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Original Article

Evaluating Risk Profiles and Treatment Modalities for Hypertension: Factors Associated with Uncontrolled Blood Pressure at a Primary Health Center

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Abstract

Background: Hypertension remains a significant global health challenge, with approximately 31.1% adults worldwide suffering from it. In Indonesia, community health centers are at the forefront in controlling hypertension. However, the prevalence of hypertension in Indonesia remains high. Identification of risk factors and treatment-related issues is needed to predict uncontrolled hypertension. This study aimed to evaluate the relationships between various risk factors, adherence to therapeutic evaluation guidelines, and hypertension control status. Furthermore, this study examines factors associated with uncontrolled hypertension among patients at community health centers.

Methods: A cross-sectional analytic study involved 295 adult hypertensive patients from community health centers. Data included demographic characteristics, cardiovascular risk factors, lifestyle factors, hypertension risk classification, and therapy evaluation adherence based on established guidelines. Inadequate therapeutic evaluations include withholding combination therapy. Bivariate analyses (Pearson Chi-square and Mann-Whitney) were performed, followed by multivariate binary logistic regression to identify significant odds ratios.

Results: The prevalence of uncontrolled hypertension was 64.7%. In multivariate analysis, factors that increased the odds of uncontrolled hypertension were older age (aOR 1.082; 95% CI 1.042-1.124; p<0.001), higher hypertension risk classification (aOR 2.156; 95% CI 1.142-4.069; p=0.018), hypertension family history (aOR 2.925; 95% CI 1.409-6.072; p=0.004), and especially inadequate therapy (aOR 4.902; 95% CI 2.353-10.212; p<0.001). Conversely, salt restriction (aOR 0.352; 95% CI 0.179-0.694; p=0.002) was protective against uncontrolled hypertension. Other clinical factors (hypercholesterolemia, hyperuricemia, and diabetes mellitus) were not significant in the model.

Conclusions: Inadequate therapy, family history, risk classification, and age are significant factors associated with uncontrolled hypertension. Salt restriction was associated with lower odds of uncontrolled hypertension. Treatment concordance has the highest odds ratio. This demonstrates that the importance of community health centers extends beyond lifestyle change agents; guideline-based therapy monitoring is also crucial.

Keywords: Hypertension, Risk Factors, Primary Health Care, Cross-Sectional Study.

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Introduction

Hypertension is a major cardiovascular risk factor worldwide and a leading cause of death. The prevalence of hypertension remains high, and uncontrolled blood pressure substantially contributes to stroke, coronary heart disease, and chronic kidney disease. In low- and middle-income countries, awareness, proper treatment, and adherence to disease control remain low.[1] In the context of primary care in Indonesia, national guidelines emphasize the importance of early detection, risk assessment, and comprehensive blood pressure control in Primary Health Care (PHCs) facilities.[2-4]

There are many risk factors and comorbidities that contribute to increased blood pressure and failure of control. Diabetes mellitus often coexists with hypertension through the mechanisms of insulin resistance, sympathetic activation, and the Renin–Angiotensin–Aldosterone System (RAAS).[5] Obesity is strongly associated with hypertension through neurohumoral interactions and renal mechanisms.[6] Hyperuricemia is also associated with the risk of hypertension and endothelial dysfunction, although the causality of its treatment is still debated.[7-8]

In terms of management, patient compliance with long-term antihypertensive therapy is a key determinant of successful control. Global evidence shows that non-compliance is common and affects cardiovascular outcomes.[9] Indonesian national guidelines emphasize a promotive, preventive, curative, and rehabilitative approach that must be integrated into primary care practice. Often, the management of hypertensive patients in community health centers focuses too much on lifestyle modification, so that therapy control is frequently overlooked and far from evidence-based guidelines. These two major factors must be considered equally to achieve controlled blood pressure targets.[2-4]

