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A STRUCTURAL EQUATION MODEL OF QUALITY-OF-LIFE DETERMINANTS

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ABSTRACT

Hypertension is a growing global health challenge, affecting about 51.3 million adults in Indonesia as of 2019. In urban areas like Babakan Ciparay, Bandung, it remains a leading cause of mortality among the elderly. Despite its prevalence, effective management of hypertension and its impact on quality of life (QoL) in this demographic are not well understood. This study examines the relationships between demographic factors (age, gender), clinical status (hypertension stage), and behavioral components (physical activity, self-management) in predicting the QoL of elderly hypertension patients. A quantitative cross-sectional study was conducted with 62 elderly participants at the Caringin Community Health Elderly Clinic in Bandung. Data were collected using the Physical Activities Scale for Elderly (PASE), Hypertension Self-Management Behavior (HSMBQ) and SF36 Quality of Life questionnaires, all of which exhibited strong reliability, with coefficients generally surpassing 0,70 across various international and Indonesian pilot tests. Additionally, the instruments demonstrated robust validity through consistent item-total correlation scores and convergent validity values $\geqslant$ 0,4. Analysis was performed using Partial Least Squares Structural Equation Modeling (PLS-SEM) and Importance-Performance Map Analysis (IPMA). The measurement model showed high reliability and validity. Structural analysis revealed that gender is a primary determinant of self-management, with a large effect size ($f2=0.503$) and a strong negative path coefficient ($\beta=-0.580$, $p<0.001$). Notably, physical activity had a significant negative impact on quality of life ($\beta=-0.285$, $p=0.024$), suggesting that high-exertion activity may reduce perceived well-being in this high-risk group. IPMA identified gender as critical for immediate intervention due to its high importance but low performance. The findings underscore a significant disconnect between clinical adherence and subjective well-being. Effective hypertension management in the elderly requires tailored, gender-specific interventions and personalized physical activity programs prioritizing psychosocial support and functional independence over strict biomedical metrics.

Keywords: elderly; hypertension; IPMA; PLS-SEM; quality of life; self- management

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INTRODUCTION

Globally, the burden of hypertension has escalated dramatically over recent decades. The number of people affected nearly doubled from 650 million in 1990 to 1.3 billion in 2019, reflecting changes in lifestyle, urbanization, and aging populations. This global trend is mirrored in Indonesia, where hypertension represents a significant public health challenge. In 2019, hypertension-related deaths in Indonesia reached approximately 1.8 million, underscoring the severe impact of this condition on population health (Ainy et al., 2022; Imam & Jitpanya, 2022; Sudharsanan & Geldsetzer, 2019). Indonesia's population, which is approximately 269.6 million, includes a significant number of adults between the ages of 30 and 79, with 51.3 million of them identified as having hypertension. Despite the widespread occurrence of this condition, hypertension management is still insufficient. Alarmingly, only around 4% of those with hypertension in this age bracket have managed to control their blood pressure, and just one-third have been formally diagnosed. This discrepancy underscores major challenges in the areas of awareness, screening, diagnosis, and effective treatment of hypertension in the country (Directorate of Non-Communicable Disease Prevention and Control RI, 2021; World Health Organization, 2022; World Health Organization (WHO), 2024).

Hypertension not only increases the risk of mortality among the elderly but also adversely impacts their quality of life. Fluctuations in blood pressure and the emergence of secondary diseases linked to hypertension significantly hinder the elderly's ability to manage daily activities independently. Evidence suggests that lowering blood pressure in older adults effectively prevents cardiovascular and cerebrovascular diseases and reduces the incidence of hip fractures, which are known to impair quality of life. Consequently, efforts to reduce blood pressure in this demographic have been incorporated into various health promotion activities targeting seniors. In addition to medical interventions, several other factors have been identified as influential in lowering blood pressure and improving the quality of life among the elderly (Alghamdi et al., 2024; Handayani et al., 2025; Sarinukul et al., 2023; Song et al., 2025; Sudharsanan & Geldsetzer, 2019). Empirical research suggests that family support, motivation, and physical activity significantly impact the quality of life in elderly individuals with hypertension, with physical activity exhibiting the strongest correlation. In addition to family support and physical activity, factors such as self-management, higher education, and income have been identified as critical determinants of quality of life in the elderly. Furthermore, previous studies have demonstrated that self-management and lifestyle improvements positively influence health and quality of life among the elderly population. Among these various factors, physical activity and self-management emerge as the predominant influences on the quality of life in the elderly. However, it remains uncertain whether these factors are also the primary determinants of quality of life for elderly individuals. Therefore, a more comprehensive investigation is essential to identify the main factors influencing the quality of life in this population(Almaini et al., 2025; Astillawati et al., 2023; Li et al., 2025; Wickramarachchi et al., 2023).

