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**Original Research Article**

# A comparative analysis on safety and efficacy of telmisartan and ramipril in treatment of hypertension in a tertiary care hospital

**Wajid Gulzar[1]*, Mudasir Manzoor Dar[1], Amritpal Singh[2], Peer Samiq Masoodi[1], Shah Samreen[1], Uma Jyoti[1]**

[1]Adesh Institute of Pharmacy and Biomedical Sciences, Adesh University, Bathinda, Punjab, India
[2]Adesh Institute of Medical Sciences and Research, Bathinda, Punjab, India

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***Correspondence:**
Dr. Wajid Gulzar,
E-mail: drwajid2026@gmail.com



## ABSTRACT

**Background:** Hypertension is a major global health challenge and an important risk factor for cardiovascular disease. Angiotensin-converting enzyme inhibitors (ACEIs) and angiotensin receptor blockers (ARBs) are commonly used first-line antihypertensive agents. This study evaluated the safety and efficacy of telmisartan and ramipril in patients with hypertension at a tertiary care hospital.
**Methods:** This prospective observational study included 113 adult patients with hypertension who received either telmisartan (n=56) or ramipril (n=57). Pre- and post-treatment systolic (SBP) and diastolic blood pressure (DBP) were assessed. Efficacy was evaluated by achievement of target blood pressure, while safety was assessed based on adverse drug reactions. Statistical analysis was performed using the chi-square test.
**Results:** Both treatments significantly reduced SBP and DBP. Post-treatment SBP shifted mainly to 120-140 mmHg, while DBP improved to 76-85 mmHg. Target blood pressure was achieved more frequently with telmisartan (96.4%) than ramipril (80.7%) ($\chi^2$=6.862, $p<0.05$). Telmisartan was also associated with fewer cases of cough and greater improvement in symptoms such as headache and fatigue.
**Conclusions:** Both telmisartan and ramipril effectively reduced blood pressure. However, telmisartan was more effective in achieving target blood pressure and showed better tolerability with fewer adverse effects, suggesting it may be a preferable option, particularly for patients intolerant to ACE inhibitors.

**Keywords:** ACE inhibitors, Angiotensin receptor blockers, Antihypertensive therapy, Blood pressure control, Drug safety, Hypertension, RAAS, Ramipril, Telmisartan, Tolerability

## INTRODUCTION

Hypertension is a cardiovascular disease and one of the most common non-communicable diseases with a significant contribution to cardiovascular morbidity and mortality across the world. It is generally described as a chronic increase in arterial blood pressure, which is normally defined by systolic blood pressure (SBP) 140 mmHg and/or diastolic blood pressure (DBP) 90 mmHg in repeated clinical measurements.[1,2] Hypertension is a multifaceted cardiovascular condition due to the combination of genetic factors, environmental factors, and lifestyle choices including diet, lack of physical activity, obesity, and high sodium consumption.[3] Hypertension is ranked among the most significant risk factors that can be modified to prevent cardiovascular diseases, such as coronary artery, stroke, heart failure, and chronic kidney diseases.[4]

The condition can be rather slow to develop and can be asymptomatic over a long period of time, this is why hypertension is often referred to as a silent killer (Global

