

Determinants of Blood Pressure Stability in Hypertensive Patients on Quality of Life

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Abstract: Hypertension is a global health problem with an increasing prevalence that impacts the quality of life of patients. This study aims to analyze the determinants of blood pressure stability and quality of life in hypertensive patients through a comprehensive multivariate approach. A *cross-sectional* design with a quantitative analytical approach was applied to 251 hypertensive patients undergoing routine treatment at primary health care facilities. Data collection used a validated standardized questionnaire to measure medication adherence, diet, physical activity, psychological stress levels, family social support, blood pressure stability, and quality of life. Data analysis included *Chi-Square* tests, Spearman's correlation, multiple linear regression, and multinomial logistic regression. The results showed that all independent variables had a significant relationship with blood pressure stability and quality of life. Diet showed the strongest correlation with blood pressure stability, while physical activity was the dominant predictor of blood pressure stability and quality of life. The regression model produced a coefficient of determination of 87.9% for blood pressure stability and 83.3% for quality of life, with classification accuracy reaching 95.2% and 96.4%, respectively. The findings indicate the importance of holistic interventions that integrate lifestyle modification, stress management, and strengthening social support in optimizing hypertension management to improve blood pressure stability and quality of life in patients.

Keywords: Blood Pressure Stability; Health Determinants; Hypertension; Multivariate Analysis; Quality of Life

Introduction

Hypertension is one of the cardiovascular diseases that has become a global health problem with a prevalence that continues to increase every year. The World Health Organization (WHO) notes that more than 1.28 billion adults aged 30-79 years worldwide suffer from hypertension, and this number is projected to continue to increase, reaching 1.56 billion cases by 2025 (Unger et al., 2020). In Indonesia, based on data from the 2018 Basic Health Research (Riskesdas), the prevalence of hypertension among people aged ≥ 18 years reached 34.1%, and this figure shows an increasing trend compared to previous years. This condition poses a serious challenge to the national health care system because uncontrolled hypertension can lead to serious complications such as stroke, coronary heart disease,

heart failure, and kidney dysfunction, which ultimately impact patients' quality of life.

Blood pressure stability is a key indicator of successful hypertension management, directly influencing patient prognosis and quality of life. Research shows that patients with unstable blood pressure have a 2-3 times higher risk of major cardiovascular events compared to patients with well-controlled blood pressure (Sakboonyarat et al., 2019). The quality of life (QOL) of hypertensive patients is not only determined by physical condition alone, but is also influenced by complex and interrelated psychological, social, and environmental aspects (Shah et al., 2020; Uchmanowicz et al., 2019). Recent studies indicate that hypertensive patients with stable blood pressure tend to have significantly higher QOL scores in the domains of physical health, psychological well-being, social

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relationships, and satisfaction with their living environment (Crepaldi et al., 2024; Saini et al., 2022).

Various factors are known to contribute to blood pressure stability in hypertensive patients. Adherence to antihypertensive medication regimens is a fundamental factor that often poses a challenge in clinical practice (Hamrahian et al., 2022). Data show that non-adherence to antihypertensive medication rates range from 40-60% in various countries, significantly contributing to blood pressure control failure (Burnier & Egan, 2019). Regular physical activity has been shown to lower systolic blood pressure by 5-8 mmHg and diastolic blood pressure by 3-6 mmHg through improved endothelial function, decreased peripheral vascular resistance, and modulation of the autonomic nervous system (Manungkalit et al., 2017; Yulianti & Aminah, 2022).

Psychosocial factors such as stress and social support also play an important but often overlooked role in hypertension management. Chronic psychological stress can activate the sympathetic nervous system and the hypothalamic-pituitary-adrenal axis, leading to increased blood pressure through the release of cortisol and catecholamine hormones (Zabixullaevich et al., 2025). Conversely, adequate social and family support has been shown to improve medication adherence, reduce stress levels, and improve clinical outcomes in hypertensive patients through the development of positive health behaviors (Win et al., 2025).

