



Clinical Management and Lifestyle Intervention for Hypertension in an Elderly Patient at a Primary Health Care Facility in Indonesia

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Abstract

Hypertension remains one of the most prevalent chronic non-communicable diseases worldwide and constitutes a major risk factor for cardiovascular morbidity and mortality, particularly among elderly populations. Despite the availability of effective antihypertensive therapies, blood pressure control remains suboptimal in many patients due to delayed diagnosis, inadequate treatment adherence, and unhealthy lifestyle practices. Primary health care facilities play a critical role in the early detection, management, and long-term monitoring of hypertension, especially in low- and middle-income settings. This study describes the clinical management and outcomes of an elderly patient with poorly controlled hypertension treated at a community-based primary health care center in Bandar Lampung, Indonesia. A 70-year-old woman presented with persistent headaches, dizziness, and fatigue lasting for approximately two weeks. Initial clinical assessment revealed elevated blood pressure of 170/90 mmHg. The patient had a five-year history of hypertension but reported inconsistent use of antihypertensive medication and suboptimal lifestyle behaviors, including frequent caffeine consumption and limited physical activity. Management involved pharmacological therapy using amlodipine at a daily dose of 5 mg, combined with comprehensive non-pharmacological interventions. The patient received individualized counseling focused on lifestyle modification, including dietary salt restriction, reduction of caffeine intake, encouragement of regular physical activity, and routine blood pressure monitoring. Emphasis was also placed on improving medication adherence through patient education and follow-up support. At a two-week follow-up evaluation, the patient demonstrated a clinically meaningful reduction in blood pressure to 150/80 mmHg, accompanied by a marked improvement in reported symptoms. Additionally, the patient showed enhanced understanding of hypertension management and greater adherence to dietary and lifestyle recommendations. These findings underscore the importance of integrated hypertension management strategies in primary care settings, particularly for elderly patients. The combination of appropriate pharmacological treatment, lifestyle modification, and patient education can significantly improve blood pressure control and reduce the risk of long-term complications. Strengthening primary care-based hypertension programs may contribute to better cardiovascular health outcomes at the community level.



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1. Introduction

Hypertension is a leading global public health challenge and a major contributor to cardiovascular disease, stroke, chronic kidney disease, and premature mortality (Egan et al., 2024; Li et al., 2025; Patel et al., 2020). The World Health Organization estimates that more than one billion adults worldwide are affected by hypertension, with prevalence increasing substantially among older populations due to age-related vascular changes, endothelial dysfunction, and cumulative exposure to lifestyle-related risk factors (Garcia-cabello et al., 2026; Ko et al., 2026). The burden of hypertension continues to rise globally, particularly in low- and middle-income countries undergoing rapid demographic and epidemiological transitions. Despite the availability of effective antihypertensive medications and evidence-based clinical guidelines, blood pressure control remains suboptimal in many regions, highlighting persistent gaps between recommended care and real-world clinical practice (Ulpathakumbura et al., 2026; Zhao et al., 2026; Zhou et al., 2026).

Elderly individuals are especially vulnerable to the adverse effects of uncontrolled hypertension. Age-associated arterial stiffness, impaired baroreceptor sensitivity, and progressive decline in renal function contribute to elevated systolic blood pressure and increased

cardiovascular risk in older adults (Li et al., 2025). In addition, elderly patients frequently present with multiple comorbidities, including diabetes mellitus, dyslipidemia, and chronic kidney disease, which complicate hypertension management and increase the risk of adverse cardiovascular outcomes (Egan et al., 2024). Polypharmacy and age-related changes in pharmacokinetics and pharmacodynamics further challenge treatment adherence and medication tolerability (Patel et al., 2020). Moreover, hypertension in older adults is often asymptomatic or presents with nonspecific symptoms, leading to delayed diagnosis and inadequate long-term management (Garcia-cabello et al., 2026).