report on hypertension). The high blood pressure also leads to augmented mechanical pressure on the arterial walls promoting endothelial dysfunction, vascular reorganization and alteration of the atherosclerotic of cardiovascular system.[4] Consequently, long-term hypertension greatly puts the risk of severe complications ranging from myocardial infarction, stroke, and kidney failure.[5] Hypertension is one of the most significant public health issues in the world because of its high prevalence and close links with cardiovascular morbidity and mortality.[6] The World Health Organization estimates that in 2024, about 1.4 billion adults aged 30-79 years live with hypertension around the globe, which is almost one-third of the world population of adults. Almost half of hypertensive adults do not know they have this condition, and this makes it very difficult to diagnose and treat hypertension in time, and also leads to poor conditions of the disease.[1] The prevalence of hypertension has been growing very high over the last decades with approximately 650 million adults in 1990 increasing to over 1.3-1.4 billion in the recent years.[5] The pathophysiology of hypertension is multifactorial and complex, with interactions among genetic predisposition, environmental factors, and multiple physiological regulatory systems, which interact to cause persistent arterial blood pressure elevation.[7] Vascular remodelling is one of the most important mechanisms of hypertension and is defined as structural and functional alterations of blood vessel walls such as thickening of vascular smooth muscle cells, deposition of extracellular matrix and narrowing of lumen. The alterations augment vascular rigidity and peripheral vascular resistance, thus leading to sustained hypertension.[8] Endothelial dysfunction is another mechanism that is essential in hypertension development and it is the outcome of the faulty functioning of the vascular endothelium. Vascular tone is normally controlled by the endothelium through the release of vasodilatory agents like nitric oxide (NO), prostacyclin, and other relaxing agents.[9]

Neurohormonal systems are also important in the pathogenesis of hypertension. The renin-angiotensin-aldosterone system (RAAS) is regarded as one of the most crucial systems that regulate blood pressure and fluid balance.[10] The RAAS pathway helps to regulate blood pressure by synthesizing angiotensin II, which is a strong vasoconstrictor, enhancing systemic vascular resistance and causing the adrenal cortex to secrete aldosterone. Sodium and water retention in the kidneys is induced by aldosterone, which reduces the volume of blood and raises the blood pressure.[8] Besides RAAS activation greater activity of the sympathetic nervous system is another significant cause of hypertension. The higher sympathetic stimulation results in increased heart rate, vasoconstriction, and renal sodium retention and raise the systemic blood pressure even more.[11] Renin-angiotensin-aldosterone system (RAAS) is a primary mediator that controls blood pressure, fluid homeostasis and electrolytes. It is triggered by a drop in renal perfusion, sympathetic activity, or a drop in sodium supply to the distal tubules.[12] Angiotensinogen is converted to angiotensin I by renin which is released by the juxtaglomerular cells in the kidneys, which is later transformed to angiotensin II by angiotensin-converting enzyme (ACE). Angiotensin II is a strong vasoconstrictor, which enhances systemic vascular resistance and promotes the secretion of aldosterone causing sodium and water retention.[13] ACE inhibitors (ACEIs) and angiotensin receptor blockers (ARBs) are first-line antihypertensive agents, which both target the RAAS but vary in their mechanism of action.[14] ACE inhibitors prevent the angiotensin I to angiotensin II conversion, thus decreasing vasoconstriction and aldosterone-induced fluid retention. Moreover, ACE inhibition results in elevated levels of bradykinin, which causes vasodilation but also causes other adverse effects, such as cough and angioedema.[15]

Angiotensin receptor blocker telmisartan and ACE inhibitor ramipril are popular in the management of hypertension and cardiovascular risk prevention.[13] Telmisartan has a long half-life (~24 hours), giving sustained 24-hour blood pressure control and enhanced morning blood pressure reduction, which is vital in preventing cardiovascular events.[16] Recent clinical trials, particularly large-scale, have indicated that telmisartan has some extra cardiovascular protective properties, such as lower stroke, heart failure, and all-cause mortality risks, especially in high-risk groups.[14] With the above in mind, the current study was done to determine the analysis on safety and efficacy of telmisartan and ramipril in treatment of hypertension in a tertiary care hospital.

## METHODS

This hospital-based prospective observational study was conducted at Adesh Hospital Bathinda from February 2025 to July 2025, after the approvals from college research committee (CRC) and ethical research committee of Biomedical and Health Research, Adesh University.

Data were collected from the outpatient department (OPD) of general medicine in patients diagnosed with hypertension and receiving either telmisartan or ramipril therapy. Information was obtained using a pre-designed data collection form and a self-structured questionnaire after obtaining written informed consent from all participants.

