelial ability to produce NO, so that blood vessels are more easily relaxed during the diastolic phase (Wahyuni & Rahayu, 2021).

In addition to the vasodilation mechanism, the consumption of Turmeric Juice Drink also lowers diastolic pressure through its anti-inflammatory properties. In chronic hypertension, low-grade inflammation can cause thickening of the arterial walls and decreased elasticity of blood vessels, so that diastolic pressure remains high. Curcumin is able to inhibit inflammatory pathways such as NF-κB and lower levels of pro-inflammatory cytokines such as IL-6 and TNF-α. With decreased inflammation, blood vessels become more elastic and do not provide excessive resistance to blood flow. This improvement in the elasticity of small arteries (arterioles) is an important factor that leads to a decrease in diastolic pressure (Guasti et al., 2022).

The mild diuretic effect of turmeric also contributes to a decrease in diastolic pressure. With increased urine output, the volume of plasma decreases and causes a decrease in pressure on the walls of blood vessels, including small arteries that are very sensitive to changes in the volume of body fluids. This effect is particularly relevant in the elderly who often experience fluid retention due to decreased kidney function. Curcumin helps improve sodium excretion function through the natriuretic effect, so that the workload of the heart is reduced and diastolic pressure drops physiologically (Guasti et al., 2022). In addition, curcumin is also able to inhibit the activity of the renin–angiotensin system (RAS), a hormonal mechanism that plays a major role in the formation of hypertension, especially diastolic hypertension. Angiotensin II, which is produced from this system, is a potent vasoconstrictor that causes increased peripheral resistance. By lowering ACE activity and inhibiting the formation of angiotensin II, curcumin lowers vascular tone, so diastolic pressure can drop significantly. The inhibitory effect of RAS is very important, because in the elderly, RAS activity often increases due to the renal aging process (Wahyuni & Rahayu, 2021).

The decrease in diastolic pressure in this study also showed that peripheral blood flow improved. Diastolic pressure is closely related to the speed of blood flow from the large arteries to the small arteries and capillaries. When peripheral resistance decreases, blood can flow more optimally to the tissues. This improvement in blood flow is important to prevent conditions such as tissue ischemia in the elderly, which is usually caused by thickening of the arteriole walls. With increased peripheral perfusion after consumption of Turmeric Juice Drink, diastolic pressure becomes more stable and close to normal values (Guasti et al., 2022).

Turmeric's effect on diastolic pressure control can also be seen from its ability to improve vascular smooth muscle flexibility. In hypertension, the smooth muscles of the blood vessels tend to be in a state of hypertonus, which leads to an increase in peripheral resistance even in the relaxation phase of the heart. Curcumin helps lower intracellular calcium levels through the inhibition of L-type calcium channels, so smooth muscles are not in a state of "chronic tension". This decrease in intracellular calcium levels directly contributes to a decrease in diastolic pressure (Wahyuni & Rahayu, 2021).

In addition to providing physiological changes, regular consumption of Turmeric Juice Drink also has a positive impact metabolically, such as lowering lipid levels and improving insulin sensitivity. These changes help lower systemic inflammation and reduce the stiffness of blood vessels. Elderly people who have high cholesterol levels tend to experience increased diastolic pressure due to plaque buildup in small arteries. Curcumin is able to inhibit the process of atherogenesis through a decrease in LDL oxidation, thereby helping to reduce vascular resistance and gradually reduce diastolic pressure (Guasti et al., 2022).

These findings also suggest that Turmeric Juice Drink can provide a sense of comfort to blood vessels and improve vascular homeostasis. In many studies, significantly decreased diastolic pressure after intervention is usually associated with decreased arterial stiffness and an increased blood vessel relaxation response to blood flow. This improvement is important in the elderly, as the diastolic phase is the phase when vital organs such as the kidneys and brain receive stable blood flow. When diastolic pressure is too high, the perfusion of vital organs can be disrupted, so that increasing the elasticity of blood vessels through turmeric consumption is very beneficial for the health of the elderly (Wahyuni & Rahayu, 2021).

Thus, the decrease in diastolic pressure by 8.9 mmHg in this study is the result of various biological mechanisms that run simultaneously: endothelial repair, inflammation reduction, decreased sympathetic activity, RAS system inhibition, increased vasodilation, diuretic effect, and improvement of blood vessel smooth muscle tone. The combination of all these effects shows that Turmeric Juice Drink has great potential to be a complementary therapy that is not only safe, but also effective in helping to control diastolic blood pressure in the elderly with hypertension (Wahyuni & Rahayu, 2021; Guasti et al., 2022).

**Bivariate Analysis**

The analysis of the relationship between two variables in this study was carried out to test the impact of giving turmeric juice drinks on blood pressure reduction in the elderly group with hypertension in East Pentadio Village, Telaga Biru District, Gorontalo Regency. Before testing the main hypothesis, an examination of normality assumptions is carried out to determine the appropriate type of statistical test, both

parametric and non-parametric.

