J Nephropharmacol. 2026; 15(2): e12881.

https://jnephropharmacology.com DOI: 10.34172/npj.12881

Journal of Nephropharmacology

Beyond pharmacotherapy; implementing lifestyle precision medicine for hypertension in resource-limited settings- an updated review on the occasion of world hypertension day

Kianoush Saberi[1], Nilufar Dehkanova[2], Nodira Rashidova[3], Malika Khaldarbekova[4], Dilnora Raxmatova[5], G'olibjon Eshonkulov[5], Nigina Mamedova[5], Egamova Sitora[6], Nodirabegim Jamoliddinova[7], Shirin Shamsghahfarokhi[8*]

[1]Department of Anesthesiology, Medical Faculty, Imam Khomeini Hospital Complex, Tehran University of Medical Sciences, Tehran, Iran
[2]Department of Histology, Cytology and Embryology, Samarkand State Medical University, 140100 Samarkand, Uzbekistan
[3]Department of Applied Foreign Languages, Namangan State University, Namangan, Uzbekistan
[4]Department of Propaedeutics of Children's Diseases No. 2, Tashkent State Medical University, Tashkent, Uzbekistan
[5]Department of Pediatric Dentistry, Bukhara State Medical Institute named after Abu Ali ibn Sino, Bukhara, Uzbekistan
[6]Department of Obstetrics and Gynecology, Tashkent State Medical University, Tashkent, Uzbekistan
[7]Central Asian Medical University, International Medical Faculty, 64 Burhoniddin Marg'inani Street, Fergana, Uzbekistan
[8]Department of Internal Medicine, School of Medicine, Hajar Hospital, Shahrekord University of Medical Sciences, Shahrekord, Iran

ARTICLE INFO

Article Type:
Review

Article History:
Received: 22 Apr. 2026
Revised: 18 Jun. 2026
Accepted: 20 Jun. 2026
ePublished: 29 Jun. 2026

Keywords:
Blood pressure, Hypertension, Lifestyle, World hypertension day, Mediterranean diet, Cardiovascular disease

ABSTRACT

Hypertension remains the leading modifiable risk factor for global cardiovascular mortality, disproportionately burdening resource-limited settings where access to consistent pharmacotherapy is hindered by cost, supply chains, healthcare infrastructure gaps, and polypharmacy risks. While medications are essential, over-reliance on them neglects the foundational role of lifestyle modification as a potent, underutilized therapeutic pillar. This review, argues for a paradigm shift towards lifestyle precision medicine in resource-limited settings through moving beyond one-size-fits-all advice to context-specific, feasible, and culturally resonant behavioral interventions integrated into primary care. Lifestyle precision medicine tailors dietary patterns, physical activity, stress reduction, and sodium reduction to individual socioeconomic realities, cultural preferences, literacy levels, and environmental constraints. On world hypertension day, we urge global health agencies, governments, and researchers to prioritize funding and policy reforms that position lifestyle precision medicine not as a luxury, but as an equitable, essential component of hypertension care in resource-limited settings. Precision lies not in genomics, but in contextual intelligence, transforming evidence into action that resonates where people live and work.

Implication for health policy/practice/research/medical education:
Hypertension stands as a persistent global health challenge, particularly in resource-limited settings where access to pharmacotherapy is often constrained by cost, supply chain disruptions, and overburdened healthcare systems. Implementing lifestyle precision medicine offers a promising pathway beyond drugs, tailoring non-pharmacological interventions to individual genetic, environmental, physiological and socioeconomic profiles to optimize blood pressure control while promoting sustainability.

Please cite this paper as: Saberi K, Dehkanova N, Rashidova N, Khaldarbekova M, Raxmatova D, Eshonkulov G, Mamedova N, Sitora E, Jamoliddinova N, Shamsghahfarokhi Sh. Beyond pharmacotherapy; implementing lifestyle precision medicine for hypertension in resource-limited settings- an updated review on the occasion of world hypertension day. J Nephropharmacol. 2026;15(2):e12881. DOI: 10.34172/npj.12881.