Previous studies have mostly examined the influence of individual factors on blood pressure control or quality of life separately, but few have integrated a comprehensive analysis of multiple determinants simultaneously. This study offers novelty in analyzing the simultaneous influence of five key determinants (adherence, medication, diet, physical activity, psychological stress, and social support) on blood pressure stability and quality of life in hypertensive patients using a comprehensive multivariate approach. This integrative approach provides an in-depth understanding of the mechanisms by which these factors interact to influence patient health outcomes. The uniqueness of this study lies in the use of multiple linear regression analysis and multinomial logistic regression, which are able to identify patterns of relationships and the relative contribution of each predictor with a high level of predictive accuracy (Zhou et al., 2021).

The identified research gaps indicate that although the literature has documented the individual roles of various factors in hypertension, there is still limited research exploring the relative contributions and synergistic interactions between factors within the context of Indonesian culture and health systems. Unique findings from preliminary studies indicate inconsistent patterns of association between some

determinants and outcomes, with family social support exhibiting varying effects on blood pressure stability, while diet has a different impact on quality of life compared to blood pressure stability. This phenomenon indicates the complexity of mechanisms that are not yet fully understood and require further exploration. This study fills this gap by using comprehensive multivariate analysis to identify the dominant determinants that contribute most to blood pressure stability and quality of life in hypertensive patients. It also evaluates the predictive power of a model based on five health behavior determinants in an Indonesian population, considering demographic, socioeconomic characteristics, and duration of hypertension as contextual factors.

Based on the above background, the study aims to analyze the determinants of blood pressure stability and quality of life in hypertensive patients and to identify the relative contribution of each predictor factor in the multivariate model. This research is expected to provide theoretical benefits in enriching a comprehensive understanding of the various determinants of blood pressure stability and its impact on the quality of life of hypertensive patients through an integrative approach. Practically, the results of this study can be the basis for developing holistic, evidence-based intervention programs to improve blood pressure stability and quality of life in hypertensive patients. For health policymakers, the findings of this study can be used as a reference in formulating comprehensive strategies for controlling hypertension that not only focus on pharmacological aspects but also integrate lifestyle modification, stress management, and strengthening social support systems as an integral part of primary and secondary health care.

Method

Research design

This study used a *cross-sectional* design with a quantitative analytical approach to identify the determinants of blood pressure stability and its effect on the quality of life of hypertensive patients. This design was chosen based on its ability to measure variables simultaneously at a given time, making it efficient for analyzing multivariate relationships between complex variables. The study population consisted of all hypertensive patients who were registered and undergoing routine treatment at primary health care facilities. The sampling technique used *purposive sampling* with inclusion criteria including patients aged at least 30 years, diagnosed with hypertension by medical personnel, undergoing antihypertensive therapy for at least three months, and willing to participate by signing a consent form. Exclusion criteria

included patients with acute cardiovascular complications, severe cognitive impairment, and those undergoing intensive care (Singh et al., 2017). A total of 251 respondents met the criteria and participated in this study, with a data completeness rate of 100% and no missing data.

Research instruments

The research instruments consisted of standardized questionnaires that had undergone cross-cultural adaptation and validation in the Indonesian population. Medication adherence was measured using an adaptation of the *Morisky Medication Adherence Scale* with five statement items and Cronbach Alpha reliability above 0.70 (Liu et al., 2017). Dietary patterns were assessed using a modified *Food Frequency Questionnaire* focusing on sodium and fat intake with five validated items. Physical activity was evaluated using a short version of the *International Physical Activity Questionnaire* with five items validated for the Asian population. Psychological stress levels were measured using the Indonesian version of the *Perceived Stress Scale-10* with five selected items, while family social support was assessed using an adaptation of the five-item *Social Support Questionnaire*. Blood pressure stability was evaluated based on objective measurements using a digital sphygmomanometer and a five-item structured questionnaire following the *American Heart Association* protocol (Zhang et al., 2016). Quality of life was measured using the Indonesian version of the *World Health Organization Quality of Life-BREF* with five representative items covering the physical, psychological, social, and environmental domains. All

instruments used a one-to-five Likert scale with dichotomous categorization into moderate and high based on the analysis of the research data distribution.

