

Review Article

Lifestyle Interventions for Blood Pressure Control: A Narrative Review of Global Evidence and Indonesian Perspectives

Hery Kurniawan^{1*}, Avril Bella Audyna²

¹Department of Community & Clinical Pharmacy, Faculty of Pharmacy, Universitas Mulawarman, Samarinda, Indonesia

²Department of Pharmacy, Faculty of Pharmacy, Universitas Mulawarman, Samarinda, Indonesia

*Correspondence email : herykurniawan@farmasi.unmul.ac.id

Abstract

Hypertension remains a major global public health concern with a steadily rising prevalence, including in Indonesia. Global estimates indicate that over 30% of the adult population is affected, while in Indonesia the prevalence ranges between 34–36%. This narrative review synthesizes findings from 35 scientific articles published within the last decade, examining the relationship between lifestyle factors and blood pressure control. Literature searches were conducted through PubMed, ScienceDirect, Google Scholar, SpringerLink, and Garuda databases. The results demonstrate that high sodium intake, physical inactivity, obesity, psychosocial stress, smoking, and excessive alcohol consumption are major determinants of elevated blood pressure. Lifestyle modifications encompassing the DASH dietary pattern, sodium restriction, regular physical activity, weight management, and stress reduction have been shown to significantly lower both systolic and diastolic blood pressure. Comprehensive strategies integrating lifestyle modification, healthcare optimization, and sustained patient education are essential for effective hypertension control.

Keywords: Hypertension, Lifestyle, Diet, Physical activity, Blood pressure control

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1 Introduction

Hypertension persists as one of the most significant public health challenges worldwide and has been identified as a principal risk factor for cardiovascular disease, cerebrovascular disease, chronic kidney disease, and premature mortality [1], [36]. Current estimates indicate that more than 1.28 billion adults globally live with hypertension, with a rising trend closely linked to modern lifestyle transitions, urbanization, and population aging [2], [20]. This condition is commonly referred to as a *silent killer* because the majority of affected individuals exhibit no overt clinical symptoms, yet progressive target organ damage may occur if blood pressure remains inadequately controlled [3]. In Indonesia, national health surveillance data reveal a concerning upward trend in hypertension prevalence, particularly among productive-age adults and the elderly population, thereby posing a substantial burden on the national healthcare system [6], [33]. Notably, the rising prevalence extends beyond adult populations, as studies have documented hypertension-associated risk factors among Indonesian adolescents as well [33], [39].

A substantial body of evidence indicates that lifestyle factors play a pivotal role both in the pathogenesis of hypertension and in non-pharmacological blood pressure management. Unbalanced dietary patterns, excessive sodium intake, inadequate fruit and vegetable consumption, tobacco use, alcohol consumption, low physical activity levels, and psychosocial stress are recognized as primary determinants of elevated blood pressure [5], [9], [42]. Epidemiological studies across diverse populations have consistently demonstrated that individuals who adopt healthy lifestyle behaviors have a significantly lower probability of developing hypertension compared to those leading unhealthy lifestyles [3], [41]. Furthermore, structured implementation of lifestyle modifications has been shown to yield clinically meaningful reductions in both systolic blood pressure (SBP) and diastolic blood pressure (DBP), in hypertensive patients as well as in individuals with prehypertension [4], [8].

Various forms of lifestyle-based interventions have been developed and scientifically evaluated, including the implementation of dietary patterns based on the *Dietary Approaches to Stop Hypertension* (DASH) principles, sodium intake restriction, intensification of physical activity, weight reduction in obese individuals, and smoking cessation. These interventions have collectively demonstrated significant therapeutic effects on blood pressure regulation [9], [10], [15]. International clinical guidelines, including the 2025 AHA/ACC guideline, position lifestyle modification as the first-line approach in hypertension management, either as monotherapy for mild hypertension or as adjunctive therapy accompanying antihypertensive pharmacological agents [5], [27]. This non-pharmacological approach offers advantages including a more favorable safety profile, greater cost-effectiveness, and more realistic long-term sustainability [11], [25].

Based on this rationale, a comprehensive review that consolidates and integrates current scientific findings regarding the role of lifestyle factors in hypertension control is warranted. This narrative review was designed with the primary objective of critically examining the contribution of each lifestyle component to blood pressure control, while comparing the situation in Indonesia with the global landscape. The findings of this review are expected to serve as a scientific reference for the formulation of lifestyle modification-based intervention strategies aimed at optimizing hypertension control in the community [16], [17].

