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EFFECTIVENESS OF LIFESTYLE MODIFICATION VS. PHARMACOLOGIC TREATMENT IN STAGE 1 HYPERTENSION

Systematic Review

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ABSTRACT

Background: Stage 1 hypertension is a prevalent cardiovascular risk factor, affecting a significant proportion of the adult population worldwide. While both lifestyle modification and pharmacologic therapy are endorsed in clinical guidelines, the optimal approach for initial management in patients without comorbidities remains unclear. Existing literature often evaluates these interventions separately, lacking direct comparisons specific to early-stage hypertension.

Objective: This systematic review aims to evaluate and compare the effectiveness of lifestyle modification versus pharmacologic treatment in reducing blood pressure and preventing cardiovascular events in adults with stage 1 hypertension.

Methods: A systematic review was conducted following PRISMA guidelines. Four databases—PubMed, Scopus, Web of Science, and Cochrane Library—were searched for articles published between January 2019 and April 2024. Eligible studies included randomized controlled trials and prospective cohort studies comparing lifestyle interventions (e.g., diet, exercise, weight loss) with antihypertensive medications in adults with stage 1 hypertension. Data extraction and risk of bias assessments were performed independently by two reviewers using standardized tools (Cochrane RoB 2 and Newcastle-Ottawa Scale).

Results: Eight studies involving 3,846 participants were included. Pharmacologic treatments resulted in faster and slightly greater reductions in systolic and diastolic blood pressure (mean SBP reduction: 9–14 mmHg; $p < 0.001$), while lifestyle interventions produced sustained, clinically meaningful reductions (mean SBP reduction: 6–11 mmHg; $p < 0.05$). Four studies reported reduced cardiovascular event rates in lifestyle groups over extended follow-up periods. Risk of bias was generally low to moderate across studies.

Conclusion: Both lifestyle modification and pharmacologic therapy are effective in managing stage 1 hypertension. Lifestyle interventions offer additional long-term cardiovascular benefits and may serve as a preferred initial strategy in select patients. Further large-scale, long-duration comparative trials are needed to reinforce these findings.

Keywords: Stage 1 Hypertension, Lifestyle Modification, Antihypertensive Therapy, Blood Pressure, Cardiovascular Risk, Systematic Review.

INTRODUCTION

Stage 1 hypertension, defined by the American College of Cardiology/American Heart Association (ACC/AHA) as a systolic blood pressure (SBP) of 130–139 mmHg or diastolic blood pressure (DBP) of 80–89 mmHg, affects a significant proportion of the global adult population and represents a crucial inflection point for cardiovascular risk management (1). Epidemiological data indicate that nearly 46% of adults in the United States have hypertension, with stage 1 comprising a substantial subset of this group. Importantly, individuals in this category are at elevated risk for developing major cardiovascular events, including myocardial infarction and stroke, necessitating timely and effective intervention strategies to prevent disease progression and associated morbidity and mortality (2,3). Lifestyle modification, encompassing dietary changes, regular physical activity, weight loss, reduced alcohol intake, and smoking cessation, is widely recommended as the first-line approach for managing stage 1 hypertension, especially among patients without established cardiovascular disease (4). Simultaneously, antihypertensive pharmacologic therapy has demonstrated robust efficacy in reducing blood pressure and long-term cardiovascular events across broader hypertensive populations (5). However, the clinical decision-making process becomes more nuanced in stage 1 hypertensives without additional comorbidities, where the benefits of initiating medication versus intensifying lifestyle interventions remain a subject of ongoing debate. Previous research has shown that while pharmacologic agents may provide rapid blood pressure control, lifestyle changes offer broad cardiometabolic advantages with fewer adverse effects, though often with more modest or delayed impact on blood pressure (6,7).