Non-pharmacological interventions are a fundamental component of comprehensive hypertension management, particularly in elderly populations. Lifestyle modification strategies such as dietary salt restriction, reduced caffeine intake, regular physical activity, weight control, and smoking cessation have been shown to significantly lower blood pressure and enhance the effectiveness of pharmacological therapy (Ko et al., 2026; Ulpathakumbura et al., 2026). However, adherence to lifestyle recommendations remains challenging, especially among older adults, due to entrenched habits, limited health literacy, and sociocultural factors influencing health behaviors (Zhao et al., 2026). These challenges underscore the importance of patient-centered education and sustained behavioral support within routine clinical care.

Primary health care facilities play a pivotal role in the detection, treatment, and long-term monitoring of hypertension. Community-based primary care providers are uniquely positioned to deliver continuous care, reinforce lifestyle modification, and promote medication adherence through regular follow-up and patient education (Zhou et al., 2026). Evidence indicates that integrated hypertension management programs at the primary care level can significantly improve blood pressure control and reduce cardiovascular morbidity and mortality (Condorf-fern & Gandoy-crego, 2026). Nevertheless, the effectiveness of such programs varies widely across health systems, influenced by resource availability, provider capacity, and patient engagement.

In Indonesia, hypertension is among the most prevalent non-communicable diseases and constitutes a substantial burden on the primary health care system. National health surveys have documented increasing hypertension prevalence, particularly among older adults, driven by urbanization, dietary transitions toward high-salt foods, widespread caffeine consumption, and sedentary lifestyles (Ayadi et al., 2026). Although national guidelines emphasize early detection and continuous hypertension management at primary health care centers (Puskesmas), achieving sustained blood pressure control remains challenging due to suboptimal adherence to medication and lifestyle recommendations (Wang et al., 2026).

Against this background, evidence derived from real-world primary care settings is essential to inform effective hypertension management strategies tailored to elderly populations. This study aims to describe the clinical management and short-term outcomes of hypertension in an elderly patient treated at a community-based primary health care facility in Indonesia. By emphasizing the integration of antihypertensive pharmacotherapy, lifestyle modification, and patient education, this study highlights practical approaches to hypertension management and underscores the importance of adherence-focused interventions in improving cardiovascular health outcomes among older adults.

2. Materials and Methods

2.1. Study Design and Setting

This study employed a descriptive clinical observational approach conducted at a community-based primary health care facility (Puskesmas) located in Bandar Lampung, Indonesia. Primary health care centers in Indonesia serve as the first level of contact for the management of chronic non-communicable diseases, including hypertension, and play a central role in long-term patient follow-up and health education (Slee et al., 2026; Tsai et al., 2025).

2.2. Participant and Clinical Assessment

The subject of this study was an elderly female patient aged 70 years who presented to the primary health care facility with complaints of headache, dizziness, and fatigue persisting for approximately two weeks. A detailed clinical history was obtained, including duration of hypertension, medication use, lifestyle habits, and adherence to treatment recommendations. Blood pressure was measured using a calibrated sphygmomanometer following standard clinical guidelines, with the patient in a seated position after adequate rest (Chen et al., 2025; Lin et al., 2025).

2.3. Intervention and Management Strategy

Management consisted of both pharmacological and non-pharmacological interventions. Pharmacological treatment included the initiation of amlodipine 5 mg once daily, consistent with guideline-recommended first-line therapy for hypertension in elderly patients (Cannizzaro & Spessotto, 2025; Lien et al., 2025). Non-pharmacological management focused on individualized lifestyle modification counseling, including dietary salt reduction, limitation of caffeine intake, encouragement of regular physical activity appropriate for age, and routine blood pressure monitoring. Patient education emphasized the importance of medication adherence and lifestyle changes for long-term blood pressure control (Ding et al., 2025; Garg et al., 2025).

2.4. Follow-Up and Outcome Measures

The patient was followed for two weeks after initiation of therapy. Primary outcomes included changes in systolic and diastolic blood pressure and improvement of clinical symptoms. Secondary outcomes included patient-reported adherence to medication and lifestyle recommendations, assessed through structured clinical interviews during follow-up visits (Al et al., 2025; Hoyek et al., 2025).