Considering the challenges of blood pressure control in primary care and the heterogeneity of risk factors in the Indonesian population, this study aims to evaluate the risk profile and therapeutic assessment behaviors among hypertensive patients at community health centers and to identify factors associated with uncontrolled hypertension. The findings are expected to provide local evidence to strengthen the implementation of national guidelines and strategies for improving hypertension control at the primary care level.[1]

Methods

This cross-sectional retrospective study aims to evaluate the risk profile and therapeutic assessment behaviors among hypertensive patients at community health centers and to examine factors associated with uncontrolled hypertension. This study protocol is approved by the Ethics Committee of the Faculty of Medicine Universitas Sebelas Maret (201/UN27.06.11/KEP/EC/2025). This study complies with the Declaration of Helsinki.

We investigated all patients diagnosed with hypertension who had undergone regular check-ups at the Kaliwungu Community Health Center and met the inclusion criteria. 295 patient data points were collected from medical records between May 2024 and May 2025. The inclusion criteria were >18 years of age, diagnosed with hypertension or undergoing antihypertensive treatment, regularly visiting the health center, having complete data on risk factors and treatment, having been on a treatment regimen for >3 months, and registered in the Chronic Disease Management Program (*Program Pengelolaan Penyakit Kronis*/PROLANIS) with a Proportion of Days Covered (PDC) >80%.

The exclusion criteria were secondary hypertension, pregnancy, acute conditions associated with increased blood pressure, new therapy <3 months, incomplete data, and patients who did not undergo regular check-ups. Secondary hypertension was excluded based on clinical evaluation and available investigations documented in the medical records, including a history of endocrine or renal disease, abrupt onset of severe hypertension, and physical examination. We excluded hypertensive patients with secondary suspicion who were referred to a specialist.

In this study, we recorded patient demographic and lifestyle data, including age, family history of hypertension, risk classification (low, intermediate, high risk, very high risk), hypercholesterolemia, hyperuricemia, diabetes mellitus, smoking status, Body Mass Index (BMI), salt restriction, and regular physical activity. In addition to lifestyle factors, we also evaluated patients' medication data and divided it into two categories: adequate therapy and inadequate therapy. Adequate therapy status is achieved if patients meet national guidelines of using combination therapy. If a patient's treatment regimen does not include combination therapy, the patient is considered to have received inadequate therapy. The recorded patient outcomes are those with controlled and uncontrolled hypertension according to the guideline cutoff. In routine practice,

antihypertensive therapy is primarily monitored by general practitioners, with support from nurses. Follow-up visits are scheduled every month in accordance with the national hypertension guideline.

Data are expressed as numbers (percentages) or mean ± standard deviation (SD) and analyzed using SPSS version 22. Bivariate analysis was performed to assess the association between demographic, lifestyle, and therapy status data and uncontrolled hypertension. Numeric data were analyzed using Mann-Whitney, and categorical data using Pearson's chi-square. Furthermore, data with a P-value <0.20 were included in a multivariate logistic regression analysis to identify independent factors associated with uncontrolled hypertension.

Results

Baseline Characteristics

Baseline characteristics are shown in Table 1. A total of 295 patients were predominantly female (254; 86.1%) with a mean age of 52.9 ± 9.3 years. Risk factors in patients were not particularly dominant, with a prevalence of hypercholesterolemia in 103 (34.9%), hyperuricemia in 90 (30.5%), diabetes mellitus in 48 (16.3%), and a family history of hypertension in 116 (39.3%). However, more than half of the population was overweight (151; 51.2%). On the other hand, suboptimal lifestyle habits were observed in half of the population. Salt restriction was practiced by only 162 (54.9%) patients, and regular physical activity was practiced by only 150 (50.8%) patients. Meanwhile, the prevalence of active and passive smokers in this study was only 50 (16.9%) patients. Uncontrolled hypertension still occurs in a significant number of patients, namely 191 (64.7%) patients, with risk classification dominated by the intermediate risk group (143; 48.5%). Interestingly, nearly half of the population received inadequate treatment (119; 40.3%).