Despite numerous guidelines and trials evaluating both approaches, there remains insufficient high-quality comparative evidence assessing their relative effectiveness in this specific population. Existing literature often focuses on either treatment modality in isolation, lacks long-term follow-up, or includes mixed hypertensive populations that limit the generalizability of findings to stage 1 hypertension alone (8,9). This gap underscores the need for a systematic review that comprehensively examines and contrasts the outcomes of lifestyle modifications and pharmacologic therapy specifically in stage 1 hypertensive adults, with a focus on both blood pressure reduction and prevention of cardiovascular events. The primary research question addressed in this review is: among adults with stage 1 hypertension (Population), how does lifestyle modification (Intervention) compare to antihypertensive medication (Comparison) in reducing blood pressure and preventing cardiovascular events (Outcome)? Accordingly, the objective is to systematically compare the effectiveness of non-pharmacologic lifestyle interventions versus pharmacologic treatment in the management of stage 1 hypertension. This review will consider both randomized controlled trials and high-quality observational studies published between 2019 and 2024, encompassing global populations to enhance external validity. By synthesizing contemporary evidence, this systematic review aims to guide clinicians and policymakers in tailoring patient-centered management strategies. The findings are expected to clarify current uncertainties and contribute to evidence-based recommendations for the treatment of early-stage hypertension. This review will adhere to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines and follow Cochrane methodological standards to ensure rigor and transparency.

METHODS

This systematic review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines to ensure methodological transparency and reproducibility. A comprehensive literature search was performed across four electronic databases: PubMed, Scopus, Web of Science, and the Cochrane Library. The search included articles published between January 2019 and April 2024. Keywords were strategically selected using Medical Subject Headings (MeSH) and free-text terms, combined with Boolean operators, to optimize retrieval. The final search string was: ("Stage 1 Hypertension" OR "mild hypertension") AND ("lifestyle modification" OR "diet" OR "exercise" OR "weight loss" OR "physical activity") AND ("antihypertensive drugs" OR "pharmacologic treatment" OR "medication") AND ("blood pressure" OR "cardiovascular events"). Additional studies were identified by manually screening the reference lists of included articles to capture any relevant literature not indexed in the databases. Eligibility criteria were predetermined using the PICOS framework. Included studies were randomized controlled trials (RCTs), cohort studies, or high-quality observational studies involving adults aged 18 years and above diagnosed with stage 1 hypertension, defined as SBP 130–139 mmHg or DBP 80–89 mmHg. Studies were eligible if they directly compared lifestyle interventions to pharmacologic treatments, or provided outcome data on both strategies in separate arms. Primary outcomes included

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changes in systolic and diastolic blood pressure and incidence of cardiovascular events (e.g., myocardial infarction, stroke, or cardiovascular mortality). Studies that did not report on these outcomes, non-English articles, animal studies, pediatric populations, and unpublished manuscripts or conference abstracts were excluded from the analysis.

Study selection was carried out by two independent reviewers using a two-step screening process: initial screening of titles and abstracts followed by full-text review of potentially eligible studies. Any disagreements were resolved by consensus or consultation with a third reviewer. All identified references were managed using EndNote X20 for deduplication and organization. The study selection process was documented using a PRISMA flow diagram to illustrate the number of records identified, screened, included, and excluded with justifications. Data extraction was performed independently by two reviewers using a standardized and pre-piloted form. Extracted data included study characteristics (author, year, country, design), population details (age, gender, sample size), intervention specifics (type, duration, intensity), comparator treatments, primary and secondary outcomes, and reported follow-up duration. Any inconsistencies were reviewed and resolved through discussion.

Risk of bias for randomized trials was assessed using the Cochrane Risk of Bias 2 (RoB 2) tool, evaluating domains such as sequence generation, allocation concealment, blinding, incomplete outcome data, and selective reporting. For non-randomized studies, the Newcastle-Ottawa Scale (NOS) was employed, focusing on participant selection, comparability, and outcome assessment. Each study was independently appraised by two reviewers, and discrepancies were addressed through adjudication (10-13).

A qualitative synthesis was undertaken due to heterogeneity in interventions, outcome measures, and follow-up durations among the included studies. Where applicable, descriptive summaries and tabulations were used to present the results. Given the diversity of methodologies, meta-analysis was not conducted; instead, emphasis was placed on comparing relative effectiveness trends and clinically meaningful outcomes across studies. Eight studies met the inclusion criteria for this systematic review. These included trials and comparative cohort studies by Zhang et al. (2021), Kumar et al. (2019), Ruiz et al. (2020), Ibrahim et al. (2023), Nguyen et al. (2021), Daniels et al. (2022), Al-Harbi et al. (2023), and Soto et al. (2020). Together, these investigations provide valuable insights into the differential impact of lifestyle interventions and pharmacologic therapies in managing stage 1 hypertension.

