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REVIEW ARTICLE

Comparative efficacy of angiotensin-converting enzyme inhibitors versus angiotensin receptor blockers for blood pressure lowering in adults with essential hypertension: a systematic review and meta-analysis

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ABSTRACT

Background: Angiotensin-converting enzyme inhibitors (ACEIs) and angiotensin receptor blockers (ARBs) serve as primary treatments for essential hypertension. Nonetheless, research is scarce directly comparing the efficacy of these medications in controlling blood pressure. This systematic review and meta-analysis sought to assess and compare the safety and efficacy of these drugs in adults diagnosed with essential hypertension.

Methods: A comprehensive review of randomized controlled trials (RCTs) published from 2015 to 2025 was carried out using PubMed, Medline, and Scopus. The studies selected for inclusion compared ACEIs and ARBs in adult patients with essential hypertension, specifically focusing on alterations in systolic blood pressure (SBP), and/or diastolic blood pressure (DBP).

Results: A total of five RCTs involving 852 participants were included. The meta-analysis showed no significant difference between ACEIs and ARBs in reducing SBP standardized mean differences [SMD = 0.01; 95% confidence intervals (CI): -0.16 to 0.18; $p = 0.91$; I-squared (I^2) = 0%]. For DBP, the pooled analysis suggested a slight advantage for ACEIs (SMD = -1.52; 95% CI: -2.86 to -0.19; $p = 0.03$), but this finding was driven by a single outlier study ($I^2 = 97\%$). After sensitivity analysis, the difference was no longer significant (SMD = -0.31; 95% CI: -0.90 to 0.28; $p = 0.30$). Blood pressure normalization rates (<140/90 mmHg) did not differ significantly between groups (OR = 0.95; 95% CI: 0.66-1.37; $p = 0.79$; $I^2 = 13\%$). The safety profiles were similar, but ACEIs were associated with a higher incidence of cough.

Conclusion: ACEIs and ARBs are equally effective in lowering SBP and managing blood pressure control in adults with essential hypertension. The decision to choose between these medications should be based on tolerability, individual patient factors, and considerations regarding vascular health, rather than differences in their ability to reduce blood pressure.

Keywords: Angiotensin-converting enzyme inhibitors, angiotensin receptor blockers, essential hypertension, blood pressure lowering, antihypertensive therapy.

Introduction

Hypertension is a major risk factor for cardiovascular diseases, accounting for over 10 million deaths worldwide. It also contributes significantly to various health issues, leading to a considerable economic burden on healthcare systems [1,2]. Hypertension is commonly treated with angiotensin receptor blockers (ARBs) and angiotensin-converting enzyme inhibitors (ACEIs). It

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was shown that ACEIs can reduce both mortality and morbidity, while ARBs do not demonstrate the same effectiveness [3].

A comprehensive review indicated that ACEIs and ARBs are comparable in their effectiveness in managing blood pressure. However, ACEIs tend to cause more coughing than ARBs. Additionally, information is scarce regarding other effects associated with these medications [4]. Furthermore, another study found that both ACEIs and ARBs can effectively lower blood pressure. ACEIs have been linked to a decrease in both total mortality and fatalities associated with cardiovascular problems, whereas ARBs have not shown similar advantages as ACEIs [5].

Studies indicate that ARBs are comparable in effectiveness and tolerability to ACEIs but have fewer adverse effects. Many studies had fewer than 500 participants and less than 10 events per group, making it difficult to accurately assess the comparative efficacy and drawbacks of ACEIs and ARBs. Furthermore, the presence of additional health conditions, such as blood disorders or musculoskeletal issues, as well as the inclusion of high-risk patient groups, can significantly affect the outcomes of these evaluations [3,6-10]. The Reduction of Atherothrombosis for Continued Health study discovered that individuals who took ARBs experienced a 10% decrease in cardiovascular events [11]. Conversely, another study suggested that there might be an increased risk of myocardial infarction linked to the use of ARBs [12].

Both classes of medications are still recommended as initial treatment options, despite their limitations. ACEIs tend to be prescribed more frequently for hypertension compared to ARBs [13,14]. However, there are significant knowledge gaps, particularly a lack of direct comparisons, as most studies do not evaluate ACEIs and ARBs head-to-head. Therefore, our study aims to assess the efficacy of ACEIs compared to ARBs in lowering blood pressure.

Methodology

This review and meta-analysis were conducted in accordance with the PRISMA 2020 guidelines [15].

Search strategy

A comprehensive search was performed in PubMed, MEDLINE, and Scopus for articles published between 2015 and 2025. The search utilized a combination of Medical Subject Headings and free-text terms. The complete PubMed search string was:

("ACE Inhibitors" OR "Angiotensin Converting Enzyme Inhibitors" OR "ACEI" OR "Lisinopril" OR "Captopril" OR "Enalapril" OR "Ramipril" OR "Perindopril" OR "Benazepril" OR "Fosinopril" OR "Quinapril" OR "Moexipril" OR "Trandolapril")

AND ("Angiotensin Receptor Blockers" OR "ARBs" OR "Angiotensin II Receptor Antagonists" OR "AT1 Receptor Blockers" OR "AT2 Receptor Blockers" OR "Losartan" OR "Valsartan" OR "Irbesartan" OR "Candesartan" OR "Olmesartan" OR "Telmisartan" OR "Eprosartan" OR "Azilsartan")

AND ("Blood Pressure" OR "Blood Pressure Reduction" OR "BP Lowering" OR "Hypertension Control" OR "Systolic Blood Pressure (SBP)" OR "Diastolic Blood Pressure (DBP)" OR "Mean Arterial Pressure" OR "Antihypertensive Effect")

AND ("Essential Hypertension" OR "Primary Hypertension" OR "High Blood Pressure" OR "Idiopathic Hypertension" OR "Chronic Hypertension" OR "Hypertensive Patients")

The same keywords and filters were used on PubMed, MEDLINE, and Scopus. The filters applied included studies involving humans, adults aged 18 years and older, randomized controlled trials (RCTs), English language publications, and a date range from 2015 to 2025. Additionally, the reference lists of relevant reviews and included trials were manually screened to ensure completeness.