Research instruments

Data analysis was conducted in stages using statistical software. Univariate analysis described the frequency distribution and percentage for each research variable. Bivariate analysis used the *Chi-Square* test to examine the relationship between independent variables and blood pressure stability and quality of life, followed by Pearson and Spearman correlation tests to identify the strength and direction of the relationship with significance set at alpha 0.05. Multivariate analysis applied multiple linear regression to identify the dominant determinants of blood pressure stability and quality of life with evaluation of the R-Square coefficient of determination and F test for model fit. Multinomial logistic regression analysis was used to model the probability of blood pressure stability and quality of life categories based on a combination of five predictor variables, with *goodness of fit* evaluation using Cox and Snell, Nagelkerke, and McFadden Pseudo R-Square and classification accuracy. Classical assumption tests included testing for residual normality using *Kolmogorov-Smirnov* with Monte Carlo simulation, testing for multicollinearity with *Variance Inflation Factor* and *Tolerance*, and evaluating heteroscedasticity to ensure the validity of the regression model. The study obtained ethical approval from the authorized health research ethics committee, and all respondents provided written *informed consent* before the data collection process was carried out in accordance with research ethics principles.

Table 1. Operationalization of Research Variables

Variable	Operational Definition	Instrument	Number of Items	Scale	Categories
Medication Adherence (X1)	Consistency of patients in taking antihypertensive medication according to the recommended dosage and schedule	Adaptation of MMAS-8	5 items	Likert 1-5	Moderate; High
Diet (X2)	Frequency of consumption of foods high in sodium and fat within a certain period	FFQ modification	5 items	Likert 1-5	Moderate; High
Physical Activity (X3)	Frequency and duration of physical activity within a specific period of time	IPAQ-Short	5 items	Likert 1-5	Moderate; High
Level of Psychological Stress (X4)	Perception of emotional pressure and ability to manage stress	PSS-10 Indonesia	5 items	Likert 1-5	Moderate; High
Family Social Support (X5)	Perception of emotional and instrumental support from family	SSQ Adaptation	5 items	Likert 1-5	Moderate; High
Blood Pressure Stability (Y1)	Consistency of blood pressure values within the target range based on objective measurements and perception	Blood Pressure Measurement + Questionnaire	5 items	Likert 1-5	Moderate; High
Quality of Life (Y2)	Perception of physical, psychological, social, and environmental well-being	WHOQOL-BREF Indonesia	5 items	Likert 1-5	Moderate; High

Note: MMAS-8 = Morisky Medication Adherence Scale-8; FFQ = Food Frequency Questionnaire; IPAQ = International Physical Activity Questionnaire; PSS-10 = Perceived Stress Scale-10; SSQ = Social Support Questionnaire; WHOQOL-BREF = World Health Organization Quality of Life-Brief; BP = Blood Pressure

Results and Discussion

Results

Relationship Between Determinants and Blood Pressure Stability in Hypertensive Patients

The study involved 251 hypertensive patients with complete data and no *missing values*. The distribution of variables showed that the majority of respondents had high medication adherence (85.7%), good eating habits (78.1%), adequate physical activity (73.7%), strong family social support (79.7%), and high blood pressure stability (74.1%). Bivariate analysis using the *Chi-Square* test showed that all independent variables had a

significant relationship with blood pressure stability ($p < 0.001$). Diet showed the strongest relationship ($\chi^2 = 182.253$; $r = 0.852$), followed by physical activity ($\chi^2 = 179.268$; $r = 0.845$), family social support ($\chi^2 = 173.589$; $r = 0.832$), psychological stress levels ($\chi^2 = 96.445$; $r = 0.620$), and medication adherence ($\chi^2 = 86.903$; $r = 0.588$). Multiple linear regression model identified dominant determinants with $R^2 = 0.879$ ($F = 355.330$; $p < 0.001$). Physical activity was the strongest predictor ($\beta = 0.283$; $t = 5.264$; $p < 0.001$), followed by psychological stress levels ($\beta = 0.269$; $t = 7.217$; $p < 0.001$), dietary patterns ($\beta = 0.244$; $t = 3.694$; $p < 0.001$), and medication adherence ($\beta = 0.211$; $t = 4.595$; $p < 0.001$).