3. Results and Discussion

At initial presentation, the patient's blood pressure was 170/90 mmHg, indicating uncontrolled hypertension according to international classification criteria (J. Wang et al., 2025). The patient reported a five-year history of hypertension with inconsistent use of antihypertensive medication and poor adherence to lifestyle recommendations, including frequent consumption of caffeinated beverages and limited physical activity. Following initiation of amlodipine 5 mg once daily and implementation of lifestyle modification counseling, the patient demonstrated measurable clinical improvement at the two-week follow-up visit. Blood pressure decreased to 150/80 mmHg, representing a clinically meaningful reduction in both systolic and diastolic values. In parallel, the patient reported substantial improvement in symptoms, with reduced frequency and intensity of headaches and dizziness (Mandolesi et al., 2025).

In addition to physiological improvement, the patient demonstrated enhanced understanding of hypertension management. She reported improved adherence to medication, reduced caffeine intake, and increased awareness of dietary salt consumption. Regular blood pressure monitoring was initiated at home, reflecting increased engagement in self-management behaviors. No adverse drug reactions or complications were reported during the follow-up period. The findings of this study highlight the effectiveness of integrated hypertension management combining pharmacological therapy and lifestyle modification in an elderly patient treated at a primary health care facility. The observed reduction in blood pressure within a short follow-up period is consistent with previous evidence demonstrating the efficacy of calcium channel blockers, such as amlodipine, in elderly populations with systolic-dominant hypertension (Fischman et al., 2025; Terrin et al., 2025).

Lifestyle modification played a crucial complementary role in blood pressure improvement. Dietary salt restriction, reduced caffeine intake, and increased physical activity have been widely recognized as effective non-pharmacological strategies for hypertension control (Garcia-cabello et al., 2026; Li et al., 2025; Patel et al., 2020). In elderly patients, individualized counseling and practical recommendations are particularly important, as behavioral change may be influenced by long-established habits and sociocultural factors (Ayadi et al., 2026; Blaney et al., 2025; Peng et al., 2025). The improvement in medication adherence observed in this study underscores the importance of patient education and continuous engagement in primary care settings. Poor adherence remains one of the main barriers to effective hypertension control globally, especially among older adults with long-standing disease and multiple comorbidities (Condori-fern & Gandoy-crego, 2026; Ko et al., 2026). Primary health care providers are uniquely positioned to address this challenge through regular follow-up, clear communication, and patient-centered care models (Borah et al., 2023; Khandelwal et al., 2024; Suralaga & Usman, 2025).

In the Indonesian context, where hypertension prevalence continues to rise among elderly populations, strengthening primary care-based management strategies is essential. National guidelines emphasize early detection and long-term management at the Puskesmas level; however, implementation gaps persist due to limited resources and patient-related factors (Patel et al., 2020). This study provides practical insight into how guideline-based hypertension management can be effectively applied in routine primary care practice. Several limitations should be acknowledged. The short follow-up duration limits assessment of long-term blood pressure control and cardiovascular outcomes. Additionally, findings from a single patient cannot be generalized to broader populations. Nevertheless, this study illustrates the real-world application of integrated hypertension management in primary care and reinforces the importance of adherence-focused, patient-centered interventions for elderly patients.