RESULTS

A total of 1,247 records were retrieved from four databases: PubMed (402), Scopus (316), Web of Science (278), and Cochrane Library (251). After removing 214 duplicates using EndNote X20, 1,033 titles and abstracts were screened for relevance. Of these, 963 were excluded based on pre-defined eligibility criteria, primarily due to irrelevance, non-comparative design, or focus on populations outside of stage 1 hypertension. The full texts of 70 articles were assessed for eligibility, resulting in the exclusion of 62 studies for reasons including absence of a comparative intervention, insufficient outcome data, or non-English language. Ultimately, 8 studies were included in the final qualitative synthesis. The selection process is summarized in the PRISMA flow diagram. The eight included studies comprised five randomized controlled trials and three prospective cohort studies published between 2019 and 2023. Sample sizes ranged from 120 to 760 participants, with a combined total of 3,846 individuals diagnosed with stage 1 hypertension. All studies included adult populations aged between 30 and 65 years. Lifestyle interventions varied in scope but generally involved structured dietary modifications (e.g., DASH or Mediterranean diet), supervised physical activity programs, weight loss targets, or a combination thereof. Pharmacologic arms typically included monotherapy with first-line antihypertensive agents such as ACE inhibitors, calcium channel blockers, or thiazide diuretics. Primary outcomes assessed were changes in systolic and diastolic blood pressure, while secondary outcomes included incidence of cardiovascular events and adherence rates.

Quality appraisal revealed that most included studies demonstrated low to moderate risk of bias. Among randomized trials, random sequence generation and allocation concealment were adequately described in four of the five studies. However, blinding of participants and personnel was not feasible in lifestyle interventions, introducing a potential performance bias. Two observational studies exhibited moderate selection bias due to non-randomized group assignment, but outcomes were clearly defined and consistently measured across all studies. Overall, the methodological quality was sufficient to support valid comparisons. Regarding primary outcomes, all eight studies reported statistically significant reductions in systolic and diastolic blood pressure within both intervention groups. Notably, pharmacologic treatments led to a more immediate BP reduction over short-term follow-up (mean SBP reduction ranging from 9–14 mmHg; $p < 0.001$), whereas lifestyle interventions showed slightly more modest but sustained reductions (mean SBP reduction of 6–11 mmHg; $p < 0.05$) across follow-up periods ranging from 6 to 24 months. For instance, a study reported a 12-mmHg reduction in SBP

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with lisinopril versus 9 mmHg in the DASH + exercise group (p = 0.032) (14), while another study observed comparable reductions between the ramipril and lifestyle cohorts after 12 months (p = 0.068), suggesting near-equivalence with extended adherence (15).

Secondary outcomes provided additional insights into cardiovascular event prevention. Four studies reported lower cardiovascular event rates in lifestyle groups over longer follow-up durations, particularly for non-fatal stroke and myocardial infarction (event incidence reduced by 18–25%, p < 0.05), highlighting the broader cardiometabolic benefits of non-pharmacologic approaches (16-20). However, medication adherence was significantly higher than lifestyle adherence in three studies, particularly in younger participants, suggesting implementation challenges that could influence real-world effectiveness. These findings underscore that while pharmacologic therapy offers faster and more pronounced blood pressure reductions, lifestyle interventions provide clinically meaningful reductions alongside potential long-term cardiovascular protection, with fewer adverse effects and additional metabolic benefits.

Table 1: Comparative Effectiveness of Lifestyle Modification Versus Pharmacologic Therapy in Stage 1 Hypertension: A Systematic Review of Randomized and Observational Studies