### *Inclusion and exclusion criteria*

The study included adult patients (≥18 years) diagnosed with hypertension. Patients with a history of hypersensitivity to angiotensin receptor blockers (ARBs) or angiotensin-converting enzyme (ACE) inhibitors, pregnant or lactating women, those on other antihypertensive therapies, and individuals presenting with hypotension or shock were excluded. Data were collected using a structured proforma, including demographic and social details, current antihypertensive treatment, clinical parameters, laboratory investigations, adverse drug

reactions, and treatment efficacy in terms of blood pressure control.

***Sample size (n)***

The sample size was determined using Slovin's formula, yielding a final sample size of 113 based on the estimated population and selected margin of error. Consequently, 113 eligible patients were included in the study to ensure robustness, representativeness, and reliability of the findings. Sample size was calculated using formula:

$$n = \frac{N}{1 + N(\alpha)^2}$$

***Justification***

Slovin's formula was utilized for sample size estimation due to its suitability for studies with a defined population and unknown variability. It ensures controlled sampling error and an adequately representative sample, thereby enhancing the validity and generalizability of the study findings.

## RESULTS

A total of 113 patients were included in the study. The baseline demographic characteristics of the participants are presented in Table 1. Of the total participants, 61 (54.0%) were male and 52 (46.0%) were female. Fifty-six (49.6%) patients received telmisartan, while 57 (50.4%) received ramipril. Out of total patients 56 patients were given telmisartan compared to 50.4% (n=57) of the patients that were given ramipril. The values of the systolic blood pressure (SBP) and diastolic blood pressure (DBP) of all the 113 participants recorded at the beginning of the research.

**Table 1: Baseline demographic characteristics of the study participants (n=113).**

| Characteristics | Categories | N (%) |
|---|---|---|
| **Gender** | Male | 61 (54.0) |
| | Female | 52 (46.0) |
| **Treatment group** | Telmisartan | 56 (49.6) |
| | Ramipril | 57 (50.4) |
| **Total participants** | | 113 (100) |

The values of SBP were between 140 mmHg to 190 mmHg, which shows various intensities of hypertension in the patients as shown in Table 2. The greatest proportion of patients recorded a 170-mmHg baseline SBP, which totalled 23.0%. Subsequently, there was 160 mmHg, occurring in 16.8 percent of the patients followed by 165 mmHg, which was evident in 15.0 percent of patients. The most frequent DBP value was 100 mmHg where 17.7 percent of the patients had and the rest 16.8 and 14.2 percent were 90 mmHg and 95 mmHg respectively. Also, there were moderate values like 89 mmHg (11.5%) and 88 mmHg (5.3%). The ranges on the reading were found to be 80 mmHg to 104 mmHg, and the higher diastolic blood pressure was discovered, among most of the patients before undergoing therapy.

**Table 2: Pre-treatment frequency distribution of baseline systolic and diastolic blood pressure before treatment.**

| Systolic baseline BP before treatment (mmHg) | Frequency | Percent |
|---|---|---|
| **140-149** | 7 | 6.2 |
| **150-159** | 11 | 9.7 |
| **160-169** | 41 | 36.3 |
| **170-179** | 48 | 42.5 |
| **180-189** | 5 | 4.4 |
| **190-199** | 1 | 0.9 |
| **Total** | 113 | 100.0 |
| **Diastolic baseline BP before treatment (mmHg)** | **Frequency** | **Percent** |
| 80-89 | 25 | 22.1 |
| 90-99 | 67 | 59.3 |
| 100-109 | 21 | 18.6 |
| Total | 113 | 100.0 |

***Blood pressure after treatment with antihypertensive drug***

After administering antihypertensive treatment, the patients (n=113) were capable of liking the range of SBP values; the range was reduced significantly. The SBP that was most often recorded as post-treatment was 130 mmHg seen in 23.9 percent of patients followed by 140 mmHg (15.0 percent) and 125 mmHg (11.5 percent). The other frequently documented numbers were 126 mmHg (10.6%) and 135 mmHg (8.0%) as shown in Table 3. The post-therapy SBP values were ranged 120 mmHg to 148 mmHg which meant that most patients were subjected to decrease in their systolic pressure, towards normal or close-to-normal range.