Inclusion and exclusion criteria

The inclusion criteria for this study are adults aged 18 and over with essential hypertension, specifically RCTs comparing ACEIs and ARBs. Eligible studies must report changes in SBP and/or DBP with a minimum follow-up of 4 weeks and be published in English between 2015 and 2025. Exclusion criteria include pediatric populations, secondary hypertension, patients with significant comorbidities like chronic kidney disease or heart failure, and non-randomized studies lacking extractable outcomes.

Study selection

The selection of studies was conducted by two reviewers who examined titles and abstracts to determine their relevance. Full texts of studies that appeared to meet eligibility criteria were obtained and evaluated for final inclusion. Any disagreements that arose were addressed through discussion or by involving a third reviewer for consensus.

Data extraction

Data extraction was conducted independently by two reviewers utilizing a standardized form that captured essential study characteristics, including the author, year of publication, and country of the research. Additionally, participants' demographic data, including age, sex, and baseline blood pressure, were documented. The details of the interventions were meticulously recorded, encompassing the type of drug used, its dosage, and the duration of the treatment. Finally, the outcomes were thoroughly assessed, focusing on changes in SBP and DBP, mean arterial pressure, and any adverse effects associated with the intervention.

Statistical analysis

Quality assessment of the included RCTs was performed using the RoB2 tool [16]. Statistical analyses were performed using Review Manager (version 5.4.1;

The Cochrane Collaboration, London, UK) [17]. Dichotomous variables were assessed as proportions, and continuous variables were analyzed by calculating standardized mean differences (SMD) with 95% confidence intervals (CI), using random-effects models. To evaluate statistical heterogeneity across studies, *I*-squared (I^2) and chi-squared tests were used; I^2 values exceeding 50% indicated significant heterogeneity. A leave-one-out sensitivity analysis was performed for high heterogeneity.

Results

A comprehensive search yielded 749 articles from three databases: PubMed, Medline, and Scopus. Of these, 239 were removed due to duplication, and 494 were excluded based on their titles and abstracts. Following a full-text screening, 11 studies were excluded. Ultimately, only five studies were included in our review (Figure 1).

Table 1 summarizes five randomized clinical trials that compare ACEIs and ARBs in patients with hypertension. The studies varied in their design, sample size, and geographic locations, but all evaluated the efficacy and/or safety of these antihypertensive agents over treatment periods ranging from 8 weeks to 6 months. Many of the studies focused on patients suffering from essential hypertension [18-22], with some also including individuals who had additional health conditions like diabetes [18,19], dyslipidemia [20,21], and metabolic syndrome [21]. Two larger multicenter trials utilized combination treatment involving Hydrochlorothiazide (HCTZ) and targeted populations at high risk for cardiovascular issues [20,21]. It is worth noting that the sample sizes in these studies were typically moderate, and information on other medications participants took was not consistently detailed. The results present a comparative review of ACEIs, including ramipril, enalapril, and zofenopril, and angiotensin II receptor