The normality test was carried out to assess whether blood pressure data before (pre-intervention) and after (post-intervention) were distributed normally. This step is important because the subsequent selection of statistical methods depends on the fulfillment of the distribution assumptions. In this study, normality testing used the Shapiro-Wilk method given the limited sample size (n=20). The test results showed a significance value (p) for pre-intervention blood pressure data of 0.000 and post-intervention was also 0.000. Both significance values are below the alpha limit of 0.05. This indicates that the distribution of blood pressure data before and after the intervention is abnormal. In other words, the pattern of data distribution moves away from the normal curve pattern. Such conditions are often found in health studies with small samples and a diversity of subject characteristics, such as in elderly populations that have different physiological conditions, treatment patterns, and responses to therapy. Since the assumption of normality is not met, parametric statistical tests such as paired t-tests cannot be applied. Therefore, the researcher chose a non-parametric test, the Wilcoxon Signed Rank Test, which does not require normal, precise distributed data to compare two paired measurements on the same group of subjects.

The Wilcoxon Signed Rank Test was used to analyze blood pressure differences before and after the consumption of turmeric juice drinks. The test operates by ranking the difference in the value of each data pair (the post-intervention value minus the pre-intervention) without considering the absolute magnitude of the difference, but rather in the order in which it is ranked. This procedure allows researchers to determine whether there are statistically significant changes after the intervention. The results of the Wilcoxon Signed Rank Test calculation showed that out of 20 respondents, all (100%) experienced a decrease in blood pressure after consuming turmeric juice drinks regularly for one week. This is reflected in the number of negative ranks as many as 20, while positive ranks and ties are worth zero. Negative rankings indicate that the post-intervention value is lower than the pre-intervention, which in this context means a decrease in blood pressure. The average rank for negative ranks is 10.50 with a total number of ranks (sum of ranks) of 210.00. The statistical value of the resulting Z test was -4.473 with a two-sided significance value (p) of 0.000.

Based on the results of the Wilcoxon test, a value of $p = 0.000$ was obtained. Because this value is much smaller than the established significance level ($\alpha = 0.05$), the null hypothesis ($H_0$) which reads "there is no effect of giving turmeric juice drinks on lowering blood pressure in elderly people with hypertension" is rejected. On the other hand, an alternative hypothesis ($H_a$) stating that "there is an effect of giving turmeric juice drinks on lowering blood pressure in elderly people with hypertension" was accepted. Thus, it can be statistically concluded that the intervention of turmeric juice drinks had a significant impact on lowering blood pressure in the elderly group studied. Descriptively, the average blood pressure before the intervention showed that the majority of respondents were classified as level two (160-179/100-109 mmHg) and level three (≥180/≥110 mmHg) hypertension. After the intervention, there was a fairly noticeable shift in the distribution of blood pressure categories. As many as 45% of respondents (9 people) reached the category of high normal blood pressure (120-129/80-84 mmHg), 50% (10 people) were in the pre-hypertension category (130-139/85-89 mmHg), and only 5% (1 person) were still in the category of level one hypertension (140-159/90-99 mmHg). There were no more respondents who survived in the category of level two or three hypertension. These changes show the effectiveness of turmeric juice drinks not only in statistically lowering blood pressure numbers, but also in changing the clinical status of respondents to a lower risk category.

The findings of this study, which reveal the significant influence of turmeric juice drinks on blood pressure reduction, can be explained through a number of pharmacological and physiological mechanisms. The content of curcuminoids, especially curcumin, in turmeric has multi-effects that support heart and blood vessel health. First, curcumin acts as a powerful antioxidant agent that is able to neutralize free radicals (reactive oxygen species / ROS) in the body. This endothelial damage interferes with the production of nitric oxide (NO), a key molecule that functions to dilate blood vessels (vasodilation). By reducing oxidative stress, curcumin helps restore endothelial function and increases the availability of NO, so that blood vessels become more relaxed and blood pressure decreases.

Second, curcumin has anti-inflammatory properties by inhibiting the nuclear signaling pathway factor-kappa B (NF-κB) and lowering the production of pro-inflammatory cytokines such as Tumor Necrosis Factor-alpha (TNF-α) and Interleukin-6 (IL-6). Low-grade inflammation is one of the underlying pathophysiological mechanisms of hypertension, especially in the elderly population. The inflammatory response causes hardening (stiffness) and narrowing of blood vessels. By suppressing the inflammatory response, the curcumin in turmeric juice drinks can reduce arterial stiffness and blood flow obstruction in the peripheral vessels, which ultimately lowers systolic and diastolic blood pressure.

Third, several studies have shown that curcumin can modulate the Renin-Angiotensin-Aldosterone (RAAS) system, which is the main blood pressure control system in the body. Curcumin is thought to be able to inhibit the activity of angiotensin-modifying enzymes (ACEs), similar to how antihypertensive drugs work in the ACE inhibitor group, although with a milder potency. This mechanism may explain the observed decrease in blood pressure after regular consumption of turmeric juice drinks.