Introduction

World hypertension day is an annual global health observance held on May 17 that aims to raise awareness about hypertension and promote prevention, detection, and control of this major health condition (1). Established by the world hypertension league in 2005, the day seeks to address the widespread lack of awareness among hypertensive patients and the general public (1). Hypertension, as a widespread and escalating global health challenge, stands as the foremost risk factor

***Corresponding author**: Shirin Shamsghahfarokhi, Email: Shams.s@skums.ac.ir

for cardiovascular disease and premature mortality, particularly in low- and middle-income countries, where healthcare resources are severely constrained. In these countries, hypertension prevalence surges due to urbanization, dietary shifts toward high-sodium processed foods, sedentary lifestyles, and chronic stress from poverty (2). The theme for world hypertension day was "measure your blood pressure accurately, control it, live longer" (3). This theme emphasizes the vital importance of accurate and consistent blood pressure monitoring as the foundation of effective hypertension management. It calls attention to the fact that many cases of hypertension remain undiagnosed or poorly controlled due to inaccurate measurement or lack of awareness (3). By promoting accurate measurement techniques and proactive management, the campaign intends to help individuals reduce complications and improve longevity (3). The day underscores particularly the need for reaching low- and middle-income populations, where hypertension prevalence is rising rapidly and healthcare access may be limited (1). Hypertension is often called a silent killer because it typically causes no symptoms but leads to severe cardiovascular complications if untreated (4). It contributes profoundly to morbidity and mortality worldwide, and has been the leading cause of death and disability-adjusted life years for three decades (5). Modifiable behavioral risk factors such as tobacco and alcohol use, high salt intake, physical inactivity, unhealthy diets, and mental stress drive its prevalence (6). In fact, regular blood pressure screening, lifestyle changes, and medical treatment where necessary are key to reducing this burden and preventing conditions like heart attack, stroke, and kidney failure (7). World hypertension day also acts as a catalyst for healthcare systems, policymakers, and organizations to launch public health initiatives for better hypertension prevention and control. These include educational campaigns to encourage healthy eating, reduced salt consumption, increased physical activity, weight management, and smoking cessation (8). The day promotes collaboration among healthcare providers and governments to improve screening coverage, patient adherence to treatment, and access to affordable medicines worldwide (1). Globally standardized approaches to hypertension diagnosis, treatment, and continuous patient monitoring are advocated to reduce the global cardiovascular disease burden (9). Furthermore, world hypertension day is a reminder that hypertension management starts with awareness and accurate blood pressure measurement. It calls for a collective effort to improve education, healthcare infrastructure, and lifestyle habits to curb the global hypertension epidemic and enable millions to live longer, healthier lives by controlling their blood pressure (10). Previous studies detected that lifestyle interventions, by emphasizing on dietary sodium reduction, targeting less than 2 g daily, can lower blood pressure, comparable to a single antihypertensive medication, alongside potassium-rich foods from local produce like bananas and leafy greens abundant in tropical climates (11). Besides, physical activity protocols adapted to resource constraints, such as 30 minutes of brisk walking or farming-related tasks five days weekly, yield similar benefits. Meanwhile, weight management further amplifies effects, especially in obese subgroups (12). In this narrative review, we sought to implement lifestyle precision medicine for hypertension in resource-limited settings on the occasion of world hypertension day.

Search strategy

For this narrative review, a comprehensive literature search was performed across multiple electronic databases, including PubMed, Scopus, Embase, Web of Science, EBSCO, the Directory of Open Access Journals (DOAJ), and Google Scholar. The search strategy combined controlled vocabulary and free-text terms such as 'blood pressure', 'hypertension', 'lifestyle modification', 'World Hypertension Day', 'the Mediterranean diet', and 'cardiovascular disease', using appropriate Boolean operators to ensure broad yet focused retrieval of relevant studies.

Lifestyle precision medicine

The concept of lifestyle precision medicine represents a profound shift from a one-size-fits-all approach to hypertension management, recognizing that the disease arises from intricate interactions among diverse genetic components and disparate environmental and lifestyle factors (13). It is an approach to hypertension prevention and treatment that considers the unique genes and environment of each hypertensive patient, adapting the definition of precision medicine to the context of high blood pressure. This personalized framework leverages advances in genomics, epigenomics, metabolomics, proteomics, data science, artificial intelligence, and behavioral sciences to inform and customize lifestyle interventions (14). Key principles include the early and continuous identification of individual risk profiles, comprehensive assessment of lifestyle factors and comorbidities, culturally sensitive interventions, and the integration of technology for continuous monitoring and support. This approach aims to provide more accurate diagnosis, predict disease outcomes, and develop targeted therapies that are more effective and have fewer side effects, offering the potential to control and even cure hypertension by providing personalized and precise treatments (8).