The Caringin Community Health Care facility, located in the urban area of Babakan Ciparay Subdistrict of Bandung City, identified primary hypertension as the leading cause of mortality in 2021, ranking first among the 21 most prevalent diseases in the area(Bandung Health Department RI, 2024). The gravity of the hypertension issue is further underscored at the Community Health Centre. A preliminary study and documentation from the elderly clinic revealed that in 2023, 437 residents were diagnosed with hypertension. Despite the significant number of registered hypertension patients, data from the Elderly Clinic indicated that, on average, only 35 elderly individuals received regular health services each month. The primary aim of this study is to investigate the structural relationships among demographic factors (age and gender), clinical status (stage of hypertension), and behavioral components (physical activity and self-management) in predicting the Quality of Life among hypertensive patients. Additionally, the study seeks to identify critical areas for clinical intervention through Importance-Performance Map Analysis (IPMA).

METHOD

The study population consisted of 72 elderly individuals attending the Caringin Community Health Elderly Clinic in Bandung, West Java, Indonesia, in September 2024, with the exclusion of those possessing comorbid conditions such as heart disease and diabetes. The sample size was determined to be 62 participants. Participants were evaluated using the Physical Activities Scale for the Elderly (PASE), the Hypertension Self-Management Behavior Questionnaire (HSMBQ), and the SF36 questionnaires. The PASE questionnaire has been validated in numerous studies, demonstrating a test-retest reliability of 0.75, with mail surveys proving more reliable (0.84) than phone surveys (0.68) (Washburn et al., 1993). Fadila, Wijaya, and Roni (2024) assessed the Indonesian version of PASE with 30 older adults, finding the validity of questions about physical activity ranged from 0.365 to 0.646, and the reliability was 0.723 (Fadila et al., 2024).

The validity of the HSMBQ was confirmed by a pilot study with 20 participants, showing a reliability score of 70, an internal consistency of 91, and an overall reliability of 95 (Akhter, 2010). Additionally, in a study involving older adults with high blood pressure, Bakar, Sari, and Komariah re-evaluated the HSMBQ, reporting validity scores between 0.456 and 0.823 and a reliability of

0.752 (Bakar et al., 2024). The SF36 tool was initially tested by Brazier et al. in 1992 with 187 participants, revealing 30 valid items, a reliability score exceeding 0.85, and a reliability coefficient over 0.75 (Brazier et al., 1992). In Indonesia, the SF36 for patients with high blood pressure was tested by Rachmawati, Perwitasari, and Adnan, achieving a reliability score of ≥ 0.70. The convergent validity indicated values in tested areas were ≥ 0.4 (Rachmawati et al., 2014). This study received ethical approval (Certificate No.035/KEPK/IKI/V/2024) from the Health Research Ethics Committee of Immanuel Institute of Health and was licensed in accordance with the Research Certificate of the National Unity and Political Agency (Bakesbangpol Kota Bandung) Number PK.03.04.05/1649-BKBP/VII/2024 and the Bandung City Health Department (DinKes) Office Research Certificate Number B/KS.12.01/3512-Dinkes/VIII/2024.

This study employs a quantitative methodology with a cross-sectional design, utilizing Partial Least Squares Structural Equation Modeling (PLS-SEM) for data analysis. This analytical approach is particularly suitable for complex models incorporating diverse data types, as it allows for the estimation of relationships without the stringent data distribution assumptions required by other methods. The research process is divided into two primary phases. Initially, the measurement model is evaluated to ensure the reliability and validity of the data. This phase is crucial for confirming the accuracy and distinctiveness of constructs such as Self-Management and Quality of Life. Subsequently, the structural model estimation is conducted to test the hypothesized pathways and assess the model's predictive capability using R2 and Q^2 metrics. To extend beyond mere correlation analysis, the study employs Importance-Performance Map Analysis (IPMA). This technique is instrumental in identifying the most critical factors and their performance levels. Through the application of these PLS-SEM methods, the research not only identifies significant predictors but also underscores key areas for enhancing hypertension management.