Table 2. Relationship between Determinants and Blood Pressure Stability and Quality of Life

Variable	Blood Pressure Stability (Y1)		KH (Y2)	
	R	Sig.	r	Sig.
Medication Adherence (X1)	0.588**	<0.001	0.585**	<0.001
Dietary Patterns (X2)	0.852**	<0.001	0.829**	<0.001
Physical Activity (X3)	0.845**	<0.001	0.875**	<0.001
Stress Level (X4)	0.620**	<0.001	0.617**	<0.001
Social Support (X5)	0.832**	<0.001	0.851**	<0.001

Note: ** Spearman's correlation is significant at the 0.01 level (2-tailed)

The Influence of Determinants on the Quality of Life of Hypertensive Patients

The distribution of quality of life showed that 76.9% of respondents were in the high category. Correlation analysis indicated that physical activity had the strongest correlation ($r = 0.875$; $p < 0.001$), followed by family social support ($r = 0.851$; $p < 0.001$), and diet ($r = 0.829$; $p < 0.001$). The linear regression model produced $R^2 = 0.833$ ($F = 244.068$; $p < 0.001$). Physical activity showed the largest contribution ($\beta = 0.411$; $t = 6.508$; $p < 0.001$), followed by family social support ($\beta = 0.287$; $t = 4.391$; $p < 0.001$), medication adherence ($\beta = 0.133$; $t = 2.466$; $p = 0.014$), and psychological stress level ($\beta = 0.112$; $t = 2.556$; $p = 0.011$). Diet had no significant direct effect ($\beta = 0.039$; $p = 0.613$).

Table 3. Regression Model of Determinants of Blood Pressure Stability and Quality of Life

Variable	Blood Pressure Stability		Quality of Life	
	Beta	Sig.	Beta	Sig.
Medication Adherence	0.211	<0.001	0.133	0.014
Diet	0.244	<0.001	0.039	0.613
Physical Activity	0.283	<0.001	0.411	<0.001
Stress Level	0.269	<0.001	0.112	0.011
Social Support	0.019	0.734	0.287	<0.001
R ²	0.879		0.833	

Model Validation and Prediction Accuracy

The Kolmogorov-Smirnov normality test with Monte Carlo simulation showed deviation from normal distribution ($p < 0.001$), but with a sample of 251 respondents, the normality assumption could be relaxed based on the central limit theorem.

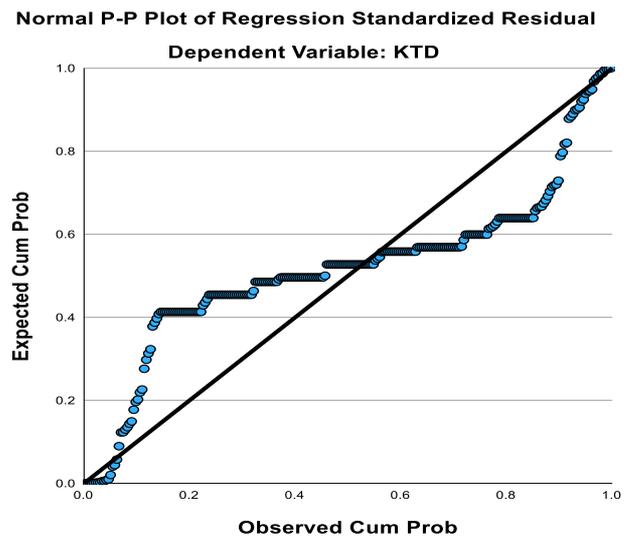


Figure 1. Normal P-P Plot of Regression Standardized Residual for Blood Pressure Stability Model.

The graph shows the distribution of standardized residuals with a diagonal line, indicating a normal distribution trend despite minor deviations at extreme values.