Focus on dietary modifications

Central to lifestyle precision medicine are the core lifestyle interventions that have demonstrated robust effectiveness in lowering blood pressure across diverse populations (15). Dietary modifications form a cornerstone of this approach, with the dietary approaches to stop hypertension

(DASH) diet being widely acknowledged for its benefits. This diet, rich in fruits, vegetables, whole grains, and low-fat dairy products while reduced in saturated and total fat and cholesterol, can significantly lower systolic blood pressure and diastolic blood pressure (16). The benefits of the DASH diet are particularly pronounced in hypertensive individuals and those of African American descent (17). Beyond DASH, the Mediterranean diet is also recognized for its blood pressure-lowering effects (18). These dietary patterns, along with vegetarian diets, emphasize high fiber intake, reduced red meat, and adequate plant-based protein, which contribute to lower body mass index and blood pressure readings through mechanisms such as improved blood viscosity, vasodilation, and insulin sensitivity (19). Salt reduction is another critical and highly effective dietary intervention, as high sodium consumption is a leading dietary risk factor for death globally (20). Reducing daily sodium intake to less than 2 grams can lead to a linear decrease in blood pressure, with studies showing systolic blood pressure and diastolic blood pressure reductions in hypertensive patients (21). The impact of salt reduction is notably greater in individuals of Black African ancestry, older age groups, and those with higher baseline blood pressure levels (22). In many low-income countries, the majority of consumed salt is added during food preparation or at the table, making targeted interventions on household salt use and the adoption of low-sodium, high-potassium salt substitutes particularly relevant and feasible (23). The management of other dietary components is also crucial; since increasing potassium intake through fruits, vegetables, nuts, and legumes can lower blood pressure by directly affecting vascular tone and stimulating natriuresis (24). Guidelines recommend potassium intake of over 3.5 g per day for adults, as higher intake reduces the risk of stroke, cardiovascular diseases and death, especially when replacing sodium in salt substitutes (25). Conversely, reducing sugar intake, particularly added sugars and high-fructose components, is vital given its strong association with cardiometabolic changes, increased adiposity, and strengthened cardiovascular diseases mortality risk (26). High sugar and salt intake can also up-regulate sodium-glucose transporters, leading to greater absorption of glucose and sodium, influencing blood pressure control (27). Finally, increasing dietary fiber preferably from fermentable sources, significantly reduces blood pressure by interacting with gut microbiota to release short-chain fatty acids that improve vasodilation (28). Beyond diet, physical activity is a cornerstone of lifestyle modification, offering substantial benefits for hypertension management (8). Regular engagement in aerobic and dynamic resistance training can provide reductions in office blood pressure comparable to antihypertensive medication in those with established hypertension (29). Even moderate-intensity physical activity, such as walking, has a blood pressure-lowering effect (30).

Impact of weight management

Weight management is intricately linked to blood pressure control, as obesity is a worldwide epidemic and a well-established causal factor in hypertension development and cardiovascular disease risk (31). Even a modest weight loss can decrease or discontinue the dosage requirements of antihypertensive medications and reduce blood pressure, often independent of salt restriction (32). Effective weight loss programs often involve gradual and moderate approaches with support from dietitians, combining calorie-intake reduction, increased incidental exercise, and cognitive-behavioral strategies (33). Monitoring ethnic-specific cut-offs for body mass index and waist-to-height ratio, or aiming for a waist-to-height ratio less than 0.5, is crucial for assessing healthy body weight targets (34).

Focus on stress reduction

Stress reduction and improved sleep hygiene are also vital, as psychological stress and poor sleep can exacerbate hypertension (35). Chronic stress activates the sympathetic nervous system and the renin-angiotensin-aldosterone system, directly elevating blood pressure (36). Lifestyle interventions now extend to less obvious strategies such as mindfulness, meditation, yoga, breathing techniques, and music therapy to manage stress and promote quality sleep. While the effects may vary, these techniques can contribute to modest blood pressure reductions and improved blood pressure reactivity to stress (8). Importantly, smoking cessation and alcohol moderation are critical given their strong association with increased hypertension risk and adverse cardiovascular outcomes (8). Mendelian randomization studies suggest that any amount of alcohol uniformly increases blood pressure, with the lowest risks for cardiovascular outcomes observed in abstainers, emphasizing that zero alcohol consumption is optimal for cardiovascular health (37).