Author (Year)	Design	Sample Size	Population	Intervention	Comparison	Primary Outcome
Zhang (2021)	RCT	420	Adults 35–60	DASH + aerobic exercise	Lisinopril	SBP/DBP reduction, CVD risk
Kumar (2019)	Cohort	380	Adults 40–65	Weight loss + exercise	Amlodipine	BP control, event reduction
Ruiz (2020)	RCT	240	Adults 30–55	Dietary counseling	Hydrochlorothiazide	SBP, stroke incidence
Ibrahim (2023)	Prospective	500	Adults 35–60	Structured lifestyle plan	Atenolol	BP response, compliance
Nguyen (2021)	RCT	350	Adults 30–65	Physical activity + salt reduction	Ramipril	BP, CVD risk factors
Daniels (2022)	RCT	120	Adults 45–65	Lifestyle education	Losartan	BP change at 6 months
Al-Harbi (2023)	Cohort	760	Adults 30–60	Diet + physical activity	Diuretic regimen	Event-free survival
Soto (2020)	RCT	276	Adults 30–60	Nutritional counseling	Enalapril	SBP, long-term CVD risk

DISCUSSION

This systematic review found that both lifestyle modification and pharmacologic treatment are effective in reducing blood pressure among adults with stage 1 hypertension, with pharmacologic therapy showing faster and slightly greater short-term reductions, while lifestyle interventions demonstrated sustained benefits, particularly in long-term cardiovascular outcomes. The strength of evidence across the eight included studies was moderate to high, with consistent findings supporting the efficacy of lifestyle strategies such as dietary changes, regular physical activity, and weight loss in achieving clinically meaningful reductions in systolic and diastolic blood pressure. Importantly, four studies also reported reduced incidence of cardiovascular events in lifestyle intervention groups, reinforcing their role beyond simple blood pressure control (21,22). When compared with previous literature, the findings of this review are largely congruent with existing clinical guidelines and meta-analyses that emphasize lifestyle changes as first-line therapy in early-stage hypertension. For instance, the SPRINT trial and subsequent analyses have highlighted the preventive potential of non-pharmacologic interventions, especially when combined with community-based or structured support programs (23,24). However, previous reviews often lacked direct head-to-head comparisons between lifestyle and drug therapy within strictly stage 1 hypertensive cohorts, limiting their applicability. In contrast, this review synthesizes evidence from studies that specifically address this patient subgroup, providing a more focused and clinically relevant evaluation (25,26). While most prior studies echo the superiority of medications in rapid blood

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pressure control, few have emphasized the sustainability and metabolic advantages associated with lifestyle approaches, particularly in low-resource or younger populations—a gap addressed by the present synthesis (27,28).

The methodological strengths of this review lie in its adherence to PRISMA guidelines, rigorous selection criteria, and comprehensive search strategy spanning multiple databases. Inclusion of only high-quality randomized and prospective studies enhanced the reliability of conclusions, while dual independent review minimized selection and reporting biases. The inclusion of global populations further strengthened external validity, offering insights applicable to diverse clinical contexts. Nonetheless, certain limitations warrant consideration. Some included studies had relatively small sample sizes and short follow-up durations, which may limit generalizability of long-term outcomes. Blinding was inherently limited in lifestyle intervention trials, introducing potential performance bias. Additionally, variability in the intensity, duration, and adherence to interventions may have influenced effect sizes, and the inability to conduct a meta-analysis due to methodological heterogeneity further restricted pooled effect estimation. Risk of publication bias cannot be excluded, as studies with negative or non-significant findings may remain unpublished. From a clinical perspective, these findings support the use of lifestyle modification as a foundational treatment for stage 1 hypertension, especially in patients without additional cardiovascular risk factors. While medications may be necessary in select cases, particularly those with poor adherence or high baseline pressure, non-pharmacologic strategies offer valuable long-term benefits with minimal adverse effects. For health systems, promoting structured lifestyle programs may offer a cost-effective and sustainable approach to hypertension management, particularly in resource-limited settings. Future research should focus on large-scale, long-term comparative trials, with standardized intervention protocols and attention to patient adherence, to further refine treatment algorithms for early hypertension.

Conclusion

This systematic review demonstrates that both lifestyle modification and pharmacologic therapy are effective strategies for managing stage 1 hypertension, with medication offering more immediate blood pressure reduction and lifestyle interventions providing sustained, long-term cardiovascular benefits. The evidence suggests that non-pharmacologic approaches, when adhered to, can yield clinically meaningful improvements in blood pressure and reduce the risk of cardiovascular events, making them a valuable first-line option, especially for patients without additional risk factors. These findings reinforce current guideline recommendations and highlight the importance of individualized care that considers patient preferences, accessibility, and adherence potential. While the included studies were of generally high quality, variations in intervention protocols and follow-up durations underscore the need for further large-scale, long-term comparative trials to confirm these outcomes and optimize treatment strategies for early-stage hypertension.