RESULT

Participant characteristics

Table 1 indicates that a substantial proportion of the participants (82.3%, n = 51) were female. The study sample was predominantly composed of individuals categorized as Middle Elderly (56.5%) and those diagnosed with Hypertension Degree II (93.5%).

Table 1.
Respondent characteristics (n= 62)

Characteristics		f	%
Gender	Female	51	82.3
	Male	11	17.7
Eldery Category	Pre Elderly (60-69)	27	43.5
	Elderly (70-79)	35	56.5
Hypertension Category	Normal- High	4	6.5
	Degree II Hypertension	58	93.5

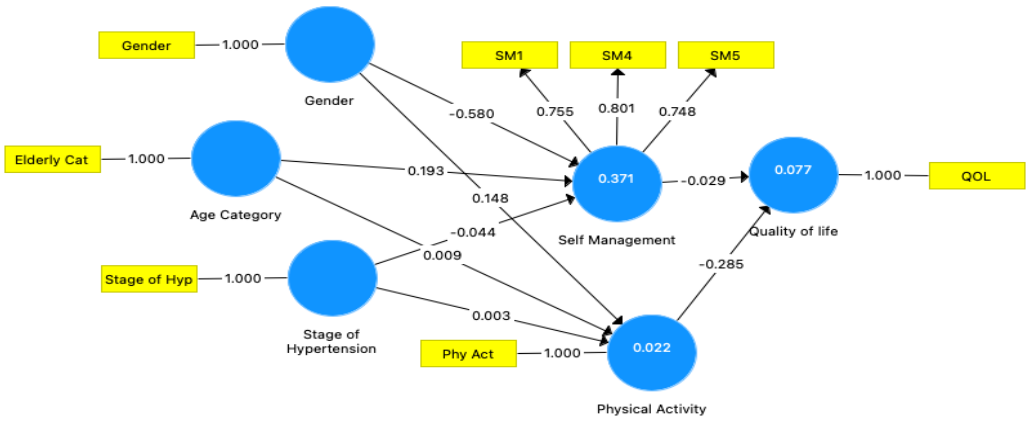

Figure 1. SEM of Quality-of-Life determinants in the hypertensive elderly population of Babakan Ciparay

Measurement Model

Table 2.
Outer Loading

Construct	Outer loading (0,7)	VIF (<5)	CA (0,7)	CR (rho a) (0,7)	CR (rho c) (0,7)	AVE (0,5)
Quality of Life	1,000	1,000	1,000	1,000	1,000	1,000
Age Categories	1,000	1,000	1,000	1,000	1,000	1,000
Physical Activities	1,000	1,000	1,000	1,000	1,000	1,000
Stage of Hypertension	1,000	1,000	1,000	1,000	1,000	1,000
Gender	1,000	1,000	1,000	1,000	1,000	1,000
Self-Management			0,659	0,664	0,812	0,590
SM1	0,755	1,175				
SM4	0,801	1,388				
SM5	0,748	1,425				

The initial assessment of the measurement model involved evaluating the internal consistency, indicator reliability, and collinearity of the constructs. For the single-item constructs, including Quality of Life, Age Categories, Physical Activities, Stage of Hypertension, and Gender, the analysis yielded uniform outer loadings and reliability scores of 1.000. These perfect coefficients are expected for single-indicator variables, indicating that the indicators are total representations of their respective constructs with no measurement error within the model framework. Furthermore, the Variance Inflation Factor (VIF) for these items remained at 1.000, confirming the absence of multicollinearity issues and ensuring that these demographic and categorical variables provide a stable foundation for the structural analysis.

In contrast, the Self-Management construct was evaluated as a multi-item reflective measurement model comprising three indicators: SM1, SM4, and SM5. Indicator reliability was supported as all outer loadings exceeded the recommended threshold of 0.707, with SM4 exhibiting the strongest loading at 0.801. Regarding internal consistency, while the Cronbach's Alpha value of 0.659 was slightly below the traditional 0.70 benchmark, the more robust Composite Reliability (rho_c) reached 0.812, comfortably surpassing the required threshold and confirming the reliability of the construct. Additionally, collinearity diagnostics for the Self-Management indicators revealed VIF values ranging from 1.175 to 1.425, well below the conservative threshold of 3.3, suggesting that the items are distinct yet complementary. Collectively, these results establish that the measurement model possesses sufficient reliability and convergent validity for subsequent hypothesis testing.