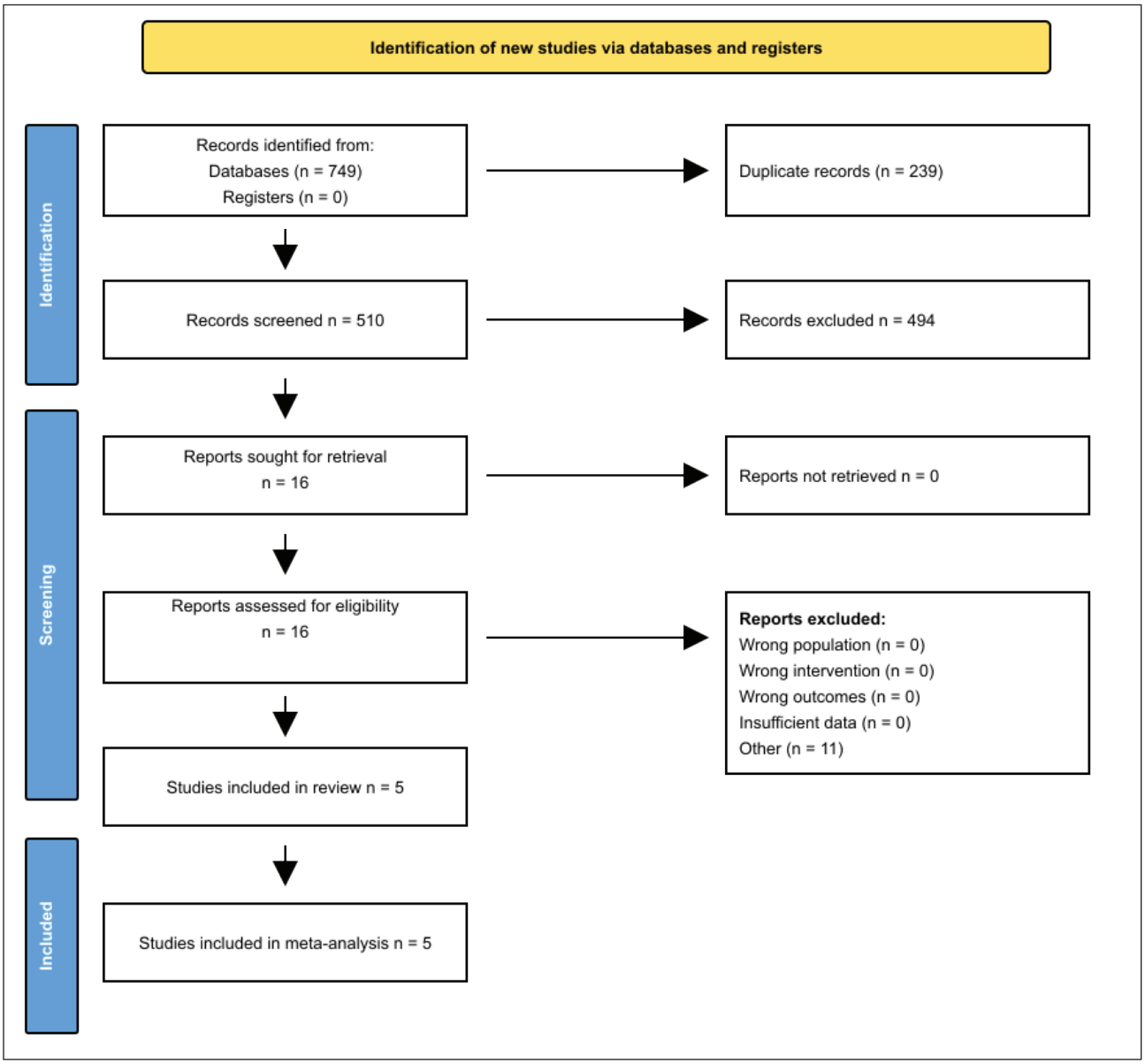


Figure 1. *Schematic representation of the criteria for selecting studies in the systematic review.*

Table 1. *Summary of randomized clinical trials comparing ACEIs and ARBs in patients with hypertension.*

First author (Year)	Study design, country	Sample size (Total;subgroups)	Age (mean/ median ± SD or range)	Gender (M/F)	Intervention (drug, dose, duration)	Comorbidities	Concomitant Medications
Ki et al. 2017 [18]	Single-center, randomized, open-label trial; South Korea	Total: 20 Ramipril: 10 Telmisartan: 10	57.9 ± 11.3 years	12/8	Ramipril: 5 mg daily, possible up-titration at week 4, duration 8 weeks. Telmisartan: 40 mg daily, possible up-titration at week 4, duration 8 weeks	All patients had essential hypertension. Diabetes mellitus: Ramipril 2/10 (20%), Telmisartan 3/10 (30%)	All prior antihypertensive medications were discontinued for a 2-week washout period before randomization. After washout, no concomitant antihypertensive or other medications were listed
Hadi et al. 2017 [19]	Randomized, single-center, single-blinded, parallel-group clinical trial conducted in Iraq	Total: 120 Hypertensive Patients: 80 (randomized into two groups of 40). Analyzed Patients: 60 (30 per group after attrition) Normotensive Controls: 40	Hypertensive Patients: 58 ± 15 years. Normotensive Controls: 57 ± 14 years	Telmisartan Group: 22/8 Enalapril Group: 20 / 10	Group 1 (Telmisartan): 80 mg once daily. Group 2 (Enalapril): 20 mg once daily. Duration: 6 months	All patients had essential hypertension; patients with diabetes, cardiovascular disease, renal impairment, arrhythmias, pregnancy, or secondary HTN were excluded (No other comorbidities reported)	No concomitant medications were reported
Modesti et al. 2016 [20]	Randomized, double-blind, parallel-group multicenter trial, conducted in Italy, Romania, and Russia	Total randomized: 230 participants. Full analysis set (efficacy population): 216 (*Z* = 107; *I* = 109)	Zofenopril group: 72.6 ± 6.0 years Irbesartan group: 72.3 ± 5.8 years	Zofenopril: 55.1% male, 44.9% female Irbesartan: 56.0% male, 44.0% female	Zofenopril + HCTZ: Zofenopril 30 mg + HCTZ 12.5 mg once daily, up-titrated to 60 mg if needed, duration 18 weeks Irbesartan + HCTZ: Irbesartan 150 mg + HCTZ 12.5 mg once daily, up-titrated to 300 mg if needed, duration 18 weeks	All patients had essential hypertension (by inclusion criteria) Cardiac disease: Zofenopril 39/107 Irbesartan 35/109 Dyslipidemia: Zofenopril 68/107 Irbesartan 60/109 Diabetes: Zofenopril 39/107 Irbesartan 37/109 Metabolic syndrome: Zofenopril 86/107 Irbesartan 72/109	Previous antihypertensive therapy allowed (≤2 agents); agents acting on RAS, β-blockers, α-blockers, CCBs, diuretics
Napoli et al. 2016 [21]	Multicenter, randomized, double-blind, parallel group, phase III study in Italy and Romania	Total: 482 essential hypertensive patients Subgroups: ACE: 231 (Zofenopril plus Hydrochlorothiazide) RAB: 235 (irbésartan plus hydrochlorothiazide)	59 ± 10 years	247/219	Group 1: Zofenopril 30 mg + HCTZ 12.5 mg once daily. Dose doubled to Zofenopril 60 mg at Week 8 if not normalized. Group 2: Irbesartan 150 mg + HCTZ 12.5 mg once daily. Dose doubled to Irbesartan 300 mg at Week 8 if not normalized. Duration: 24-week double-masked treatment period	All patients had - Essential Hypertension - Metabolic Syndrome (ATP-III criteria) Specific Comorbidities: - Diabetes: 75.1% Dyslipidemia: 70% - Cardiac Disease: 31%	-Oral hypoglycemic drugs: 71.0% (Zofenopril) *vs.* 60.9% (Irbesartan) -Lipid-Lowering Drugs: 67.1% (Zofenopril) *vs.* 54.9% (Irbesartan)
Raja et al. 2016 [22]	Prospective, randomized, comparative, observational study in India	Total: 100 Telmisartan: 50 Ramipril: 50	More than 25 years of age	NR	Tablet telmisartan 40 mg orally once a day in the morning for 24 weeks. Tablet ramipril 5 mg orally once a day in the morning for 24 weeks	Mild to moderate hypertension	No concomitant medications were reported