2 Method

This study adopted a *narrative review* approach aimed at comprehensively examining the contribution of various lifestyle factors to hypertension control at both global and national (Indonesian) levels. This approach was selected because it enables the synthesis, analysis, and interpretation of relevant research findings in a systematic manner, thereby providing a holistic understanding of the relationship between lifestyle behaviors and blood pressure control outcomes across heterogeneous populations.

Literature searches were conducted systematically through several reputable databases, including PubMed, ScienceDirect, Google Scholar, SpringerLink, and Garuda (Garba Rujukan Digital). The search strategy employed combinations of keywords in both English and Indonesian, including: *hypertension*,

lifestyle factors, blood pressure control, dietary pattern, physical activity, smoking, obesity, stress, hipertensi, gaya hidup, pengendalian tekanan darah, and Indonesia. All keywords were combined using Boolean operators (AND, OR) to optimize search coverage and precision. The publication period was restricted to 2016–2025 to ensure data relevance and currency.

Inclusion criteria applied were: (1) original research articles or *systematic reviews* published in nationally or internationally accredited journals; (2) investigating the relationship between lifestyle factors and hypertension incidence or control; (3) involving adult study subjects (≥ 18 years); (4) presenting quantitative or qualitative data related to blood pressure or hypertension prevalence; and (5) available in *full-text* format. Article selection was performed in stages, beginning with title and abstract screening, evaluation against inclusion and exclusion criteria, and concluding with full-text assessment. From the overall search results, 35 articles were deemed most relevant to the review objectives. In addition to these 35 core articles, supplementary literature was referenced to provide epidemiological data, clinical practice guidelines, and conceptual frameworks to strengthen the discussion.

Extracted data were analyzed and narratively synthesized by grouping findings according to the primary lifestyle factors: dietary patterns, physical activity, smoking habits, alcohol consumption, obesity, and stress management. The synthesis results are presented as a systematic descriptive narrative, accompanied by a data extraction table (Table 1) to facilitate reader comprehension.

3 Result and Discussion

The review of 35 scientific articles revealed that lifestyle factors play a determinant role in hypertension control, both globally and in the Indonesian context. Multiple studies consistently confirm that lifestyle modifications encompassing dietary regulation, increased physical activity, weight management, smoking cessation, alcohol restriction, and stress management contribute substantially to SBP and DBP reduction [1], [26], [30], [36]. Lifestyle-based interventions have even been reported to reduce the need for antihypertensive pharmacotherapy in certain patients, particularly those with mild to moderate hypertension [5], [40]. Studies conducted across various healthcare settings in Indonesia, from primary health centers to hospitals, have corroborated these findings, demonstrating significant associations between lifestyle patterns and hypertension incidence [37], [41], [43].

3.1 Dietary Patterns and Hypertension Control

Among all lifestyle components examined, dietary patterns demonstrated the most consistent association with successful blood pressure control. Numerous global studies provided robust evidence that implementing a low-sodium diet enriched with fiber, fruits, and vegetables – as recommended within the DASH dietary framework – yielded clinically meaningful blood pressure reductions [9], [14]. This finding was reinforced by the meta-analysis of Filippou et al. [46], which analyzed multiple randomized controlled trials and reported that the DASH diet consistently lowered both SBP and DBP in adults with and without hypertension. SBP reductions of 8–14 mmHg and DBP reductions of 4–8 mmHg were reported in individuals who consistently adopted this dietary pattern. Longitudinal evidence from Zhang et al. [19] further demonstrated that sustained high vegetable consumption was associated with hypertension risk reductions of up to 30% over a multi-decade follow-up period. The biological mechanisms underlying the antihypertensive effects of this diet involve the roles of potassium, magnesium, calcium, and antioxidant compounds contained in fruits and vegetables, which participate in improving vascular endothelial function and reducing peripheral vascular resistance [14], [22].

In the Indonesian context, similar findings were identified, although population-level adherence to healthy dietary patterns remains low. Consumption of foods high in sodium, saturated fat, and ultra-processed products continues to dominate dietary habits across various regions [13], [34], [43]. National surveillance data revealed that the average daily sodium intake of the Indonesian population exceeds the World Health Organization (WHO) recommendation of less than 2 grams per day, thereby contributing to the high hypertension prevalence. Analysis of the Indonesian Health Survey 2023 confirmed that dietary

consumption patterns significantly impact hypertension risk in the population [34]. Meta-analytic evidence from Wu et al. [18] corroborated that traditional low-fat dietary patterns in Asian populations are protective against hypertension development. Sodium intake reduction has been demonstrated to produce meaningful blood pressure decreases, particularly among the elderly and individuals with a familial predisposition to hypertension [11], [13], [38].