Heterotrait Monotrait

Table 3.
Heterotrait Monotrait

	Age Category	Gender	Physical Activity	Quality of life	Self-Management
Age Category					
Gender	0,067				
Physical Activity	0,019	0,149			
Quality of life	0,298	0,016	0,277		
Self-Management	0,185	0,691	0,341	0,152	
Stage of Hypertension	0,112	0,241	0,039	0,069	0,199

To assess the discriminant validity of the research model, the Heterotrait-Monotrait (HTMT) ratio of correlations was examined. As shown in the table, all HTMT values range from a low of 0.016 (between Quality of Life and Gender) to a maximum of 0.691 (between Self-Management and Gender). Because every value remains significantly below the most conservative threshold of 0.85, it can be concluded that discriminant validity has been successfully established. These results indicate that each construct captures a unique phenomenon that is not redundant with other

variables in the model, confirming that the structural model is suitable for further hypothesis testing.*Structural Model*

Table 4. Structural Model

	R Square	R Square Adjusted	Q²_predict
Physical Activity	0,022	-0,028	-0,093
Quality of life	0,077	0,046	-0,009
Self-Management	0,371	0,339	
SM1			0,233
SM4			0,165
SM5			0,029

F Square

	Physical Activity	Quality of life	Self-Management
Age Category	0,000		0,058
Gender	0,021		0,503
Physical Activity		0,081	
Quality of life			
Self-Management		0,001	
Stage of Hypertension	0,000		0,003

Following the assessment of the measurement model, the structural model was evaluated to determine the explanatory power and predictive relevance of the proposed research framework. The R-square (R^2) values reveal varying degrees of variance explained across the endogenous constructs. Self-Management exhibits the most substantial explanatory power with an R^2 of 0.371 (adjusted R^2= 0.339), indicating that approximately 37.1% of its variance is accounted for by its predictors. In contrast, the model demonstrates weaker explanatory power for Quality of Life (R^2= 0.077) and Physical Activity (R^2= 0.022). To further assess predictive power, the Q²_predict values were examined; the positive values for the Self-Management indicators SM1 (0.233), SM4 (0.165), and SM5 (0.029) confirm the model's predictive relevance for this specific construct. However, the negative Q² values for Physical Activity and Quality of Life suggest that the model's predictive accuracy for these particular variables is limited compared to a simple mean-based benchmark.

The Effect Size (f^2) analysis provides a more granular look at the relative impact of each predictor on the endogenous variables. A standout finding is the relationship between Gender and Self-Management, which yields an f^2 value of 0.503. According to Cohen's guidelines, this represents a large effect, identifying Gender as a primary driver of Self-Management within this study. Other relationships, such as Age Category on Self-Management (f^2= 0.058) and Physical Activity on Quality of Life (f^2 = 0.081), show small effect sizes. Conversely, several paths, including the impact of Stage of Hypertension and Self-Management on Quality of Life (f^2= 0.001), exhibit negligible effects. Collectively, these results suggest that while the model is highly effective at explaining the drivers of Self-Management, the current predictors have a more modest influence on the broader lifestyle and outcome variables.

Table 5.
Hypothesis

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values
Age Category → Physical Activity	0,009	0,022	0,126	0,072	0,943
Age Category →Self-Management	0,193	0,208	0,111	1,742	0,082
Gender → Physical Activity	0,148	0,138	0,147	1,009	0,314
Gender → Self-Management	-0,580	-0,588	0,132	4,402	0,000
Physical Activity → Quality of life	-0,285	-0,283	0,126	2,259	0,024
Self-Management → Quality of life	-0,029	-0,034	0,150	0,196	0,845
Stage of Hypertension → Physical Activity	0,003	-0,003	0,095	0,030	0,976
Stage of Hypertension → Self-Management	-0,044	-0,040	0,078	0,573	0,567

The final stage of the structural model analysis involves hypothesis testing through the examination of path coefficients, T-statistics, and P-values. The results reveal that out of the eight proposed relationships, only three reach statistical significance (typically defined as $P < 0.05$ or $T > 1.96$). The most prominent relationship is found between Gender and Self-Management, which displays a strong negative path coefficient of -0.580 (T = 4.402This indicates a highly significant difference in self-management levels across gender g, $P < 0.001$). roups. Additionally, Physical Activity was found to have a significant negative impact on Quality of Life (ß =-0.285, T = 2.259, P = 0.024), suggesting that within this specific sample, higher physical activity levels surprisingly correlate with lower reported quality of life scores. The third significant path is the link between Age Category and Self-Management (ß = 0.193, T = 1.742, P = 0.082); while this exceeds the strict 0.05 threshold, it is often considered significant at the 0.10 level in exploratory research.