Table 1. Baseline characteristics of patients.

Variable	Mean ± SD
Sex	
Male [n(%)]	41 (13.9%)
Female [n(%)]	254 (86.1%)
Age	52.9 ± 9.3
Systolic blood pressure	147.4 ± 24.9
Diastolic blood pressure	85.7 ± 15.0
Heart rate	83.0 ± 12.2
Hypercholesterolemia [n(%)]	103 (34.9%)
Hyperurisemia [n(%)]	90 (30.5%)
Diabetes melitus [n(%)]	48 (16.3%)
Hypertension family history [n(%)]	116 (39.3%)
Body mass index	25.3 ± 4.5
Overweight [n(%)]	151 (51.2%)
Salt restriction [n(%)]	162 (54.9%)
Regular physical activity [n(%)]	150 (50.8%)
Smoker [n(%)]	50 (16.9%)
Alcohol consumption [n(%)]	0 (0%)
Hypertension risk classification	
Low risk [n(%)]	52 (17.6%)
Intermediate risk [n(%)]	143 (48.5%)
High risk [n(%)]	81 (27.4%)
Very high risk [n(%)]	19 (6.4%)
Inadequate therapy [n(%)]	119 (40.3%)
Uncontrolled hypertension	191 (64.7%)

Bivariate Analysis

Bivariate analysis was performed to assess the association between demographic, lifestyle, and therapy status data with uncontrolled hypertension, as shown in Table 2. Age (p<0.001), hypercholesterolemia (OR 3.512; 95% CI 1.979-6.233; p<0.001), hyperuricemia (OR 2.235; 95%

CI 1.274-3.923; p=0.005), diabetes mellitus (OR 5.753; 95% CI 2.202-15.030; p<0.001), family history of hypertension (OR 3.911; 95% CI 2.242-6.823; p<0.001), salt restriction (OR 0.302; 95% CI 0.180-0.507; p<0.001), regular physical activity (OR 0.424; 95% CI 0.259-0.695), hypertension risk classification (p<0.001), and inadequate therapy (OR 6.438; 95% CI 3.519-11.776; p<0.001) had a significant association with uncontrolled hypertension. Meanwhile, gender and BMI showed insignificant results.

Multivariate Analysis

Multivariate analysis was further conducted to determine which factors were independently associated with uncontrolled hypertension. The analysis is shown in Table 3. It can be seen that inadequate therapy (aOR 4.902; 95% CI 2.353-10.212; p<0.001), family history of hypertension (aOR 2.925; 95% CI 1.409-6.072; p=0.004), hypertension risk classification (aOR 2.156; 95% CI 1.142-4.069; p=0.018), and age (aOR 1.082; 95% CI 1.042-1.124; p<0.001) can be independently associated with higher odds of uncontrolled hypertension. A salt-restricted lifestyle (aOR 0.352; 95% CI 0.179-0.694; p=0.003) was independently associated with lower odds of uncontrolled hypertension. Meanwhile, diabetes mellitus, hypercholesterolemia, hyperuricemia, and regular physical activity did not show significant results (p>0.05). Figure 2 shows that the multivariate model had excellent discriminatory ability, with an Area Under the Curve (AUC) of 0.865 (95% CI, 0.824–0.906), and adequate calibration (Hosmer–Lemeshow p = 0.530).

Table 2. Bivariate association between demographic, lifestyle, and therapy status data with uncontrolled hypertension.