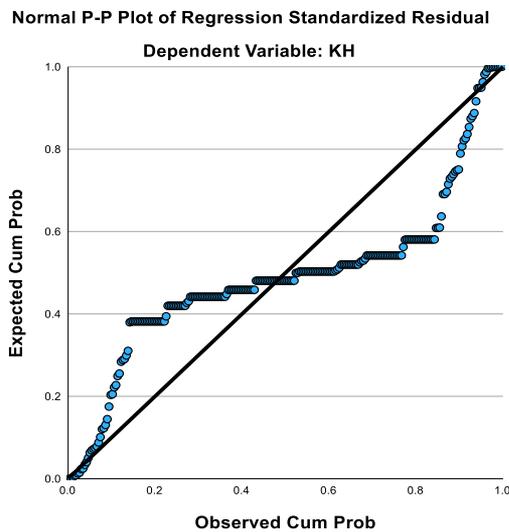


Figure 2. Normal P-P Plot of Regression Standardized Residuals for the Quality-of-Life Model.

The residual distribution shows a pattern similar to the blood pressure stability model, with the majority of observations following the diagonal line of normality. The multicollinearity test shows VIF ranging from 2.801 to 8.855, which is still within the tolerance limit. Multinomial logistic regression confirmed classification accuracy of 95.2% for blood pressure stability and 96.4% for quality of life, with Nagelkerke's *Pseudo R-Square* of 0.857 and 0.891, demonstrating the model's excellent predictive capacity.

Discussion

Relationship Between Determinants and Blood Pressure Stability in Hypertensive Patients

The study findings indicate that all independent variables have a significant relationship with blood pressure stability in hypertensive patients. Diet shows the strongest correlation ($r=0.852$; $p<0.001$), indicating that excessive consumption of foods high in sodium and fat contributes substantially to blood pressure fluctuations. The physiological mechanism explains that excess sodium intake causes fluid retention and increased blood volume, which triggers an elevation in arterial pressure, while saturated fat contributes to vascular endothelial dysfunction that interferes with blood pressure regulation. Research in Ethiopia confirms that non-compliance with weight management increases the risk of uncontrolled blood pressure by 2.02 times, where obesity triggered by unhealthy food intake and inappropriate use of traditional medicine are significant determinants with an *adjusted odds ratio* of 9.13 for the use of non-standardized alternative medications (Thi et al., 2025).

Physical activity ranked second with a very strong correlation ($r=0.845$; $p<0.001$) with blood pressure

stability, indicating that regular physical exercise plays a fundamental role in modulating arterial pressure through various physiological mechanisms. Patients who engage in adequate physical activity experience reduced activation of the sympathetic nervous system and modulation of the renin-angiotensin-aldosterone system, resulting in sustained antihypertensive effects. A study in Bandung identified a significant correlation between stress levels and the quality of life of hypertensive patients ($p=0.01$), where chronic psychological stress activates the hypothalamic-pituitary-adrenal axis, releasing cortisol and catecholamines, hormones that increase myocardial contractility and peripheral vasoconstriction. Therefore, stress management through physical activity is an effective strategy to improve hemodynamic stability and the holistic well-being of patients (Ratnawati, 2023).

Family social support showed a strong correlation ($r=0.832$; $p<0.001$) with blood pressure stability, indicating that the presence of an emotional and instrumental support system from the family facilitates adherence to therapeutic regimens and sustainable lifestyle modifications. Medication adherence showed the lowest but still significant correlation ($r=0.588$; $p<0.001$), consistent with findings that productive age has a substantial impact on the quality of life of hypertensive patients by a factor of 8.902, where younger patients tend to have more complex adherence challenges due to demanding work and social activities, thus requiring more comprehensive management strategies tailored to specific demographic characteristics to optimize therapeutic outcomes and prevent long-term complications (Gultom & Batubara, 2024).