ACE: Angiotensin-Converting Enzyme, ACEI: Angiotensin-Converting Enzyme Inhibitor, ARB: Angiotensin II Receptor Blocker, CCB: Calcium Channel Blocker, HCTZ: Hydrochlorothiazide, HTN: Hypertension, M/F: Male/Female, NR: Not Reported, RAS: Renin-Angiotensin System, SD: Standard Deviation.

antagonists, including telmisartan and irbesartan. This analysis considers both single and combination therapies among various groups of patients with hypertension.

Table 2 demonstrates that both ACEIs (ramipril, enalapril, zofenopril) and ARBs (telmisartan, irbesartan) are effective in lowering blood pressure. Most studies reported high rates of blood pressure control, achieving levels below 140/90 mmHg. Notably, Ki et al. [18] suggested that ramipril may have a superior effect on vascular health, potentially preserving endothelial function better than telmisartan. In combination therapy studies [20,21], the pairing of zofenopril and hydrochlorothiazide showed consistent non-inferiority compared to irbesartan plus hydrochlorothiazide. Adverse events were generally mild and typical for these drug classes. This included dizziness, headache, fatigue, and the characteristic cough associated with ACEIs, resulting in a low but significant discontinuation rate. Overall, the evidence supports both drug classes as effective and well-tolerated options for managing hypertension. Specific patient factors and considerations regarding vascular health may influence the choice between these medications.

Three studies showed a low risk across all evaluated domains, indicating a strong design and implementation. However, two studies were assessed as having a high overall risk, primarily due to concerns in key areas, including the randomization process, handling of protocol deviations, and management of missing data (Figure 2).

Figure 3 compares ACEIs and ARBs on SBP across five randomized trials. The overall pooled SMD was 0.01 (95% confidence intervals (CI): -0.16 to 0.18; $p = 0.91$), showing no significant difference in efficacy. Subgroup analyses also revealed no significant differences among drug pairs. These findings indicate that ACEIs and ARBs are equally effective in lowering SBP in hypertensive patients.

Figure 4 reveals significant statistical heterogeneity ($I^2 = 97\%$) in the comparative effect of ACEIs and ARBs on DBP reduction. The overall pooled effect slightly favors ACEIs (SMD = -1.52, 95% CI: -2.86 to -0.19, $p = 0.03$).

This sensitivity analysis removed the Hadi et al. [19] study due to its extreme effect size to test the robustness of the original DBP findings. After its removal, the overall pooled effect was no longer statistically significant (SMD = -0.31, 95% CI: -0.90 to 0.28; $p = 0.30$), indicating that the earlier advantage of ACEIs over ARBs in reducing DBP was primarily driven by this outlier study, as shown in Figure 5.

Figure 6 shows that the blood pressure normalization rates (<140/90 mmHg) do not differ significantly between ACEIs and ARBs. The pooled odds ratio was 0.95 (95% CI: 0.66-1.37; $p = 0.79$), with minimal heterogeneity observed ($I^2 = 13\%$). These results suggest that both drug classes are equally effective in achieving standard blood pressure control targets in patients with hypertension.

Figure 7 compares the safety of an ACEI (zofenopril) and an ARB (irbesartan), both with hydrochlorothiazide. The analysis found no significant difference in adverse events between the treatments, with a pooled odds ratio of 0.82 (95% CI: 0.43-1.57; $p = 0.55$), suggesting similar safety profiles.

Discussion

Our review found no significant differences between ACEIs and ARBs in reducing SBP or achieving normalized blood pressure (defined as less than 140/90 mmHg). While ACEIs appeared to show a slight advantage in reducing DBP, this finding was driven primarily by a single outlier study and was not consistent across sensitivity analyses. The safety profiles of the two drug classes were largely similar; however, ACEIs were consistently associated with a higher incidence of cough.

Our meta-analysis found no significant difference in SBP reduction between ACEIs and ARBs. This finding was consistent across all included RCTs. Hadi et al. [19] reported comparable SBP reductions with telmisartan and enalapril, while Modesti et al. [20] and Napoli et al. [21] found zofenopril plus hydrochlorothiazide non-inferior to irbesartan plus hydrochlorothiazide in elderly and metabolic syndrome populations. Raja et al. [22] observed a slightly greater reduction in SBP with telmisartan than with ramipril. These results align with a previous review, which concluded that ACEIs and ARBs achieve similar reductions in SBP [3]. A recent review indicates that ARB offers greater benefits than ACEI for managing blood pressure. Compared with ACEI, ARB has shown greater reductions in both SBP and DBP.