Variable	Controlled HT Mean ± SD	Uncontrolled HT Mean ± SD	P-value OR [95% CI]
Sex (male) [n(%)]	14 (4.7%)	27 (9.2%)	0.873 0.945 [0.472-1.893]
Age	49.0 ± 9.9	55.0 ± 8.3	<0.001
Hypercholesterolemia [n(%)]	19 (6.4%)	84 (28.5%)	<0.001 3.512 [1.979-6.233]
Hyperurisemia [n(%)]	21 (7.1%)	69 (23.4%)	0.005 2.235 [1.274-3.923]
Diabetes melitus [n(%)]	5 (1.7%)	43 (14.6%)	<0.001 5.753 [2.202-15.030]
Hypertension family history [n(%)]	21 (7.1%)	95 (32.2%)	<0.001 3.911 [2.242-6.823]
Body Mass Index (BMI)	25.3 ± 4.0	25.3 ± 4.7	0.830
Overweight [n(%)]	53 (18.0%)	98 (33.2%)	0.955 1.014 [0.629-1.635]
Salt restriction [n(%)]	76 (25.8%)	86 (29.2%)	<0.001 0.302 [0.180-0.507]
Regular physical activity [n(%)]	67 (22.7%)	83 (28.1%)	<0.001 0.424 [0.259-0.695]
Smoker [n(%)]	15 (5.1%)	35 (11.9%)	0.393 1.331 [0.689-2.572]
Hypertension risk classification			<0.001
Low risk [n(%)]	38 (10.1%)	18 (4.8%)	
Intermediate risk [n(%)]	47 (12.4%)	151 (39.9%)	
High risk [n(%)]	18 (4.8%)	87 (23.0%)	
Very high risk [n(%)]	1 (0.3%)	18 (4.8%)	
Inadequate therapy [n(%)]	16 (5.4%)	103 (34.9%)	<0.001 6.438 [3.519-11.776]

Table 3. Factors associated with uncontrolled hypertension: multivariate logistic regression analysis.

Variable	aOR	95% CI	P-value	VIF
Inadequate therapy	4.902	2.353-10.212	<0.001	1.197
Hypertension family history	2.925	1.409-6.072	0.004	1.168
Hypertension risk classification	2.156	1.142-4.069	0.018	2.551
Hypercholesterolemia	1.262	0.395-4.031	0.694	2.770
Diabetes mellitus	1.259	0.357–4.442	0.720	1.61
Hyperuricemia	1.240	0.409-3.763	0.704	2.191
Age (years)	1.082	1.042-1.124	<0.001	1.140
Regular physical activity	0.512	0.261–1.007	0.052	1.279
Salt restriction	0.352	0.179-0.694	0.003	1.238

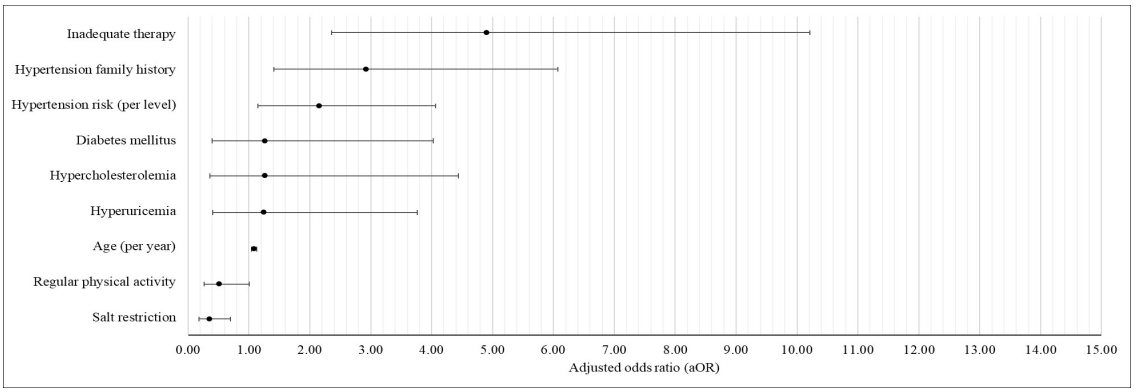

Figure 1. Factors associated with uncontrolled hypertension (forest plot).
Adjusted odds ratios (aOR) with 95% confidence intervals from the multivariable logistic regression model. Dots show aOR; horizontal lines show 95% CI. Values <1 indicate a protective association.