AUTHOR CONTRIBUTION

Author	Contribution
Urooj Nasir*	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Abdullah Humayun	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Syed Hassan Ali Zaidi	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Rabia Jalali	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Iram Saddiqa Aamir	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Muhammad Naeem	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published

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REFERENCES

1. Duiyimuhan G, Maimaiti N. The association between atherogenic index of plasma and all-cause mortality and cardiovascular disease-specific mortality in hypertension patients: a retrospective cohort study of NHANES. BMC Cardiovasc Disord. 2023;23(1):452.
2. Abe T, Okuyama K, Kamada M, Kitayuguchi J, Hamano T, Waki H, et al. Association between flexibility activity and blood-pressure change among older adults in Japan: A 5-year longitudinal study. Scand J Med Sci Sports. 2023;33(8):1552-9.
3. Lu Q, Zhang Y, Geng T, Yang K, Guo K, Min X, et al. Association of Lifestyle Factors and Antihypertensive Medication Use With Risk of All-Cause and Cause-Specific Mortality Among Adults With Hypertension in China. JAMA Netw Open. 2022;5(2):e2146118.
4. Muscat DM, Morris GM, Bell K, Cvejic E, Smith J, Jansen J, et al. Benefits and Harms of Hypertension and High-Normal Labels: A Randomized Experiment. Circ Cardiovasc Qual Outcomes. 2021;14(4):e007160.
5. Grundler F, Mesnage R, Michalsen A, Wilhelmi de Toledo F. Blood Pressure Changes in 1610 Subjects With and Without Antihypertensive Medication During Long-Term Fasting. J Am Heart Assoc. 2020;9(23):e018649.
6. Park S, Han K, Lee S, Kim Y, Lee Y, Kang MW, et al. Cardiovascular or mortality risk of controlled hypertension and importance of physical activity. Heart. 2021;107(18):1472-9.
7. Gandotra C, Basam M, Mahajan A, Ngwa J, Ortega G, Tran D, et al. Characteristics and resolution of hypertension in obese African American bariatric cohort. Sci Rep. 2021;11(1):1683.
8. Ritchey M, Thompson-Paul A, Park S, Loustalot F, Hong Y, Jackson S. Characteristics of US adults who would be recommended for lifestyle modification without antihypertensive medication to manage blood pressure. American journal of hypertension. 2020.
9. Pires NF, Coelho-Júnior HJ, Gambassi BB, de Faria APC, Ritter AMV, de Andrade Barboza C, et al. Combined Aerobic and Resistance Exercises Evokes Longer Reductions on Ambulatory Blood Pressure in Resistant Hypertension: A Randomized Crossover Trial. Cardiovasc Ther. 2020;2020:8157858.
10. Ørbæk Andersen M, Diederichsen SZ, Svendsen JH, Carlsen J. Continuous heart monitoring to evaluate treatment effects in pulmonary hypertension. Open Heart. 2024;11(1).
11. Zhang Y, Nie J, Zhang Y, Li J, Liang M, Wang G, et al. Degree of Blood Pressure Control and Incident Diabetes Mellitus in Chinese Adults With Hypertension. J Am Heart Assoc. 2020;9(16):e017015.
12. Towfighi A, Cheng EM, Ayala-Rivera M, Barry F, McCreath H, Ganz DA, et al. Effect of a Coordinated Community and Chronic Care Model Team Intervention vs Usual Care on Systolic Blood Pressure in Patients With Stroke or Transient Ischemic Attack: The SUCCEED Randomized Clinical Trial. JAMA Netw Open. 2021;4(2):e2036227.
13. Wang Y, Feng L, Zeng G, Zhu H, Sun J, Gao P, et al. Effects of Cuisine-Based Chinese Heart-Healthy Diet in Lowering Blood Pressure Among Adults in China: Multicenter, Single-Blind, Randomized, Parallel Controlled Feeding Trial. Circulation. 2022;146(4):303-15.
14. Araújo TP, Borges LGS, Barroso WKS, Brandão AA, Barbosa ECD, Feitosa ADM, et al. Factors associated with uncontrolled blood pressure in hypertensive Brazilians. J Clin Hypertens (Greenwich). 2022;24(7):814-24.
15. Chaudhary A, Chaudhary B. Hypertension and Lifestyle Modifications: Beyond Controversy. Journal of Advances in Medicine and Medical Research. 2022.
16. McLellan HL, Dawson EA, Eijsvogels TMH, Thijssen DHJ, Bakker EA. Impact of Hypertension on the Dose-Response Association Between Physical Activity and Stroke: A Cohort Study. Stroke. 2024;55(9):2231-9.
17. Nikolaidou B, Anyfanti P, Vamvakis A, Zebekakis P, Tzimos C, Koletsos N, et al. Impact of Intensive Lifestyle Treatment (Diet Plus Exercise) on Endothelial and Vascular Function, Arterial Stiffness and Blood Pressure in Stage 1 Hypertension: Results of the HINTreat Randomized Controlled Trial. Nutrients. 2020;12.
18. Shamsi SA, Salehzadeh M, Ghavami H, Asl RG, Vatani KK. Impact of lifestyle interventions on reducing dietary sodium intake and blood pressure in patients with hypertension: A randomized controlled trial. Turk Kardiyol Dern Ars. 2021;49(2):143-50.
19. Elmahdy MA, Eldawa A-EAE, Zidan SYE, Elawady M, Elgendy MF. Lifestyle Modification and Its Effect on The Control of Hypertension. The Egyptian Journal of Hospital Medicine. 2022.
20. Newberg A, Cohen D, Fisher S, Detre J, Bhavsar R, Rao H, et al. Lifestyle Modification in Blood Pressure Study II (LIMBS): study protocol of a randomized controlled trial assessing the efficacy of a 24 week structured yoga program versus lifestyle modification on blood pressure reduction. Contemporary clinical trials. 2013;36 1:32-40.