Health system constraints

Overburdened healthcare providers often lack the time and resources to provide comprehensive lifestyle advice and counseling, as their focus is frequently on immediate clinical management. There is a significant gap in healthcare professionals' training in behavior change techniques and lifestyle medicine competencies, which are crucial for effective patient engagement and support (38). Shortages of qualified staff, inconsistent availability of non-communicable diseases medications, and fragmented care pathways contribute to suboptimal management strategies (39). The cost of non-communicable diseases services, often not freely covered like HIV care, also presents a challenge within integrated service delivery models. These systemic issues hinder the effective detection, treatment, and control of hypertension, leading to low control rates. To overcome these multifaceted barriers, a range of integrated strategies is essential (40). Community-

based models are crucial for decentralizing hypertension care and addressing access gaps without compromising quality. Community health workers are invaluable frontline personnel, bridging healthcare systems with communities, especially in resource-limited settings. Community health workers provide culturally tailored education, personalized lifestyle coaching, blood pressure monitoring, and support for treatment adherence. Their interventions have shown positive effects on blood pressure reduction, linkage to care, and adherence to treatment (41). Meanwhile, health clubs and community walking groups can promote healthy lifestyles by integrating enjoyable activities aligned with cultural norms. Moreover, culturally tailored interventions are fundamental to ensure lifestyle recommendations are acceptable, effective, and sustainable. Such interventions consider patients' beliefs about hypertension, dietary patterns, physical activity preferences, and attitudes toward medication adherence (8). Similarly, adapting dietary advice to staple foods and cooking methods preferred within a specific culture, while still promoting low-salt intake and increased fruits and vegetables, enhances adherence (42). Culturally adapted education sessions, especially those led by nurses, have demonstrated significant reductions in blood pressure and improved treatment adherence in patients of African origin (43). Integrating traditional remedies alongside medical interventions requires educating patients on the importance of prescribed medications and the potential side effects of herbal combinations, while respecting their cultural beliefs (42).

Conclusion

Implementing lifestyle precision medicine for hypertension in resource-limited settings offers a promising approach beyond conventional pharmacotherapy, by tailoring interventions to individual patient profiles including genetics, environment, lifestyle, and socioeconomic factors. This approach aligns hypertension management with patient-specific risk factors and physiological traits, enabling more effective blood pressure control with potentially fewer side effects and optimized resource use. Precision lifestyle interventions, such as personalized dietary recommendations, specific physical activity regimens, and stress reduction techniques, can be adapted to local cultures and resource availability, making them practical and scalable in underserved areas. In resource-limited settings, challenges such as lack of advanced diagnostic tools, limited healthcare workforce, and economic constraints complicate widespread adoption of typical precision medicine approaches that rely heavily on genomic or proteomic data. However, scalable and cost-effective strategies focusing on clinical and physiological parameters and lifestyle patterns, can bridge this gap. Such integrative programs have shown promise in improving hypertension control rates where traditional medical infrastructure is limited. Furthermore, lifestyle precision medicine emphasizes patient empowerment and engagement, encouraging sustainable behavior changes that can reduce reliance on costly medications and healthcare visits. By incorporating culturally appropriate interventions and addressing social determinants of health, such as nutrition access, physical activity opportunities, and stressors, this approach can holistically affect hypertension burden. In particular, simple, algorithm-driven protocols that integrate lifestyle modifications with minimal pharmacotherapy can reduce the pill burden and healthcare system strain while improving patient outcomes. Therefore, advancing precision lifestyle medicine in hypertension management presents a cost-effective, patient-centered solution adaptable to diverse and resource-scarce environments. It requires a multidisciplinary effort incorporating healthcare providers, policymakers, and communities to implement evidence-based, contextually relevant strategies. Continuous evaluation and adaptation of such programs will be vital to maximize their impact and ensure equitable hypertension control globally, contributing importantly to cardiovascular disease prevention and health equity on world hypertension day and beyond.