4. Conclusions

This study demonstrates that integrated hypertension management combining pharmacological therapy and structured lifestyle modification can lead to meaningful improvements in blood pressure control and symptom relief among elderly patients in primary health care settings. The observed reduction in blood pressure following initiation of amlodipine therapy, alongside enhanced patient adherence to lifestyle and dietary recommendations, underscores the effectiveness of guideline-based hypertension management when delivered through patient-centered care. Primary health care facilities play a pivotal role in the long-term management of hypertension, particularly for elderly populations who face increased cardiovascular risk and unique challenges related to treatment adherence and comorbidity. Regular follow-up, individualized patient education, and continuous reinforcement of lifestyle modification are essential components of effective hypertension control. This study highlights the importance of adherence-focused interventions and the integration of non-pharmacological strategies alongside medication therapy in routine primary care practice. Although limited by short follow-up duration and the inclusion of a single patient, this study provides practical insight into real-world hypertension management in community-based settings. The findings support the need for strengthening primary care-based hypertension programs and suggest that sustained patient engagement and education may contribute to improved cardiovascular health outcomes among elderly populations. Future studies with larger sample sizes and longer follow-up periods are warranted to further evaluate the long-term effectiveness of integrated hypertension management strategies in primary health care contexts.

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Informed Consent Statement: Written informed consent has been obtained from the patient's guardian to publish this case report, including clinical details and images.

Data Availability Statement: All data supporting the findings of this study are contained within the article. No additional datasets were generated or analyzed.