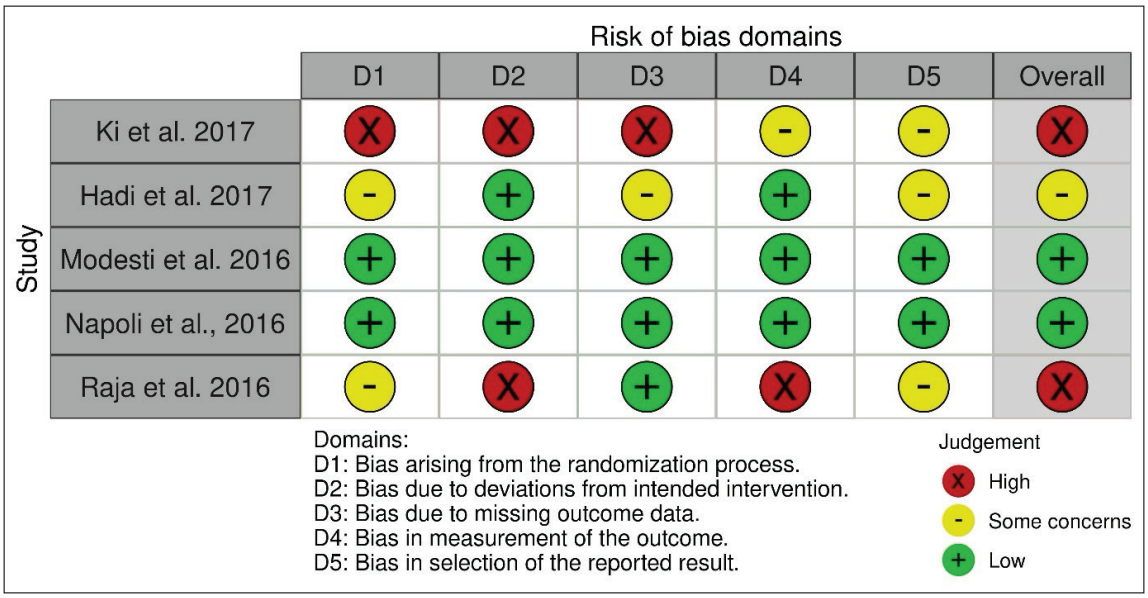
Regarding DBP, our pooled analysis suggested a slight advantage of ACEIs in reducing DBP. Hadi et al. [19] reported greater DBP reduction with enalapril than with telmisartan, whereas Raja et al. [22] found that telmisartan produced earlier and more pronounced reductions in DBP than ramipril. Ki et al. [18] observed comparable reductions in DBP with ramipril and telmisartan, though ramipril was associated with improved endothelial function. Moreover, our analysis found no significant difference in normalization rates between ACEIs and ARBs. This was consistent with the majority of included RCTs. Modesti et al. [20] reported similar normalization rates between zofenopril + HCTZ and irbesartan + HCTZ, while Napoli et al. [21] found nearly identical normalization rates (65.8% *vs.* 67.7%). Ki et al. [18] observed slightly higher normalization with ramipril compared to telmisartan, but the small sample size limits interpretation. These results are consistent with the 2017 ACC/AHA guideline evidence review, which concluded that both ACEIs and ARBs are effective for achieving blood pressure (BP) control [6].

The safety profiles identified in the studies displayed comparable trends, with both groups experiencing symptoms such as dizziness, headaches, and fatigue. Notably, ACEIs were repeatedly associated with cough, prompting some patients to discontinue their treatment, as reported by Ki et al. [18]. Additionally, Napoli et al. [21] pointed out a slightly higher rate of drug-related side effects with zofenopril plus HCTZ compared to irbesartan with HCTZ, although both medications were generally well-tolerated. These results align with earlier reviews that have shown ARBs to be better accepted, primarily because they are less likely to cause cough

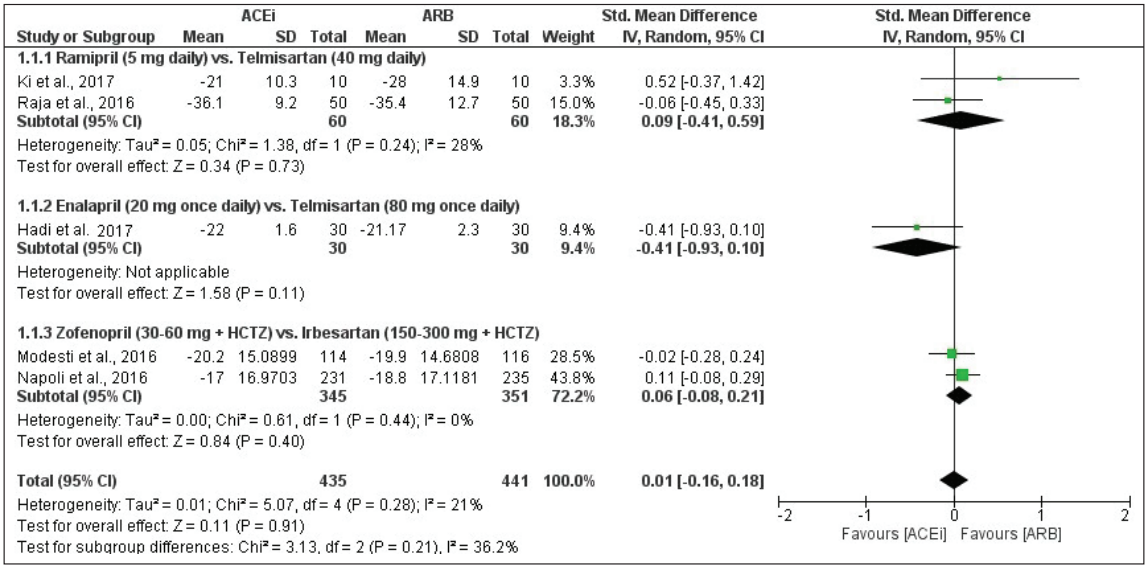
Table 2. *Efficacy and safety outcomes of ACEI and ARB therapy in patients with hypertension.*