3.2 Physical Activity and Blood Pressure Reduction

Regular physical activity constitutes another critical pillar in the non-pharmacological management of hypertension. The literature synthesis indicated that moderate-intensity aerobic exercise performed for 30–60 minutes per session, with a minimum frequency of five times per week, was capable of producing SBP reductions of 5–10 mmHg [4], [23]. This finding aligns with the large-scale network meta-analysis by Edwards et al. [47], which compared various exercise modalities and concluded that aerobic exercise, resistance training, and their combination were all effective in lowering resting blood pressure in hypertensive individuals. From a physiological perspective, regular physical activity enhances arterial wall elasticity, improves insulin sensitivity, and suppresses sympathetic nervous system hyperactivity, which contributes to elevated vascular tone and blood pressure [23], [47].

Studies conducted in Indonesia revealed that population-level physical activity remains below recommended thresholds, particularly in urban populations characterized by sedentary lifestyles [8], [21]. Insufficient physical movement, increased sitting duration, and dependence on motorized transportation further exacerbate hypertension risk [8], [42]. Epidemiological data from developed countries similarly indicate that sedentary behavior is a substantial contributor to hypertension prevalence at the population level [24]. Community-based interventions facilitating simple physical activities such as walking, group exercise, and light sports have proven effective in reducing blood pressure while simultaneously improving cardiorespiratory fitness [6], [21]. A qualitative systematic review by Li et al. [50] identified that the primary barriers to physical activity adherence among hypertension patients include time constraints, comorbid conditions, and lack of social support – findings that are highly relevant to the Indonesian context, where similar socioeconomic barriers have been documented [35], [37].

3.3 Obesity and Its Correlation with Hypertension

Obesity has been identified as a major hypertension risk factor closely linked to unbalanced dietary patterns and low physical activity. Global evidence indicates that each 1 kg/m² increase in body mass index (BMI) correlates with an approximately 1–2 mmHg SBP elevation [6]. Conversely, weight loss of 5–10% from baseline body weight has been demonstrated to produce clinically significant blood pressure reductions accompanied by overall metabolic profile improvements [5].

In Indonesia, obesity prevalence has shown a concerning upward trend over the past decade, particularly among productive-age groups [21], [28]. This condition amplifies the cardiovascular disease burden, including hypertension. Weight management programs integrating nutritional education, increased physical activity, and behavioral modification have yielded positive results in blood pressure reduction, although maintaining long-term adherence remains a challenge requiring targeted attention [21], [28], [45].

3.4 Smoking Habits and Alcohol Consumption

Smoking is known to exert both acute and chronic effects on blood pressure elevation through sympathetic nervous system stimulation and vascular endothelial damage. Global studies report that active smokers have significantly higher hypertension risk compared to non-smokers [1], [10]. Nicotine exposure has also been reported to impair therapeutic responses in patients receiving antihypertensive regimens, making smoking cessation a critical intervention for optimizing blood pressure control. A comprehensive review by Okorare et al. [48] confirmed that smoking cessation provides substantial cardiovascular benefits, including improved endothelial function and reduced arterial stiffness.

Furthermore, the randomized controlled trial by Gaya et al. [49] in hypertensive smokers demonstrated that structured smoking cessation programs significantly lowered arterial blood pressure in patients concurrently receiving antihypertensive therapy.

In Indonesia, smoking prevalence among males ranks among the highest globally, directly contributing to the high hypertension incidence [33]. Cessation of smoking has been proven to lower blood pressure and enhance pharmacological therapy responsiveness [48], [49]. Meanwhile, excessive alcohol consumption also shows a positive correlation with blood pressure elevation, as demonstrated in the Cochrane meta-analysis by Tasnim et al. [12], although alcohol use prevalence in Indonesia is relatively lower compared to Western countries.

3.5 The Role of Psychosocial Stress

Psychosocial stress is increasingly recognized as a contributing factor in hypertension pathophysiology. Chronic stress exposure induces excessive activation of the hypothalamic-pituitary-adrenal (HPA) axis and the sympathetic nervous system, resulting in elevated circulating catecholamine and cortisol levels, which in turn increase peripheral vascular resistance and blood pressure [7], [13]. Wang et al. [7] demonstrated through network analysis that psychological stress and physical inactivity constituted the primary determinants of unhealthy lifestyle patterns associated with hypertension. Several studies indicate that stress management interventions – including relaxation techniques, meditation, and psychological counseling – contribute positively to blood pressure reduction in hypertensive patients [7], [28].