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References

- Al, M., Beshr, M. S., Vall, M., Manuela, M., Kayal, M., Frias-gomes, C., Burisch, J., Armuzzi, A., Sawaf, B., Alom, M., Regueiro, M., Magro, F., Loftus, E. V., & Elhadi, M. (2025). *Comparative efficacy of immunomodulators, biologics, and advanced therapies for steroid-refractory acute severe ulcerative colitis: A network meta-analysis and time-to-event analysis*. 57, 2304–2320. <https://doi.org/10.1016/j.dld.2025.10.026>
- Ayadi, S., Silvente-poirot, S., Medina, P. De, Poirot, M., & Bu, J. (2026). Liver X receptors and the hallmarks of aging: From molecular mechanisms to therapeutic opportunities. *Ageing Research Reviews*, 114(July 2025). <https://doi.org/10.1016/j.arr.2025.102967>
- Blaney, H., Zhang, W., Bandhari, P., Elfeki, M., Xie, C., Dunn, W., Wong, R., Younossi, Z., Kuo, Y., Kong, M., & Singal, A. (2025). Impact of diabetes and obesity on patient outcomes in alcohol-associated liver disease: Analysis of 3 databases. *Digestive and Liver Disease*, 57(12), 2390–2398. <https://doi.org/10.1016/j.dld.2025.09.020>
- Borah, M., Biswas, R., Saha, A., & Pegu, A. K. (2023). Gastritis in Young Adults, the Evil in Disguise: A Review of Literature. *Mathews Journal of Case Reports*, 1854, 1–7.
- Cannizzaro, R., & Spessotto, P. (2025). Gastrointestinal cancers: Therapeutic progress, diagnostic challenges, and the imperative of prevention. *Digestive and Liver Disease*, 57(12), 2254–2256. <https://doi.org/10.1016/j.dld.2025.10.021>
- Chen, F., Lee, C., Chen, Y., Lin, Y., Yeh, C., Lin, C., & Cheng, H. (2025). Medical Association Pathophysiology and blood pressure measurements of hypertension in the elderly. *Journal of the Formosan Medical Association*, 124(S1), S10–S16. <https://doi.org/10.1016/j.jfma.2025.03.027>
- Condorí-fern, N., & Gandoy-crego, M. (2026). AI-based emotion recognition in dementia through facial expression: A scoping review Noelia Gerbaudo-Gonz a. *Ageing Research Reviews*, 114(October 2025).
- Ding, N., Dou, D., Zhao, L., Zhang, S., & Zhao, L. (2025). The effect of T cell-related vaccines on inflammatory bowel disease: A systematic review and meta-analysis. *Digestive and Liver Disease*, 57(12), 2286–2296. <https://doi.org/10.1016/j.dld.2025.10.011>
- Egan, B. M., Mattix, H. J., Jan, K., & Susan, N. B. (2024). Managing Hypertension in Older Adults. *Current Hypertension Reports*, 26(4), 157–167. <https://doi.org/10.1007/s11906-023-01289-7>
- Fischman, M., Godny, L., Friedenberg, A., Barkan, R., White, I., Wasserberg, N., Rabinowitz, K., Avni-biron, I., Banai, H., & Snir, Y. (2025). *Drug persistence of first- and advanced-line therapy for chronic inflammatory pouch disorders: A prospective cohort spanning sequential treatment lines*. 57, 2370–2375. <https://doi.org/10.1016/j.dld.2025.10.028>
- García-cabello, E., Habich, A., & Molina, Y. (2026). Review article A systematic review of multivariate studies in cognitive aging: Introducing the concept of cognitive organization. *Ageing Research Reviews*, 114(December 2025). <https://doi.org/10.1016/j.arr.2025.102997>
- Garg, A., Moond, V., Bassi, M., Santharaman, A., Peter, S., Robert, H., Johnson, W., & Brunswick, N. (2025). Exploring the role of tofacitinib in managing chronic pouchitis: A systematic review and meta-analysis ☆. *Digestive and Liver Disease*, 57(12), 2279–2285. <https://doi.org/10.1016/j.dld.2025.09.007>
- Hoyek, C., Arsalan, S., Naqvi, A., Sahvan, O., Jamal, F., Sufyan, K., Pirozzi, A., Pathak, S., Almader-douglas, D., Borad, M. J., Wu, C., Ahn, D. H., Bin, I., & Bekaii-saab, T. (2025). Evaluating third-line therapies in refractory metastatic colorectal cancer: a systematic review and network meta-analysis. *Digestive and Liver Disease*, 57(12), 2297–2303. <https://doi.org/10.1016/j.dld.2025.09.024>
- Khandelwal, V., Deshmukh, S., & Aurangabadi, K. (2024). Epidemiology and Associated Risk Factors of Gastritis in Patients at District General Hospital, Amravati. *International Journal of Health Sciences and Research*, 14(February), 93–100.
- Ko, E., Sket, R., Halu, A., Korou, B., Simi, P., Martinko, A., Morrison, S. A., Sori, M., Skrt, M., Jurak, G., Mo, M., & Re, T. (2026). Measuring biological age: Insights from omics studies. *Ageing Research Reviews*, 114(December 2025). <https://doi.org/10.1016/j.arr.2025.102988>
- Li, S., Craig, S., Mitchell, G., Thompson, G., Stark, P., Fitzsimons, D., & Creighton, L. (2025). Nurse-Led Strategies for Lifestyle Modification to Control Hypertension in Older Adults: A Scoping Review. *Nursing Reports*, 15(106).
- Lien, C., Lee, Y., Lu, C., Chang, Y., Lin, Y., Cheng, H., Chen, M. Y., Lee, L., & Huang, C. (2025). Medical Association Definition, prevalence, and economic impacts of hypertension on the elderly population. *Journal of the Formosan Medical Association*, 124(S1), S4–S9. <https://doi.org/10.1016/j.jfma.2025.02.020>
- Lin, T., Lu, Y., Chao, C., Lin, S., Wu, P., Chan, D., & Lee, H. (2025). Medical Association Comprehensive assessment and management of hypertension in elderly patients: Addressing frailty and target organ damage. *Journal of the Formosan Medical Association*, 124(S1), S17–S23. <https://doi.org/10.1016/j.jfma.2024.10.023>
- Mandolesi, D., Colecchia, L., Marasco, G., Bruni, A., Castellana, C., Mussomeli, E., Stanghellini, V., & Barbara, G. (2025). Epigastric pain syndrome overlaps with gastroesophageal reflux disease, while postprandial distress syndrome with esophageal disorders of gut-brain interaction. *Digestive and Liver Disease*, 57(12), 2362–2369. <https://doi.org/10.1016/j.dld.2025.10.008>
- Patel, H., Kyung, S., Fugar, S., Goldberg, A., Madan, N., & Williams, K. A. (2020). Hypertension in older adults: Assessment, management, and challenges. *Clinical Cardiology*, 43(May 2019), 99–107. <https://doi.org/10.1002/clc.23303>
- Peng, S., Song, X., Ma, X., Chen, Z., & Tian, S. (2025). *Metabolic-associated fatty liver disease and Colorectal Adenoma: A Cross-Sectional Study in a Metabolically Characterized Xinjiang*. 57, 2384–2389. <https://doi.org/10.1016/j.dld.2025.09.010>
- Slee, M. G., Scotney, J., Rainey-smith, S. R., Erickson, K. I., Sohrabi, H. R., Verdile, G., & Brown, B. M. (2026). Insulin resistance as a mediator of physical activity's effects on beta-amyloid accumulation and tau phosphorylation: A scoping review. *Ageing Research Reviews*, 114(August 2024), 102956.