Conversely, the majority of the hypothesized paths failed to reach statistical significance, indicating a lack of a measurable relationship between several key variables. Notably, Self-Management appears to have no meaningful influence on Quality of Life (ß = -0.029, T = 0.196, P = 0.845), a finding that contradicts common theoretical expectations. Similarly, the Stage of Hypertension showed no significant effect on either Physical Activity (P = 0.976) or Self-Management (P = 0.567), suggesting that the severity of the condition does not necessarily dictate patient behavior or management efficacy in this context. Furthermore, the demographic variables of Age Category and Gender demonstrated no significant relationship with Physical Activity levels. These non-significant findings are crucial as they highlight that the primary drivers of behavioral outcomes in this study are limited to specific demographic influences on self-management rather than the clinical stages of the disease itself.

Important Performance Map Analysis (IPMA)

Table 6.
IPMAA

	Quality of life	Performances
Age Category	-0,011	56,452
Gender	-0,043	17,742
Physical Activity	-0,402	30,645
Self-Management	-0,039	70,936
Stage of Hypertension	0,000	76,210
Average	-0,099	50,397

The Importance-Performance Map Analysis (IPMA) in this study plotted into a four-quadrant matrix based on the average importance (-0.099) and average performance (50.397), we can identify which areas offer the most significant opportunities for improving the Quality of Life of the respondents. The analysis reveals that Stage of Hypertension is situated in Quadrant I and Self-Management, and Age Category in Quadrant II. These constructs exhibit high importance and high-

performance scores, with Stage of Hypertension leading the group at a performance level of 76.210. This indicates that stage of hypertension factor is currently the primary strengths of the population being studied and should be maintained as they are already contributing effectively to the model's outcomes. Notably, while it has the highest performance, its total effect on Quality of Life is near zero (0.000), suggesting it is a stable baseline factor rather than a dynamic driver for change.

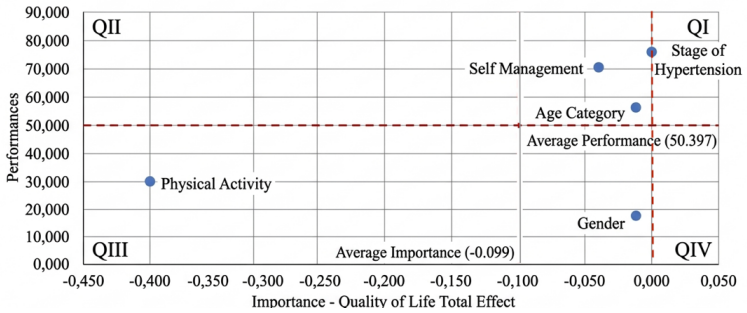

Figure 2. The IPMA variables of Quality-of-Life determinants in the hypertensive elderly population of Babakan Ciparay

In contrast, Physical activity and gender is located in Quadrant III (Low Priority), characterized by both low importance and low performances. This suggests that, within the current context, increasing physical activity may not yield the most efficient improvements in Quality of Life compared to addressing the performance gaps found in gender-related factors. This positioning also identifies Gender as a critical area for immediate intervention; it suggests that specific gender-based disparities are significantly underperforming and represent the most viable pathway for enhancing overall Quality of Life if addressed through targeted policy or support.