3.6 The Significance of Education in Hypertension Control

Findings from several studies underscore the urgency of sustained education as an integral component of hypertension control. Educational interventions delivered by healthcare professionals, whether through individual counseling or group education programs, have been demonstrated to enhance patient knowledge, awareness, and adherence to lifestyle modifications and pharmacological therapy [16], [25], [29]. Self-care management education, as reviewed by Assegaf et al. [31], has shown positive effects on blood pressure control by empowering patients to actively participate in their own disease management. Community-based health screening combined with lifestyle education has also been reported to effectively reduce hypertension risk at the population level [32], [44]. Prospective evidence from Ren et al. [26] further confirmed that sustained lifestyle improvement, facilitated through educational support, reduced hypertension risk by 35% in a rural cohort. In Indonesia, the primary challenges include low community health literacy, limited healthcare facility accessibility in remote areas, and the influence of sociocultural factors that may impede adoption of healthy lifestyle behaviors [30], [35], [40].

3.7 Study Limitations

This narrative review has several limitations that should be considered when interpreting its findings. First, the narrative review approach carries a higher degree of subjectivity compared to systematic reviews with standardized protocols, thereby introducing potential selection bias in article inclusion. Second, heterogeneity in study designs, populations, and operational definitions of lifestyle variables among the reviewed articles makes direct inter-study comparisons difficult. Third, the majority of Indonesian studies employed cross-sectional designs that preclude causal inference. Fourth, this review did not perform formal methodological quality assessment of the included articles. Nevertheless, this review provides a comprehensive overview of the role of lifestyle factors in hypertension control that can serve as a foundation for further research with more rigorous designs.

Table 1 Data extraction from the 35 reviewed articles

No	Author, Year	Study Design	Sample & Setting	Lifestyle Focus	Key Findings
1	Booth et al., 2016	Prospective cohort	13,000 respondents, USA	Diet, physical activity, BMI	Healthy lifestyle combination reduced hypertension risk and cardiovascular mortality.
2	Lelong et al., 2016	Cross-sectional	5,800 respondents, France	Healthy diet adherence	Healthy diet was significantly associated with normal blood pressure levels.
3	Mills et al., 2016	Systematic analysis	90 countries	Global lifestyle	Countries with healthier lifestyles demonstrated superior hypertension control.
4	Ndanuko et al., 2016	Meta-analysis	Global (RCTs)	Dietary patterns	Mediterranean and DASH diets effectively lowered blood pressure in RCTs.
5	Wiklund, 2016	Review	Global	Physical activity	Regular exercise reduced blood pressure and improved body composition.
6	Padwal et al., 2016	Epidemiological review	Adults, Canada	Lifestyle factors	Sedentary lifestyle contributed substantially to high hypertension prevalence.
7	Yang et al., 2017	Quasi-experimental	320 patients, South Korea	Lifestyle education	Education improved blood pressure control by 41%.
8	Belozo et al., 2018	Experimental	60 patients, Brazil	Aerobic exercise	Aerobic exercise 90 min/week reduced SBP by 11 mmHg and DBP by 7 mmHg.
9	Lee et al., 2019	Quasi-experimental	180 patients, South Korea	Lifestyle education	Intensive education significantly improved blood pressure control.
10	Tasnim et al., 2020	Meta-analysis (Cochrane)	Global	Alcohol consumption	Alcohol consumption was positively correlated with blood pressure elevation.
11	Filippou et al., 2020	Systematic review & meta-analysis	Global adults (RCTs)	DASH diet	DASH diet significantly reduced SBP and DBP in hypertensive and non-hypertensive adults.
12	Treciokiene et al., 2021	Systematic review & meta-analysis	Global	Healthcare professional education	Professional-led education interventions improved blood pressure control.
13	Lai et al., 2022	Systematic review	Global	Sodium intake	Sodium reduction lowered SBP by 5–10 mmHg.
14	Alfaqeeh et al., 2023	Cross-sectional	IFLS, Indonesia	Obesity, physical activity, diet	Low physical activity and obesity significantly increased hypertension risk.
15	Theodoridis et al., 2023	Systematic review & meta-analysis	Global	DASH diet adherence	DASH adherence reduced SBP by 7–12 mmHg.
16	Krishnamoorthy et al., 2023	Network meta-analysis	Global	Multiple lifestyle interventions	Combined diet and exercise were most effective in lowering blood pressure.
17	Zhang et al., 2023	Longitudinal	10,500 respondents, China	Long-term dietary patterns	High vegetable diet reduced hypertension risk by up to 30%.
18	Edwards et al., 2023	Network meta-analysis	Global (RCTs)	Exercise modalities	Aerobic, resistance, and combined exercise effectively lowered resting blood pressure.
19	Okorare et al., 2023	Narrative review	Global	Smoking cessation	Smoking cessation improved endothelial function and reduced arterial stiffness.
20	Rachmawati et al., 2024	Cross-sectional	1,200 patients, Indonesia	Physical activity, diet, smoking, stress	Regular activity, balanced diet, and non-smoking were significantly associated with blood pressure control.
21	Charchar et al., 2024	Guideline review (ISH)	Global	Lifestyle management	Lifestyle modification recommended as first-line hypertension treatment.
22	Suwaryo et al., 2024	Cross-sectional	410 respondents, Indonesia	Sedentary behavior	Sedentary lifestyle increased hypertension risk 1.9-fold.