First author (Year)	Change in blood pressure	Achieving BP control	Adverse event	Conclusion
Ki et al. 2017 [18]	Ramipril group: SBP: from baseline: 151 ± 7.49 After 8 weeks: 130 ± 7.12 mmHg DBP: ↓ from 90.6 ± 9 to 79.2 ± 5.25 mmHg Telmisartan group: SBP: ↓ from 159 ± 3.83 to 131 ± 14.4 mmHg DBP: ↓ from 83.7 ± 14 to 73.1 ± 8.61 mmHg	Achieving Target BP (<140/90 mmHg): Ramipril: 9/10 Telmisartan: 6/10	Ramipril Group (*n* = 10): 1 case of transient global amnesia; 1 patient switched medication due to cough. Withdrawals/Loss to Follow-up: 4	Both drugs effectively lowered blood pressure, but their effects differed. Telmisartan reduced pulse pressure significantly but did not improve endothelial function. In contrast, ramipril showed a positive association between decreased pulse pressure and improved RHI. The authors noted that telmisartan might impair endothelial vasodilation, whereas ramipril preserves the bradykinin-NO pathway, supporting better vascular health.
Hadi et al. 2017 [19]	Telmisartan: SBP: 156.5 ± 2.09 to 135.33 ± 1.07 mmHg DBP: 94.5 ± 0.73 to 82.67 ± 0.79 mmHg Enalapril: SBP: 157.50 ± 1.43 to 135.50 ± 0.77 mmHg DBP: 97.17 ± 0.57 to 80.50 ± 0.65 mmHg	BP control (<140/90): Achieved in both groups Enalapril showed slightly greater DBP improvement	Telmisartan (10/30): dizziness 4(13.3%), headache 3(10%), fatigue 2(6.7%), impotence 1(3.3%) Enalapril (8/30): dizziness 2(6.7%), headache 2(6.7%), fatigue 3(10%), impotence 1(3.3%)	After 6 months, both telmisartan and enalapril effectively reduced blood pressure. Enalapril showed slightly greater DBP improvement.
Modesti et al. 2016 [20]	Office SBP reduction at 18 weeks Z+H: -20.2 mmHg (95% CI: -23.0 to -17.4) I+H: -19.9 mmHg (95% CI: -22.6 to -17.2)	Office BP Normalization (<140/90 mmHg) at 18 Weeks Z+H: (76/114) I+H: (80/116)	Overall Adverse Events Z+H group: 31/114 I+H group: 43/116 Serious Adverse Events 2 patients in each group. One death in I+H group (not drug-related). Study Discontinuation due to AE Z+H: 8/114 I+H: 9/116 Drug-Related Adverse Events Z+H: 5/114 (4.4%) I+H: 7/116	Zofenopril+HCTZ was non-inferior to Irbesartan+HCTZ in reducing BP. Both effective and well tolerated. Zofenopril showed higher BP-control rates at 18 weeks.
Napoli et al. 2016 [21]	At Week 24 Office BP reduction (Mean, 95% CI): SBP: Zofenopril+HCTZ: -17.0 (-19.2, -14.8) mmHg Irbesartan+HCTZ: -18.8 (-21.0, -16.6) mmHg DBP: Zofenopril+HCTZ: -9.8 (-11.1, -8.4) mmHg Irbesartan+HCTZ: -10.4 (-11.8, -9.0) mmHg	Normalization Rate (BP <140/90 mmHg): Zofenopril+HCTZ: 152/231 (65.8%) Irbesartan+HCTZ: 159/235 (67.7%) Responder Rate (Normalized or SBP↓≥20/DBP↓≥10 mmHg): Zofenopril+HCTZ: 179/231 (77.5%) Irbesartan+HCTZ: 192/235 (81.5%)	- Overall: 28.4% of patients reported an adverse event. Drug-Related: Zofenopril + HCTZ: 36 / 241 (14.9%) Irbesartan + HCTZ: 22 / 241 (9.1%) Patients with Serious AEs (SAEs): Zofenopril + HCTZ: 5 / 241 patients Irbesartan + HCTZ: 7 / 241 patients Deaths: 0 / 482 Patients Withdrawn due to AEs: Zofenopril + HCTZ: 12 / 241 patients Irbesartan + HCTZ: 12 / 241 patients	Zofenopril and hydrochlorothiazide are as effective as irbesartan plus hydrochlorothiazide in lowering blood pressure in hypertensive patients with metabolic syndrome. Both options offer effective 24-hour blood pressure control, especially in the morning, and are well-tolerated with a low incidence of side effects. This study provides clinicians with a safe and effective treatment option for managing hypertension in high cardiovascular risk patients.
Raja et al. 2016 [22]	At 24 weeks Ramipril group: SBP: from 163.4 ± 7.3 to 127.3 ± 5.6 DBP: from 97.1 ± 5.0 to 82.6 ± 3.5 Telmisartan group: SBP: from 165.0 ± 8.3 to 129.6 ± 9.6 DBP: from 98.5 ± 4.3 to 84.1 ± 4.6	NR	NR	Telmisartan and ramipril are both effective medications for managing mild to moderate hypertension. However, telmisartan reduces DBP beginning in the fourth week. Additionally, between the fourth and twelfth weeks, telmisartan results in a greater decrease in SBP and MBP than ramipril.