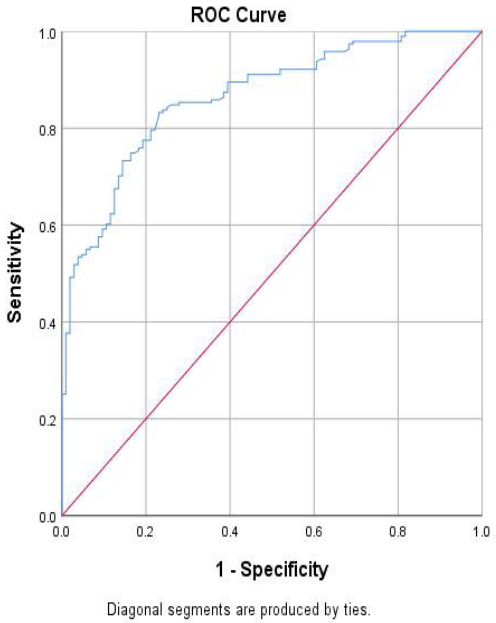

Figure 2. Multivariable model ROC curve.
Receiver operating characteristic curve of the final multivariable model associated with uncontrolled hypertension; AUC = 0.865 (95% CI 0.824–0.906); Hosmer–Lemeshow p = 0.530.

Discussion

This study shows that the prevalence of uncontrolled hypertension remains high (64.7%) in community health centers. Figure 1 shows that inadequate therapy emerges as the strongest association with uncontrolled hypertension, far ahead of other factors. Other factors, such as family history, higher risk classification, and older age, may also play a role as factors associated with uncontrolled hypertension. Conversely, a salt-restricted lifestyle has lower odds of uncontrolled hypertension. Metabolic risk factors (diabetes, hypercholesterolemia, hyperuricemia) and regular physical activity are not significant.

The magnitude of the effect of inadequate therapy (aOR 4.902) is consistent with a strong association between therapeutic inertia and the lack of guideline-based evaluation in the failure to control hypertension in patients. Various evidence from studies around the world shows the importance of medication adherence and persistence as one of the main factors in hypertension management.[9-10] This study evaluated patient medication adherence by the PDC, a metric of patient compliance in the timely retrieval of new prescriptions within a designated timeframe. PDC was determined by dividing the number of days covered by the filled prescription period by the total number of days in the month between the initial fill date and the end of the month. In this study, patients routinely took their medications for 30 days. Patients with a delay of ≥ 7 days had a PDC <80% and were therefore excluded.

Indonesian national guidelines recommend the use of combination therapy from the outset in a wider population, encouraging drug titration until the target is achieved, and refraining from reducing medication if the patient does not show adverse effects. The implementation of appropriate treatment algorithms, 1-3-month follow-up, and prescription evaluation has the potential to significantly reduce the proportion of patients with uncontrolled hypertension in community health centers.[2-4]

Several studies show that drug compliance and availability in PHCs in Indonesia face many challenges. Only 13 of 60 essential medicines are available in >90% of PHCs. Meanwhile, one-third of essential medicines are only available in <30% of PHCs. The unavailability of these medicines is mostly due to the reason "not needed" (46%). Meanwhile, 38% is due to the insufficient supply of drugs to PHCs. The report shows that Cardiovascular Disease (CVD) drugs are not fully available, so combination therapy and drug switching strategies in case of side effects can be a challenge for PHCs. It is suspected that many factors influence drug availability, namely geographical issues, supply chain management, and procurement practices.[12-13] In addition to availability, the fact that drug unavailability is dominated by the reason "not needed" emphasizes the need for education for PHC drivers regarding guideline-appropriate treatment. This needs to be noted because sometimes "not needed" can mean "unaware that we need it."