No	Author, Year	Study Design	Sample & Setting	Lifestyle Focus	Key Findings
23	Gaya et al., 2024	RCT (subgroup analysis)	113 patients, Brazil	Smoking cessation in hypertension	Smoking cessation program reduced arterial blood pressure in hypertensive smokers.
24	Li et al., 2024	Qualitative systematic review	Global	Physical activity experience	Barriers to PA adherence included time constraints, comorbidities, and lack of social support.
25	Vaezi et al., 2025	Longitudinal cohort	3,400 patients, Iran	Healthy lifestyle score	High lifestyle score correlated with 38% reduction in uncontrolled hypertension risk.
26	Wang et al., 2025	Network analysis	2,700 respondents, China	Stress, diet, activity	Psychological stress and physical inactivity were primary hypertension determinants.
27	Saleem et al., 2025	Systematic review	Global adults	Diet and lifestyle	DASH diet, physical activity, and stress management effectively lowered blood pressure.
28	Kashum & Bahari, 2025	Cross-sectional	980 patients, Qatar	Smoking, diet, activity	Combination of healthy diet and regular exercise significantly reduced blood pressure.
29	Tresnawan, 2025	Cross-sectional	210 elderly, Indonesia	Stress and dietary habits	High stress and high-sodium diet increased hypertension risk.
30	Wu et al., 2025	Systematic review & meta-analysis	Adults, China	Dietary patterns	Traditional low-fat dietary pattern reduced hypertension risk.
31	Suryani et al., 2025	Cross-sectional	350 patients, Indonesia	Physical activity, obesity	Low physical activity and obesity were primary predictors of elevated blood pressure.
32	Han et al., 2025	Narrative review	Global	Lifestyle interventions	Primary care education effectively improved hypertension patient compliance.
33	Ren et al., 2025	Cohort study	6,000 respondents, China	Lifestyle changes	Consistent lifestyle improvement reduced hypertension risk by 35%.
34	Halim, 2025	Cross-sectional	420 respondents, Indonesia	Diet, stress, exercise	Stress and lack of exercise were dominant hypertension factors in productive age.
35	Fauziyah et al., 2025	Scoping review	Adults, Indonesia	Healthy lifestyle	Healthy lifestyle was consistently associated with reduced hypertension risk.

4 Conclusion

Based on the narrative review of 35 scientific articles, it can be concluded that lifestyle factors play a highly significant role in hypertension control, both at the global level and in Indonesia. Lifestyle modifications encompassing the adoption of a healthy diet based on DASH principles, sodium and alcohol intake restriction, regular physical activity, weight management, and stress management have been demonstrated to effectively reduce SBP and DBP. Lifestyle-based interventions also contribute to optimizing antihypertensive pharmacotherapy effectiveness and suppressing cardiovascular complication risks.

Nevertheless, adherence to lifestyle changes remains a primary challenge, particularly in developing countries including Indonesia, influenced by social determinants, cultural factors, and low community health literacy. Therefore, sustainable education strategies, strengthening of professional healthcare roles, and formulation of integrated promotive and preventive policies are needed to enhance community awareness and adherence to healthy lifestyle adoption as a fundamental approach to optimal and sustainable hypertension control.

5 Declarations

5.1 Acknowledgements

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5.2 Author contributions

HK was responsible for research conceptualization, supervision, and manuscript revision. ABA conducted the literature search, data extraction, analysis, and drafting of the initial manuscript. All authors have read and approved the final version of this manuscript.

5.3 Ethics

This study is a literature-based narrative review and therefore did not require ethical approval.

5.4 Conflict of Interest

The authors declare no conflict of interest in the preparation and publication of this article.

5.5 Funding Statement

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