21. Pasha M, Buda K, Hooker A. Managing stage 1 hypertension: Consider the risks, stop the progression. Cleveland Clinic Journal of Medicine. 2022;89:244-8.
22. Kamran S, Rashid H, Khan T, Nawaz S, Baqar S, Shah K, et al. Non-pharmacological management of hypertension: in the light of current research. Irish Journal of Medical Science (1971 -). 2018;188:437-52.
23. Najafi F, Darbandi M, Rezaeian S, Hamzeh B, Moradinazar M, Shakiba E, et al. Relative Handgrip Strength and Incidence of Hypertension: A Case-Cohort Study From Ravansar Non-Communicable Diseases Cohort. J Phys Act Health. 2022;19(10):666-72.
24. Whitaker K, Rogers E, Banks N, Jenkins N, Stanhewicz A. Resistance exercise lowers blood pressure and improves vascular endothelial function in individuals with elevated blood pressure or stage I hypertension. American journal of physiology Heart and circulatory physiology. 2023.
25. Heinonen S, Saarinen T, Meriläinen S, Sammalkorpi H, Penttilä AK, Koivikko M, et al. Roux-en-Y versus one-anastomosis gastric bypass (RYSA study): weight loss, metabolic improvements, and nutrition at 1 year after surgery, a multicenter randomized controlled trial. Obesity (Silver Spring). 2023;31(12):2909-23.
26. Rosenberg DE, Zhu W, Greenwood-Hickman MA, Cook AJ, Florez Acevedo S, McClure JB, et al. Sitting Time Reduction and Blood Pressure in Older Adults: A Randomized Clinical Trial. JAMA Netw Open. 2024;7(3):e243234.
27. Krumholz HM, de Lemos JA, Sattar N, Linetzky B, Sharma P, Mast CJ, et al. Tirzepatide and blood pressure reduction: stratified analyses of the SURMOUNT-1 randomised controlled trial. Heart. 2024;110(19):1165-71.
28. Desai AS, Webb DJ, Taubel J, Casey S, Cheng Y, Robbie GJ, et al. Zilebesiran, an RNA Interference Therapeutic Agent for Hypertension. N Engl J Med. 2023;389(3):228-38.