DISCUSSION

Gender Differences in Self-Management

This study identifies a significant influence of gender on self-management behaviors (ß = -0.580, $p < 0.001$), accompanied by a considerable effect size ($f^2 = 0.503$). The results demonstrate a distinct difference in the management of hypertension between elderly men and women. The Importance-Performance Map Analysis (IPMA) further underscores this by placing Gender in the *Concentrate Here* quadrant, indicating high importance but alarmingly low performance. This finding highlights the complex interplay of social and psychological factors that disproportionately affect older women's ability to maintain consistent self-management of their health. Caregiving responsibilities, often assumed by women, can limit the time and energy available for attending to their own health needs, leading to inconsistent adherence to treatment regimens or health-promoting behaviours. Additionally, heightened health anxiety, which may stem from concerns about aging, chronic conditions, or family health history, can contribute to stress and emotional burden, further complicating self-management efforts (Nuampa et al., 2023; Vu et al., 2023; Zhu et al., 2026). These psychosocial challenges create barriers that are less commonly experienced by older men, who may have different social roles and coping mechanisms (Brown, 2017; Hicks et al., 2020). Moreover, these gender-specific challenges underscore the need for tailored interventions in healthcare that address not only the clinical aspects of disease management but also the social context in which older women live. Support systems, such as respite care and mental health resources, could alleviate some of the caregiving burden and anxiety, thereby improving adherence and overall health outcomes (Halloway, 2020; Mahmoud, 2021; Zhou et al., 2024). Recognizing and addressing these unique psychosocial factors is essential for developing equitable, effective strategies to support older women in managing their health consistently and successfully.

The inverse relationship of Physical Activity and Quality of Life

This unexpected negative association between physical activity and quality of life highlights the complex interplay between health behaviors and subjective well-being in populations with significant chronic conditions. For elderly individuals with Degree II Hypertension, engaging in

physical activity may not yield the typical psychological and physiological benefits observed in healthier populations. Instead, the exertion required could exacerbate symptoms such as fatigue, dizziness, or chest discomfort, which may increase anxiety and reduce overall life satisfaction (ANDI et al., 2022; Mattioli et al., 2015; Yamamoto et al., 2016). This suggests that the usual positive framing of exercise as universally beneficial must be carefully reconsidered in clinical contexts where physical limitations and health risks are pronounced. Furthermore, the activity-restriction model highlights the paradox wherein the necessity to engage in health-promoting behaviors can become a source of stress and reduced well-being, particularly when baseline health is compromised (Quezada-Horne et al., 2025; Smith et al., 2022). Within this framework, physical activity transcends its role as merely preventive or restorative, becoming a demanding obligation that may serve as a reminder of an individual's vulnerability and frailty. This psychological burden, coupled with physical challenges, can result in a diminished perceived quality of life, even when individuals adhere to recommended health guidelines (Chiracu et al., 2023; Noreen et al., 2021; Xiangni et al., 2022). These findings emphasize the need for personalized interventions that consider the nuanced experiences of high-risk elderly patients, potentially integrating customized exercise programs with supportive measures to alleviate discomfort and fear.

Decoupling Self-Management from Quality of Life

The observed lack of a significant relationship between self-management and quality of life underscores a critical disconnect in chronic disease management, particularly for conditions such as hypertension, where symptoms are often imperceptible or absent. This disjunction suggests that adherence to prescribed regimens such as medication intake, dietary restrictions, and lifestyle modifications may not inherently enhance patients' perceived well-being or life satisfaction. Instead, these self-management tasks may be perceived as intrusive or burdensome, potentially diminishing motivation and engagement over time. This phenomenon highlights the importance of addressing patients' subjective experiences and psychological responses to their treatment routines, rather than focusing solely on clinical adherence metrics (Christidis et al., 2025; Groves & Muskin, 2018). Moreover, this finding is consistent with broader gerontological research, which emphasizes that quality of life in elderly populations is more intricately linked to psychosocial factors such as social support networks, autonomy, and functional ability than to biomedical indicators alone (Adara et al., 2025; Fathy et al., 2020; Javadi et al., 2025; Lina et al., 2020). For patients managing chronic illnesses, feeling socially connected and maintaining independence may contribute more substantially to their overall life satisfaction than strict clinical management. Therefore, interventions aimed at improving quality of life should incorporate strategies that enhance social integration and preserve functional capacity, alongside promoting effective self-management behaviours. This multidimensional approach could better address the complex needs of patients and bridge the gap between clinical practice and lived experience.

CONCLUSION

The increasing prevalence of hypertension in Indonesia, particularly in urban regions such as Babakan Ciparay, constitutes a significant public health challenge. Despite the high incidence of this condition, both diagnostic rates and effective blood pressure management remain concerningly low. While medical intervention is essential, this study highlights that physical activity and self-management are the most critical determinants of quality of life among the elderly. Nevertheless, as the precise hierarchy of these influencing factors is not yet fully understood, further comprehensive research is required to develop health promotion strategies that effectively support the elderly in maintaining independence and reducing mortality associated with primary hypertension.

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