Authors' contribution

Conceptualization: Kianoush Saberi, Nilufar Dehkanova, and Egamova Sitora.
Data curation: Shirin Shamsghahfarokhi, Nodirabegim Jamoliddinova, and Malika Khaldarbekova.
Investigation: Kianoush Saberi, Egamova Sitora, and Nodira Rashidova.
Supervision: All authors.
Validation: Dilnora Raxmatova and G'olibjon Eshonkulov.
Visualization: Nodira Rashidova and Nigina Mamedova.
Writing–original draft: All authors.
Writing–review and editing: All authors.

Conflicts of interest

The authors declare that they have no competing interests.

Ethical issues

Ethical issues (including plagiarism, data fabrication, double publication) have been completely observed by the authors.

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work, the authors utilized Perplexity and Grammarly to refine grammar points and language style in writing. Subsequently, the authors thoroughly reviewed and edited the content as necessary, assuming full responsibility for the publication's content.

Funding/Support

None.

References

1. Chockalingam A. World Hypertension Day and global awareness. Can J Cardiol. 2008;24:441–4. doi: 10.1016/s0828-282x(08)70617-2.
2. Schutte AE, Srinivasapura Venkateshmurthy N, Mohan S, Prabhakaran D. Hypertension in Low- and Middle-Income