The finding that family history is one of the associated factors of the difficulty of controlling hypertension is in line with the same genetic and environmental theory. A family history of hypertension has been shown to increase the prevalence of hypertension at age 50. In addition to genetics, epigenetic changes play a major role in familial increases in blood pressure. This is triggered by similar behavioral patterns within families, such as diet, food preferences, and physical activity.[14-15] Meanwhile, hypertension risk classification and age as significant associated factors confirm the pathophysiological mechanisms related to RAAS activation and changes in vascular status with increasing age.[16]

Salt restriction remains protective after multivariate analysis, supporting the 2023 Indonesian Society of Hypertension (InaSH) consensus on promotive-preventive pillars. However, in practice, only about half of patients adhere to these measures. Repeated education, goal-based counseling, family involvement, and the formation of cadres that encourage lifestyle changes at the neighborhood level need to be prioritized alongside intensified pharmacotherapy.[4]

The insignificance of diabetes, hypercholesterolemia, hyperuricemia, smoking, regular physical activity, and overweight association does not necessarily eliminate these risk factors in terms of complicating hypertension management. This is likely only illustrated when all risk factors are combined and presented as a hypertension risk classification. This is supported by the fact that when all risk factors are combined, the hypertension risk classification can become one of the main associated factors.

The multivariate model results show excellent discriminative ability, with an AUC of 0.865 (95% CI, 0.824–0.906), and adequate calibration (Hosmer–Lemeshow p = 0.530). The results of this study are useful for mapping modifiable factors, especially in the therapeutic process. Researchers understand how community health centers are encouraged in

the promotive and preventive fields. Even so, this study opens our eyes to the fact that community health centers are not only agents of change in the lifestyles of hypertensive patients but also provide comprehensive pharmacological treatment and adhere to guidelines before complex hypertension occurs.

However, this study has several important limitations. First, its single-center, cross-sectional retrospective design precludes any inference about temporal or causal relationships. Second, we assessed patient medication adherence solely from the PDC factor. This is susceptible to bias because we could not directly assess whether patients were actually taking their medications. Patients often came in on schedule due to the overlap with the monthly PROLANIS program, which could affect the validity of the PDC assessment results. Furthermore, we did not analyze actual PDC data. This presents an opportunity for further research to assess patient medication adherence in the analysis of uncontrolled hypertension. Third, we are unable to conduct a comprehensive assessment to validate the secondary hypertension. Finally, the high number of patients receiving inadequate therapy offers an opportunity for further research into the causes of this situation.

Conclusion

Inadequate therapy, family history, risk classification, and age are significant factors associated with uncontrolled hypertension. Salt restriction was protective against uncontrolled hypertension. Treatment concordance has the strongest associated factor. This demonstrates that the importance of community health centers extends beyond lifestyle change agents; monitoring of guideline-based therapy is also crucial.

List of Abbreviations

AUC	Area Under the Curve
BMI	Body Mass Index
CVD	Cardiovascular Disease
InaSH	Indonesian Society of Hypertension
PDC	Proportion of Days Covered
PHCs	Primary Health Care
PROLANIS	Chronic Disease Management Program
RAAS	Renin–Angiotensin–Aldosterone System

Ethical Clearance

Ethical approval was obtained the Ethics Committee of the Faculty of Medicine Universitas Sebelas Maret (201/UN27.06.11/KEP/EC/2025).

Publication Approval

The authors consent to the publication of this manuscript.

Authors' Contributions

ALA: Conceptualization, methodology, data collection, data analysis and interpretation, and writing of the original draft; RB: Conceptualization, methodology, data collection, and critical revision of the manuscript; NBFP: Methodology, data collection, and critical revision of the manuscript; NC: Data collection, data validation, supervision, and critical revision of the manuscript. All authors reviewed and approved the final version of the manuscript and agreed to be accountable for all aspects of the work.

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Conflict of Interest

None.

Availability of Data and Materials

Not applicable.

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Copyright/Permissions for Figures

Not applicable.

Generative AI and AI-Assisted Technologies in the Writing Process

Authors acknowledge that artificial intelligence (AI) tools were only used to assist in language editing and did not generate or alter the scientific content, analyses, or conclusions presented in this manuscript.

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