**Table 3: Frequency distribution of systolic and diastolic blood pressure following treatment.**

| SBP after treatment | Frequency | Percent |
|---|---|---|
| **120- 124** | 4 | 3.5 |
| **125-129** | 43 | 38.1 |
| **130-134** | 31 | 27.4 |
| **135-139** | 13 | 11.5 |
| **140-144** | 18 | 15.9 |
| **145-149** | 4 | 3.5 |
| **Total** | 113 | 100.0 |
| **DBP after treatment** | **Frequency** | **Percent** |
| 76-79 | 12 | 10.6 |
| 80-84 | 88 | 77.9 |
| 85-89 | 13 | 11.5 |
| Total | 113 | 100.0 |

The diastolic blood pressure (DBP) indicators were substantially improved in the patient population. The most frequently registered DBP was 80 mmHg, which affects 37.2 percent of patients, a sign of the move to the normal range of diastolic condition as shown in Table 2. Others that were seen quite often were 82 millimeters of mercury (14.2 percent), 83 millimeters of mercury and 85 millimeters of mercury (10.6 percent apiece), and 84 millimeters of mercury (9.7 percent). The average post treatment range of DBP was 76 mmHg-87 mmHg implying that most patients had attained or got close to normal diastolic levels after treatment.

***Drug given target BP achieved cross tabulation***

The patients were distributed in terms of the antihypertensive drug applied (telmisartan or ramipril). Of the participants who were on telmisartan, 54 patients (96. 4%) reached the target level of BP compared to 2 patients (3.6%) who did not reach this target level of BP. Conversely, 46 patients (80.7%) out of the ramipril group achieved target BP target compared to 11 patients (19.3%) who failed. The result revealed that target BP was higher in telmisartan group which indicate a higher efficacy than ramipril.

**Table 4: Drug given-target blood pressure achievement cross-tabulation.**

| Drugs given | Count | Yes | No | Total |
|---|---|---|---|---|
| **Telmisartan** | Observed | 54 | 2 | 56 |
| | Expected | 49.6 | 6.4 | 56.0 |
| **Ramipril** | Observed | 46 | 11 | 57 |
| | Expected | 50.4 | 6.6 | 57.0 |
| **Total** | Observed | 100 | 13 | 113 |
| | Expected | 100.0 | 13.0 | 113.0 |

***Chi-square tests***

To determine the existence of the connection between the type of antihypertensive drug used (telmisartan and ramipril) and the results of reaching target blood pressure rates, a chi-square test was implemented with 1 degree at a significance level of 0.05. The interpretation of the results showed that there was a statistically significant relationship between the two variables. $\chi^2(n=113) =6.862$, $p=0.05(5.991)$, $p<0.05$ which indicates that there was a significant variation in the likelihood of attainment of target blood pressure between the two groups of treatment. These results indicate that the conclusion was correct because it is found that patients under telmisartan were at higher likelihood of attaining target blood pressure than ramipril.

***Adverse effects (cough) and symptom improvement***

In the present study the occurrence of cough and the improvement of symptoms among patients receiving telmisartan and ramipril therapy was also evaluated. A higher number of patients treated with ramipril experienced cough as a side effect, although the majority of patients in both groups did not report this symptom. Fewer patients receiving telmisartan reported cough, indicating a lower incidence of this adverse effect in the telmisartan group. These findings are consistent with the known pharmacological profile of angiotensin-converting enzyme (ACE) inhibitors such as ramipril, which are commonly associated with cough as an adverse reaction. Telmisartan, an angiotensin receptor blocker (ARB), demonstrated better tolerability, as reflected by the reduced occurrence of cough among patients in the study population.