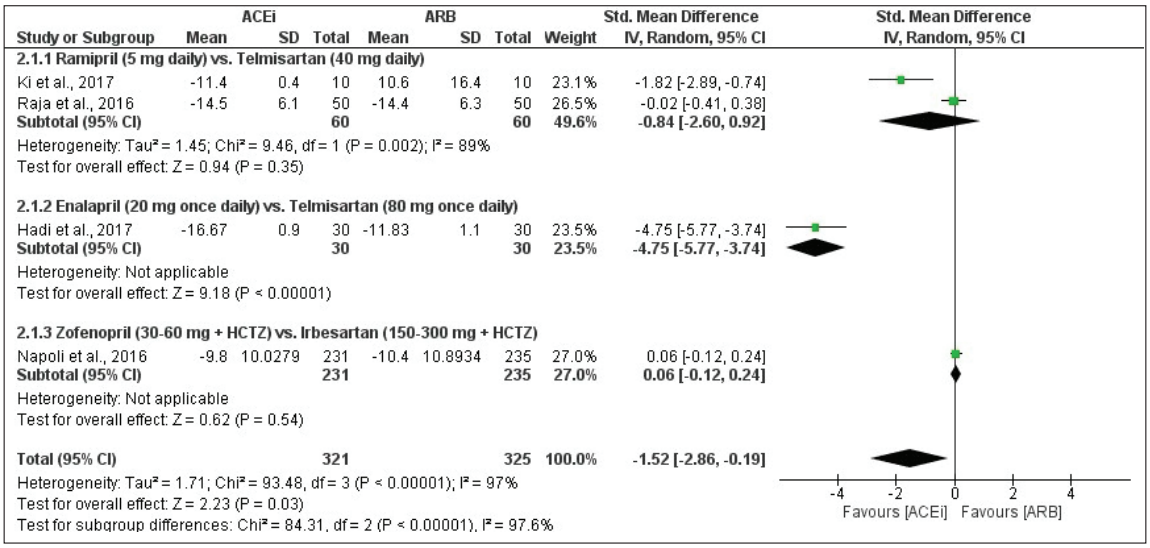
AE: Adverse Event, ARB: Angiotensin II Receptor Blocker, BP: Blood Pressure, CI: Confidence Interval, DBP: Diastolic Blood Pressure, HCTZ: Hydrochlorothiazide, NR: Not Reported, RHI: Reactive Hyperemia Index, SBP: Systolic Blood Pressure, SAE: Serious Adverse Event.



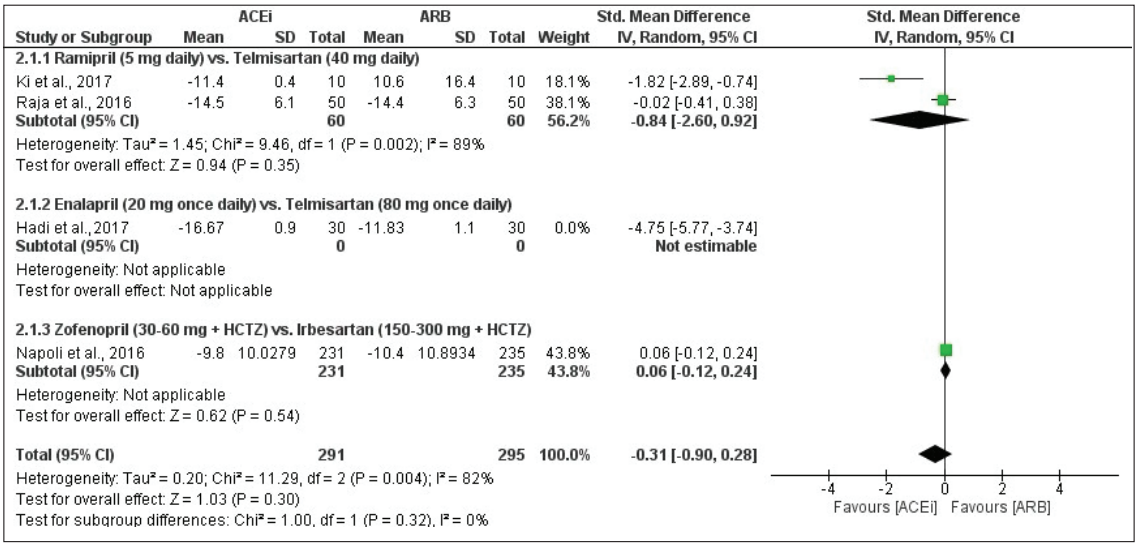
313 ***Figure 2.*** *Risk of bias assessment for included studies.*



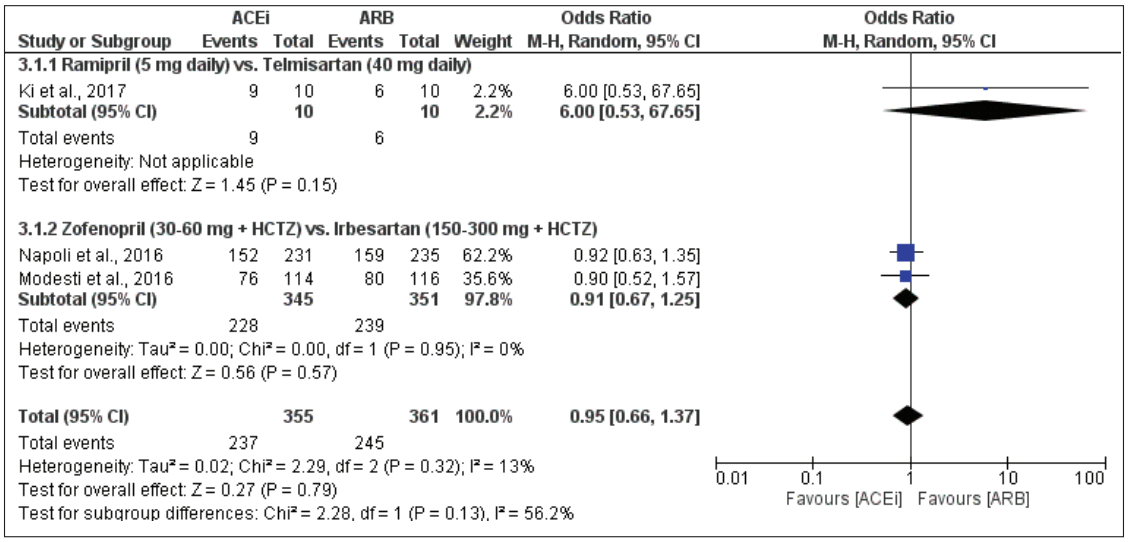
314 ***Figure 3.*** *Forest plot of SMD in SBP reduction: ACEIs versus ARBs.*