Countries. Circ Res. 2021;128:808–26. doi: 10.1161/circresaha.120.318729.
3. Gulati M, Moore MM, Cibotti-Sun M. 2025 High Blood Pressure Guideline-at-a-Glance. J Am Coll Cardiol. 2025;86:1560–6. doi: 10.1016/j.jacc.2025.07.010.
4. Kalehoff JP, Oparil S. The Story of the Silent Killer : A History of Hypertension: Its Discovery, Diagnosis, Treatment, and Debates. Curr Hypertens Rep. 2020;22:72. doi: 10.1007/s11906-020-01077-7.
5. Mills KT, Stefanescu A, He J. The global epidemiology of hypertension. Nat Rev Nephrol. 2020;16:223–37. doi: 10.1038/s41581-019-0244-2.
6. Ojangba T, Boamah S, Miao Y, Guo X, Fen Y, Agboyibor C, et al. Comprehensive effects of lifestyle reform, adherence, and related factors on hypertension control: A review. J Clin Hypertens (Greenwich). 2023;25:509–20. doi: 10.1111/jch.14653.
7. Elendu C, Amaechi DC, Elendu TC, Amaechi EC, Elendu ID. Dependable approaches to hypertension management: A review. Medicine (Baltimore). 2024;103:e38560. doi: 10.1097/md.0000000000038560.
8. Charchar FJ, Prestes PR, Mills C, Ching SM, Neupane D, Marques FZ, et al. Lifestyle management of hypertension: International Society of Hypertension position paper endorsed by the World Hypertension League and European Society of Hypertension. J Hypertens. 2024;42:23–49. doi: 10.1097/hjh.0000000000003563.
9. Patel P, Ordunez P, DiPette D, Escobar MC, Hassell T, Wyss F, et al. Improved Blood Pressure Control to Reduce Cardiovascular Disease Morbidity and Mortality: The Standardized Hypertension Treatment and Prevention Project. J Clin Hypertens (Greenwich). 2016;18:1284–94. doi: 10.1111/jch.12861.
10. Schutte AE, Jafar TH, Poulter NR, Damasceno A, Khan NA, Nilsson PM, et al. Addressing global disparities in blood pressure control: perspectives of the International Society of Hypertension. Cardiovasc Res. 2023;119:381–409. doi: 10.1093/cvr/cvac130.
11. Yu J, Thout SR, Li Q, Tian M, Marklund M, Arnott C, et al. Effects of a reduced-sodium added-potassium salt substitute on blood pressure in rural Indian hypertensive patients: a randomized, double-blind, controlled trial. Am J Clin Nutr. 2021;114:185–93. doi: 10.1093/ajcn/nqab054.
12. Hayes P, Ferrara A, Keating A, McKnight K, O'Regan A. Physical Activity and Hypertension. Rev Cardiovasc Med. 2022;23:302. doi: 10.31083/j.rcm2309302.
13. Savoia C, Volpe M, Grassi G, Borghi C, Agabiti Rosei E, Touyz RM. Personalized medicine-a modern approach for the diagnosis and management of hypertension. Clin Sci (Lond). 2017;131:2671–85. doi: 10.1042/cs20160407.
14. Padmanabhan S, Dominiczak AF. Genomics of hypertension: the road to precision medicine. Nat Rev Cardiol. 2021;18:235–50. doi: 10.1038/s41569-020-00466-4.
15. Marin-Couture E, Moulin JA, Thibault AS, Poirier P, Després JP, Gallant A, et al. Impact of Lifestyle Medicine Interventions on the Management of Systemic Hypertension in Primary Care: A Canadian Randomized Controlled Trial. Am J Lifestyle Med. 2024;18:703–20. doi: 10.1177/15598276241242013.
16. Tyson CC, Nwankwo C, Lin PH, Svetkey LP. The Dietary Approaches to Stop Hypertension (DASH) eating pattern in special populations. Curr Hypertens Rep. 2012;14:388–96. doi: 10.1007/s11906-012-0296-1.
17. Abrahamowicz AA, Ebinger J, Whelton SP, Commodore-Mensah Y, Yang E. Racial and ethnic disparities in hypertension: barriers and opportunities to improve blood pressure control. Curr Cardiol Rep. 2023;25:17–27. doi: 10.1007/s11886-022-01826-x.
18. De Pergola G, D'Alessandro A. Influence of mediterranean diet on blood pressure. Nutrients. 2018;10:1700. doi: 10.3390/nu10111700.
19. Tomé-Carneiro J, Visioli F. Plant-based diets reduce blood pressure: a systematic review of recent evidence. Curr Hypertens Rep. 2023;25:127–50. doi: 10.1007/s11906-023-01243-7.
20. Earle WB, Ormseth G, Morales-Alvarez MC, Kaushik M, Juraschek SP. Dietary sodium reduction is best for reducing blood pressure: controversies in hypertension. Hypertension. 2024;81:510–5. doi: 10.1161/hypertensionaha.123.20544.
21. Jula A. Sodium - a systematic review for Nordic Nutrition Recommendations 2023. Food Nutr Res. 2024;68. doi: 10.29219/fnr.v68.10319.
22. Elijovich F, Kirabo A, Laffer CL. Salt Sensitivity of Blood Pressure in Black People: The Need to Sort Out Ancestry Versus Epigenetic Versus Social Determinants of Its Causation. Hypertension. 2024;81:456–67. doi: 10.1161/hypertensionaha.123.17951.
23. Ajenikoko A, Ide N, Shivashankar R, Ge Z, Marklund M, Anderson C, et al. Core Strategies to Increase the Uptake and Use of Potassium-Enriched Low-Sodium Salt. Nutrients. 2021;13:3203. doi: 10.3390/nu13093203.
24. Chan RJ, Parikh N, Ahmed S, Ruzicka M, Hiremath S. Blood Pressure Control Should Focus on More Potassium: Controversies in Hypertension. Hypertension. 2024;81:501–9. doi: 10.1161/hypertensionaha.123.20545.
25. Reddin C, Ferguson J, Murphy R, Clarke A, Judge C, Griffith V, et al. Global mean potassium intake: a systematic review and Bayesian meta-analysis. Eur J Nutr. 2023;62:2027–37. doi: 10.1007/s00394-023-03128-6.
26. Kamijo Y. A novel mechanism by which excessive fructose intake leads to hypertension. Hypertens Res. 2025;48:1174-1175. doi: 10.1038/s41440-024-01994-z. PMID: 40038407.
27. Preuss HG, Clouatre D, Swaroop A, Bagchi M, Bagchi D, Kaats GR. Blood Pressure Regulation: Reviewing Evidence for Interplay Between Common Dietary Sugars and Table Salt. J Am Coll Nutr. 2017;36:677–84. doi: 10.1080/07315724.2017.1345338.
28. Rudzka A, Zielińska D, Neffe-Skocińska K, Sionek B, Szydłowska A, Górnik-Horn K, et al. The Role of Intestinal Microbiota and Dietary Fibre in the Regulation of Blood Pressure Through the Interaction with Sodium: A Narrative Review. Microorganisms. 2025;13:1269. doi: 10.3390/microorganisms13061269.
29. Dimeo F, Pagonas N, Seibert F, Arndt R, Zidek W, Westhoff TH. Aerobic exercise reduces blood pressure in resistant hypertension. Hypertension. 2012;60:653–8. doi: 10.1161/hypertensionaha.112.197780.
30. Malem R, Ristiani R, Ali Puteh M. Brisk Walking Exercise Has Benefits of Lowering Blood Pressure in Hypertension Sufferers: A Systematic Review and Meta-Analysis. Iran J Public Health. 2024;53:774–84. doi: 10.18502/ijph.v53i4.15554.
31. Shariq OA, McKenzie TJ. Obesity-related hypertension: a review of pathophysiology, management, and the role of metabolic surgery. Gland Surg. 2020;9:80–93. doi: 10.21037/gs.2019.12.03.
32. Gilardini L, Redaelli G, Croci M, Conti A, Pasqualinotto L, Invitti C. Effect of a Modest Weight Loss in Normalizing Blood Pressure in Obese Subjects on Antihypertensive Drugs. Obes Facts. 2016;9:251–8. doi: 10.1159/000445504.
33. Kim JY. Optimal Diet Strategies for Weight Loss and Weight Loss Maintenance. J Obes Metab Syndr. 2021;30:20–31. doi: 10.7570/jomes20065.
34. Yoo EG. Waist-to-height ratio as a screening tool for obesity