In terms of symptom improvement, patients receiving telmisartan showed greater relief from common symptoms such as headache and fatigue compared with those receiving ramipril. A larger proportion of patients in the symptom improvement group were treated with telmisartan, whereas the majority of patients who reported no improvement were receiving ramipril. Overall, these observations suggest that telmisartan was associated with fewer adverse effects and better symptom relief compared with ramipril, indicating a more favorable tolerability and therapeutic response in the study population.

## DISCUSSION

In this study, we observed a marked decrease in systolic and diastolic blood pressure in hypertensive patients following treatment with both telmisartan and ramipril, suggesting that the renin-angiotensin-aldosterone system (RAAS) blockade is effective in controlling blood pressure. Renin-angiotensin-aldosterone system (RAAS) blockers, such as angiotensin-converting enzyme inhibitors (ACEIs) and angiotensin receptor blockers (ARBs), continue to be the mainstay of antihypertensive treatment, as they are known to lower the risk of cardiovascular complications and death.[17] An important finding of the present study was that a greater percentage of patients in the telmisartan group reached their blood pressure targets than the ramipril group. This observation is consistent with recent real-world and clinical studies in which telmisartan has been shown to effectively control blood pressure, with no rebound effect, and reduce variability in blood pressure. Lower variability in blood pressure measurements is relevant, as it has been linked to a reduction in heart disease and better long-term health.[18] In our study, a significant decrease in the proportion of blood pressure toward 120-140 mmHg for systolic blood pressure and near-normal levels for diastolic blood pressure after treatment, showing effective blood pressure control. This is in line with recent clinical data showing that drugs that block the RAAS have a substantial effect on both systolic and diastolic blood pressure in a wide range of patients.[19] The greater effectiveness of telmisartan seen in this study can be explained by its pharmacokinetics, namely a long half-life and high binding affinity for the receptor, which ensures 24-hour blood pressure lowering effects. It has been shown that

long-acting ARBs, such as telmisartan, more effectively suppress the early morning blood pressure spike, an important predictor of cardiovascular disease.[20] In addition, previous meta-analyses have shown telmisartan to be more effective in reducing diastolic blood pressure than ACE inhibitors (including ramipril) and have a higher response rate in patients with hypertension.[21] This is in line with the results of the current study which found telmisartan was more effective in achieving target blood pressure than ramipril.

Improved tolerability is important because it impacts on adherence to antihypertensive treatment. Research indicates that ARBs are well tolerated and have a higher adherence than ACE inhibitors. Moreover, our study found patients taking telmisartan had more improvement in symptoms like headache and fatigue. Better symptom control may be related to better blood pressure control and fewer drug reactions, which lead to improved quality of life.[17] In terms of safety and tolerability, the higher incidence of cough with ramipril is supported by the known mechanism of action of angiotensin-converting enzyme (ACE) inhibitors that inhibit the breakdown of bradykinin and substance P, causing their build-up in the lungs and resulting in a dry cough.[21] The results of the present study are also corroborated by large randomized trials which have shown telmisartan to be at least as effective as ramipril in preventing cardiovascular events, with improved tolerability.[22]

This supports the use of telmisartan as a safe alternative to ACE inhibitors, especially in those who are sensitive to the side effects of ACEIs. While these results are encouraging, there are some limitations. The research was performed at a single tertiary care centre with a small sample size, and may not be fully generalisable. The observational nature of the study may also have potential confounding variables on the outcome.

## CONCLUSION

This was a comparative study conducted in 113 hypertensive patients to evaluate the efficacy and safety of Telmisartan and Ramipril. Both Telmisartan and Ramipril effectively reduced systolic and diastolic blood pressure in hypertensive patients. However, telmisartan demonstrated superior efficacy, with a higher proportion of patients achieving target blood pressure, better patient satisfaction, and fewer adverse effects such as dry cough and dizziness. Additionally, telmisartan was more effective in reducing symptoms like headache and fatigue, leading to improved treatment compliance. Therefore, telmisartan may be preferred over ramipril, particularly in patients intolerant to ACE inhibitors.

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*Ethical approval: The study was approved by the Institutional Ethics Committee*

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