Multiple linear regression identified physical activity as the dominant predictor ($\beta=0.283$; $p<0.001$) of blood pressure stability, followed by psychological stress levels ($\beta=0.269$; $p<0.001$), dietary patterns ($\beta=0.244$; $p<0.001$), and medication adherence ($\beta=0.211$; $p<0.001$). The coefficient of determination $R^2=0.879$ indicates that 87.9% of the variability in blood pressure stability can be explained by the combination of the five predictor variables, indicating the model's very high predictive power. A study in India confirmed that overall quality of life and general health scores were significantly lower in hypertensive patients compared to healthy subjects, with factors such as low educational status, occupation as a housewife, low socioeconomic class, and the presence of comorbidities being significantly associated with poor quality of life, emphasizing the importance of a multifactorial approach in hypertension management that not only focuses on blood pressure control but also considers social determinants of health (Hasna et al., 2023; Patil et al., 2023).

The complex interaction between health behavior determinants shows that a multifactorial approach is key to the success of long-term hypertension management. High blood pressure variability is an independent predictor of major cardiovascular events, including ischemic and hemorrhagic stroke, acute myocardial infarction, and congestive heart failure, which can significantly reduce patient life expectancy and productivity (Stevens et al., 2016). Optimal blood pressure stability does not depend solely on pharmacological monotherapy but requires synergy between drug interventions and comprehensive lifestyle modifications that include optimizing nutritional intake, increasing structured physical activity, managing psychosocial stress, and strengthening a sustainable family support system (Elendu et al., 2024; Wei, 2024).

Bivariate analysis using the *Chi-Square* test revealed varying strengths of association among determinants, indicating that each factor contributes specifically to blood pressure regulation mechanisms. The dietary pattern with the highest correlation emphasizes the urgency of intensive nutrition education, particularly limiting sodium intake to below 2000 mg per day and reducing saturated fat consumption through substitution with polyunsaturated fatty acids, which have a cardioprotective effect. At least 150 minutes per week of moderate-intensity physical activity has been shown to lower systolic and diastolic blood pressure through mechanisms of endothelium-mediated *nitric oxide* release-mediated vasodilation, decreased systemic vascular resistance, and improved insulin sensitivity that reduces sympathetic nervous system activation. Family social support plays a role in increasing patients' *self-efficacy* to make health behavior changes, providing consistent external motivation, and creating an environment conducive to the implementation of effective and sustainable hypertension management strategies in patients' daily lives (Bahari et al., 2019; Wu et al., 2025).

The Influence of Determinants on the Quality of Life of Hypertensive Patients

Physical activity showed the strongest influence on quality of life ($\beta=0.411$; $p<0.001$), confirming that regular physical exercise not only improves physiological parameters such as cardiorespiratory capacity and metabolic function, but also comprehensively enhances psychological well-being, social functioning, and satisfaction with the living environment. Research in North Sumatra identified ten factors significantly associated with the quality of life of hypertensive patients, including stress, self-efficacy, family support, regularity of antihypertensive medication consumption, blood pressure, body mass index, salt intake, physical activity, blood pressure checks, and comorbidities,

indicating the complexity of interactions between biomedical, behavioral, and psychosocial factors in influencing patients' perceptions of well-being, which requires an integrated intervention approach through a comprehensive health care system (Prastika, 2021).

Family social support shows a substantial influence ($\beta=0.287$; $p<0.001$) on quality of life, in line with findings that family support is a protective factor that facilitates treatment adherence, reduces psychological burden, and increases patient resilience in facing the challenges of chronic disease management. A study of elderly hypertensive patients in Semarang identified that employment status, comorbidity, physical activity, and treatment adherence were significantly associated with quality of life, with employment status being the most influential factor with a prevalence ratio of 4.933, followed by comorbidity with a prevalence ratio of 4.304, and medication adherence with a prevalence ratio of 3.619, indicating that contextual factors such as socioeconomic status and comorbid health conditions have a significant impact on perceptions of quality of life that must be considered in planning holistic interventions (Habtegiorgis et al., 2024).