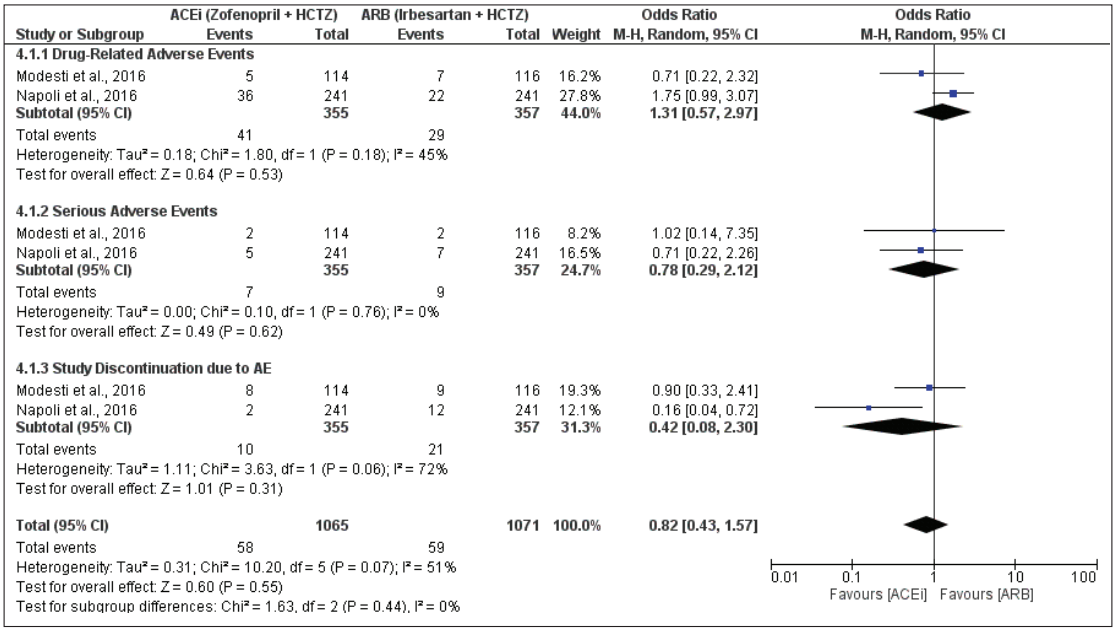
315 ***Figure 4.*** *Forest plot of SMD in DBP reduction: ACEIs versus ARBs.*



316 ***Figure 5.*** *Forest plot of sensitivity analysis: SMD in DBP reduction.*



317 ***Figure 6.*** *Forest plot of odds ratios for blood pressure normalization (<140/90 mmHg) with ACEIs versus ARBs.*



318 ***Figure 7.*** *Forest plot of adverse events: ACEIs versus ARBs*

and angioedema than ACEIs [3]. Research suggests that both ACEIs and ARBs are similarly effective in reducing blood pressure. Nonetheless, ACEIs might offer additional cardiovascular benefits, particularly by reducing overall and heart-related mortality. Conversely, ARBs typically have a better side effect profile, making them a more suitable choice for patients prone to cough or angioedema linked to ACEIs.

Limitations

This review highlights several significant limitations, including the limited number of studies meeting the inclusion criteria, inconsistent results, variations in research methodologies, and differences in study populations. To address these challenges, future investigations should aim for thorough, well-organized RCTs that adhere to standardized protocols and include longer follow-up periods.

Conclusion

Our review indicates that both ACEIs and ARBs are equally effective at reducing SBP and managing essential hypertension. ACEIs offer a marginal benefit in reducing DBP. Both classes of medications have similar safety profiles; however, ACEIs are more likely to cause cough as a side effect. Adapting treatment approaches to cater to the unique needs of each patient is crucial. These results support current recommendations that suggest ACEIs and ARBs as effective first-line treatments, emphasizing the importance of further investigation into their prolonged impact on cardiovascular health.

List of Abbreviations

ACE	Angiotensin-Converting Enzyme
ACEI	Angiotensin-Converting Enzyme Inhibitor
AE	Adverse event
ARB	Angiotensin II Receptor Blocker
BP	Blood pressure
CCB	Calcium Channel Blocker
CI	Confidence interval
DBP	Diastolic blood pressure
HCTZ	Hydrochlorothiazide
HTN	Hypertension
M/F	Male / Female
NR	Not reported
RAS	Renin-Angiotensin System
RCT	Randomized controlled trial
RHI	Reactive Hyperemia Index
SAE	Serious adverse event
SBP	Systolic blood pressure
SD	Standard deviation
SMD	Standardized mean difference

Conflict of interests

The authors declare that there is no conflict of interest regarding the publication of this article.

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Consent to participate

Not applicable.

Consent for publication

Not applicable.

Ethical approval

Not applicable.

Author details

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Supplementary content (if any) is available online.

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