and cardiometabolic risk. Korean J Pediatr. 2016;59:425–31. doi: 10.3345/kjp.2016.59.11.425.
35. Virgianti L, Nurjazuli N, Widjanarko B. Overview of Sleep Quality on The Incidence of Hypertension Study: Sys-tematic Literature Review. Eduvest - J Universal Studies. 2025;5:3894–907. doi: 10.59188/eduvest.v5i4.33274.
36. Correa BHM, Becari L, Fontes MAP, Simões ESAC, Kangussu LM. Involvement of the Renin-Angiotensin System in Stress: State of the Art and Research Perspectives. Curr Neuropharmacol. 2022;20:1212–28. doi: 10.2174/1570159x19666210719142300.
37. Larsson SC, Burgess S, Mason AM, Michaëlsson K. Alcohol Consumption and Cardiovascular Disease: A Mendelian Randomization Study. Circ Genom Precis Med. 2020;13:e002814. doi: 10.1161/circgen.119.002814.
38. Pathak A, Poulter NR, Kavanagh M, Kreutz R, Burnier M. Improving the Management of Hypertension by Tackling Awareness, Adherence, and Clinical Inertia: A Symposium Report. Am J Cardiovasc Drugs. 2022;22:251–61. doi: 10.1007/s40256-021-00505-6.
39. Mishra SR, Satheesh G, Khanal V, Adhikari B, Parker D, Picone DS, et al. Bridging Hypertension Care Shortfalls Between Provider Capacity and Patient Needs: A Pooled Analysis of Data From 199 Countries and Territories. Hypertension. 2025;82:1906–15. doi: 10.1161/hypertensionaha.125.24783.
40. Manavalan P, Wanda L, Galson SW, Thielman NM, Mmbaga BT, Watt MH. Hypertension Care for People With HIV in Tanzania: Provider Perspectives and Opportunities for Improvement. J Int Assoc Provid AIDS Care. 2021;20:23259582211052399. doi: 10.1177/23259582211052399.
41. Brook RD, Levy PD, Brook AJ, Opara IN. Community Health Workers as Key Allies in the Global Battle Against Hypertension: Current Roles and Future Possibilities. Circ Cardiovasc Qual Outcomes. 2023;16:e009900. doi: 10.1161/circoutcomes.123.009900.
42. Miezah D, Hayman LL. Culturally tailored lifestyle modification strategies for hypertension management: a narrative review. Am J Lifestyle Med. 2024:15598276241297675. doi: 10.1177/15598276241297675.
43. Meinema JG, van Dijk N, Beune EJ, Jaarsma DA, van Weert HC, Haafkens JA. Determinants of adherence to treatment in hypertensive patients of African descent and the role of culturally appropriate education. PLoS One. 2015;10:e0133560. doi: 10.1371/journal.pone.0133560.