Medication adherence showed a significant but moderate effect ($\beta=0.133$; $p=0.014$) on quality of life, indicating that consistency in pharmacological therapy contributes to the prevention of complications and maintenance of optimal health function, although its effect on subjective well-being is more limited than behavioral and psychosocial factors. Psychological stress levels had a significant effect ($\beta=0.112$; $p=0.011$), consistent with evidence that physical activity characteristics, family history, and obesity status have the greatest influence on the quality of life of elderly people with hypertension, where increased physical activity contributes to obesity prevention and psychological stress reduction, which in turn improves physical, psychological, and social functioning simultaneously, emphasizing the importance of comprehensive lifestyle interventions that integrate weight management, structured exercise programs, and stress management techniques (Bhagat et al., 2024).

Interestingly, the findings show that diet has no significant direct effect on quality of life ($\beta=0.039$; $p=0.613$), in contrast to its strong effect on blood pressure stability. This phenomenon indicates that the impact of diet on quality of life is mediated through blood pressure stability and the prevention of complications, rather than a direct effect on patients' subjective perception of well-being. Research in Vietnam confirms that younger age, moderate to high economic status, and engagement in regular physical activity are positively associated with higher quality of life scores in the physical, psychological, and environmental domains, while living in rural areas and the presence of

comorbid conditions are negatively associated with quality of life, emphasizing the need for targeted and context-specific interventions aimed at improving the quality of life of individuals living with hypertension through approaches that consider geographical factors and accessibility to health services (Ainiyah et al., 2024).

The dominance of physical activity as the strongest predictor of quality of life reflects the multidimensional impact of regular exercise on the holistic well-being of hypertensive patients. The benefits of physical activity extend beyond improvements in hemodynamic parameters, including increased functional capacity that facilitates independence in daily activities, reduction of chronic fatigue symptoms that often interfere with productivity, and stimulation of endorphin release that produces natural analgesic effects and mood improvement contributing to optimal mental health. Structured exercise programs combining aerobic activity, resistance training, and flexibility exercises have been shown to improve sleep quality, reduce anxiety and depression, and improve cognitive function, which is often impaired in hypertensive patients with suboptimal blood pressure control.

The substantial influence of family social support underscores the importance of a family-based approach in hypertension management. The family functions as *the primary support system* that provides instrumental assistance in home blood pressure monitoring, medication reminders, accompaniment to medical visits, and emotional support that reduces the perceived burden of illness. Family-based interventions involving joint education, therapeutic communication skills training, and the formation of collective agreements on family dietary modifications have been shown to improve long-term compliance and significantly improve clinical *outcomes*. The absence of a direct effect of diet on quality of life indicates that perceptions of well-being are more influenced by functional capacity, psychological conditions, and social interactions than dietary aspects alone, although optimal nutrition remains essential for preventing complications and maintaining hemodynamic stability, which is the foundation of long-term health for hypertensive patients.

Conclusion

This study identified multiple determinants that influence blood pressure stability and quality of life in hypertensive patients through a comprehensive multivariate approach. The findings show that the five independent variables, namely medication adherence, dietary patterns, physical activity, psychological stress levels, and family social support, have a significant relationship with blood pressure stability in

hypertensive patients. Diet showed the strongest correlation with blood pressure stability, followed by physical activity and family social support, indicating that lifestyle modifications play a fundamental role in hypertension management. The multiple linear regression model revealed that physical activity was the dominant predictor of blood pressure stability with the highest contribution, followed by psychological stress levels, diet, and medication adherence. The coefficient of determination of 87.9% demonstrates the model's excellent predictive power in explaining the variability of blood pressure stability. Regarding quality of life, physical activity showed the strongest influence, followed by family social support, medication adherence, and psychological stress levels. An interesting phenomenon was found that dietary patterns did not have a significant direct effect on quality of life, indicating that their impact was mediated through blood pressure stability. Model validation using multinomial logistic regression resulted in very high classification accuracy of 95.2% for blood pressure stability and 96.4% for quality of life, confirming the model's excellent predictive capacity in the Indonesian population.

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Author Contributions

Conceptualization, D.M. and S.S.; methodology, D.M., S.S., and S.S.; resources, D.M.; writing – original draft preparation, D.M., S.S., and S.S.; writing – review and editing, D.M., S.S., and S.S. All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest

The authors declare that they have no competing interests.

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