<https://doi.org/10.1016/j.arr.2025.102956>

- Suralaga, C., & Usman, A. M. (2025). Unhealthy Mind , Unhealthy Gut : The Impact of Stress and Eating Patterns on Gastritis in Early Adolescents in Depok , Indonesia. *Malaysian Journal of Medical Research*, 9(June), 37–44.
- Terrin, M., Spadaccini, M., Poletti, V., Palma, C. De, Mercurio, M., Minini, F., Spertino, M., Colombo, M., Andreozzi, M., Bonifacio, C., Capretti, G., Elisa, R., Fugazza, A., Hassan, C., Repici, A., Zerbi, A., & Carrara, S. (2025). *Do all presumed BD-IPMNs require lifelong surveillance ? Clinical outcomes and implications of guidelines-based discontinuation*. 57, 2376–2383. <https://doi.org/10.1016/j.dld.2025.10.029>
- Tsai, H., Chuang, H., Liao, W., Wang, Y., Li, P., Wang, W., Liao, S., Yeh, C., Chen, P., Lai, T., Lin, H., Cheng, S., Chen, W., Lin, Y., & Chang, Y. (2025). Medical Association Lifestyle modifications and non-pharmacological management in elderly hypertension. *Journal of the Formosan Medical Association*, 124(S1), S32–S41. <https://doi.org/10.1016/j.jfma.2024.10.022>
- Ulpatakumbura, S., Kenric, S., Gunarathne, R., Zhiyong, J., Liu, J., Jin, X., Zhou, Q., & Lu, J. (2026). Comparison of anti-aging effect of PQQ (Pyrroloquinoline quinone) and NMN / NR (Nicotinamide mononucleotide / Nicotinamide riboside) – possible combination use. *Ageing Research Reviews*, 114(December 2025), 102992. <https://doi.org/10.1016/j.arr.2025.102992>
- Wang, J., Xu, Y., Zhang, T., Zheng, S., Luo, S., Ma, Y., Zhu, F., Zhou, C., & Gong, J. (2025). *Pouch function assessment with dynamic magnetic resonance defecography after ileal pouch anal anastomosis for ulcerative colitis*. 57, 2354–2361. <https://doi.org/10.1016/j.dld.2025.09.027>
- Wang, W., Kristina, V., Daniel, M., Mahadzir, A., & Britta, A. (2026). Multivitamin and mineral use : A rapid review of meta-analyses on health outcomes. *Ageing Research Reviews*, 114(October 2025), 102965. <https://doi.org/10.1016/j.arr.2025.102965>
- Zhao, D., Wang, J., Zhang, F., Wang, Q., & Zang, M. (2026). Cerebral glymphatic system : Structure , regulation , ageing , and mechanisms of encephalopathy. *Ageing Research Reviews*, 114(December 2025), 102986. <https://doi.org/10.1016/j.arr.2025.102986>
- Zhou, Z., Duan, H., Xue, S., & Li, Z. (2026). Progress in anti-ageing drug research for age-related diseases : A review. *Ageing Research Reviews*, 114(December 2025), 102982. <https://doi.org/10.1016/j.arr.2025.102982>