The results of this study are in line with several previous studies. Research by Destri, Hayulita, and

Cania (2020) in Bukittinggi found that administering grated turmeric brewing twice a day for 7 days significantly lowered blood pressure in the hypertensive elderly, with a p=0.001 value. Similarly, Yogiantoro (2021) reported that the consumption of 150 ml of turmeric juice twice a day had an effect on the reduction of systolic and diastolic blood pressure in the elderly group. Laboratory studies by Shaumi and Ahmad (2020) also corroborate these findings by explaining how curcumin works in inducing vasodilation through increased NO availability and antioxidant activity. However, the success of the intervention in this study was inseparable from other supporting factors. The addition of hot water in the manufacturing process helps the withdrawal of active compounds, and consumption in liquid form facilitates absorption in the digestive tract, which often slows down in the elderly. In addition, the intervention carried out for 7 days provides sufficient time for curcumin to accumulate in the body and exert a therapeutic effect.

The behavioral and psychological factors of the respondents also play a role. The research process involving regular visits and monitoring by researchers may create the Hawthorne effect, in which respondents become more compliant with general health recommendations, including perhaps more protective of their diet and activities. However, efforts to control external disruptive factors have been carried out by providing counseling to respondents to maintain their routine activity and medication consumption patterns. However, this study has limitations. A relatively short intervention period (7 days) was only able to capture the immediate or short-term effects of turmeric juice drinks. It is not known whether this blood-lowering effect can be sustained in the long term after the intervention is stopped. In addition, this study did not use a placebo comparison group, so the possibility of a placebo effect or regression to mean could not be completely eliminated. Factors of diet, stress levels, and sleep quality of respondents that are not strictly controlled can also affect blood pressure variations.

Clinically, the observed decrease in blood pressure has important implications. A decrease in systolic blood pressure of 20-40 mmHg and diastolic 10-20 mmHg, as seen in some respondents who moved from stage two/three hypertension to the normal or pre-hypertensive category, can substantially reduce the risk of major cardiovascular events such as stroke and heart attack. Epidemiological studies show that a decrease in systolic blood pressure by 10 mmHg can reduce the risk of stroke by about 40% and coronary heart disease by about 25% in the elderly population. Therefore, turmeric juice drinks have the potential to be a safe and easy adjunct therapy to be combined with pharmacological treatment of hypertension in the elderly. For community health workers, these findings can be the basis for developing education and training programs for making simple herbal drinks as part of health promotion and prevention of non-communicable diseases in elderly posyandu.

For further studies, it is recommended to use more robust research designs, such as randomized controlled trials (RCTs) with placebo-controlled groups, longer intervention periods (e.g. 4-12 weeks), and measurement of additional parameters such as endothelial function (e.g. via flow-mediated dilation), the rate of inflammatory markers (hs-CRP), and oxidative stress to better elucidate the mechanism of action. Research with a larger and more diverse sample is also needed to generalize the findings.

Overall, the results of this bivariate analysis provide empirical evidence that turmeric juice is an effective non-pharmacological intervention to help lower blood pressure in elderly people with hypertension. The synergistic effect between turmeric's bioactive content, easily absorbed form, and good acceptance from respondents makes this intervention worthy of consideration for integration in the holistic management of hypertension at the primary health service level.

## CONCLUSION

The blood pressure of elderly people with hypertension before being given turmeric juice drink is in the category of hypertension, both systolic and diastolic pressure, which indicates that the condition of blood pressure has not been well controlled.

Blood pressure in the elderly after being given turmeric juice drink intervention decreased compared to before treatment, both at systolic and diastolic pressure.

The administration of turmeric juice drink has been proven to have an effect on reducing blood pressure in the elderly with hypertension, so it can be used as an alternative to complementary non-pharmacological therapy in hypertension control.

Thus, it can be concluded that regular administration of Turmeric Juice Drink for seven days has a significant effect on lowering blood pressure in elderly people with hypertension.

## SUGGESTIONS

It is hoped that the results of this research can be a basis for health workers, especially community nurses, to develop herbal non-pharmacological interventions as an effort to prevent and control hypertension in the community. Nurses are also expected to provide education to the public on how to make and consume Turmeric Juice Drink properly and safely.

The elderly are advised to consume Turmeric Juice Drink regularly as part of a healthy lifestyle, accompanied by limiting salt intake, increasing physical activity, and regular blood pressure checks. Families

are expected to play an active role in supporting the elderly to consistently live a healthy lifestyle.

Puskesmas can consider the results of this research to integrate local herbal interventions in non-communicable disease management (NCD) programs. In addition to increasing community participation, this step can also strengthen local empowerment through the use of family medicinal plants (TOGA).

It is recommended to conduct follow-up studies with a larger number of respondents, longer duration of interventions, and add examination of biochemical parameters such as cholesterol levels, blood glucose, and biomarkers of oxidative stress to provide a more comprehensive physiological picture of the effects of Turmeric Juice Drink.

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