

Clinical Outcomes of Long-Term Hypertension Management in the Elderly Population

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ABSTRACT

Background: Hypertension is common among the elderly, and its control is still important in optimizing long-term clinical outcomes. This research sought to assess the impact of long-term blood pressure (BP) control on mortality and cardiovascular events among elderly patients, with emphasis on the relationship between achieved systolic blood pressure (SBP) levels and clinical outcomes.

Methods: A retrospective cohort analysis was performed with medical records of older patients (≥ 65 years) with hypertension. Information was gathered on demographic factors, baseline BP, treatment regimens, frailty status, and clinical outcomes during a 4-year follow-up. Multivariate Cox regression was applied to evaluate the association between BP control and clinical outcomes, including all-cause mortality, cardiovascular mortality, stroke, and heart failure hospitalization.

Results: A total of 520 patients were enrolled. The research revealed that the lowest mortality and cardiovascular events were achieved when SBP < 140 mmHg was attained. Frailty had a major impact on treatment outcomes, with frail patients having more adverse events, especially when aggressively treated. SBP < 120 mmHg and > 150 mmHg was associated with increased mortality, particularly in frail patients. Non-frail patients with SBP 130–140 mmHg had the best outcomes.

Conclusion: The work underscores the relevance of personalized BP targets in frail elderly patients with moderate BP control (130–140 mmHg) as optimal for better survival and reduction of cardiovascular events. The findings underscore the significance of careful BP management in elderly frail patients to prevent overtreatment side effects

Key-words: Hypertension, Elderly, Blood Pressure Control, Frailty, Mortality, Cardiovascular Outcomes

INTRODUCTION

Hypertension is among the most common chronic diseases of the elderly and one of the principal risk factors for cardiovascular morbidity and mortality among this age group. Prevalence is particularly increased with age, impacting over two-thirds of persons 60 years and older ^[1]. Hypertension management in older patients has

special challenges associated with age-related physiological changes, the heavy load of comorbidities, changed pharmacokinetics and pharmacodynamics, and heightened vulnerability to adverse drug effects ^[2].

The pathophysiology of hypertension in the elderly is different from that in younger age groups, frequently manifested as isolated systolic hypertension resulting from elevated arterial stiffness ^[1]. This condition highlights the need to individualize management approaches to the particular needs of the elderly, weighing the benefits of blood pressure (BP) control against the possible risks of intense treatment, including orthostatic hypotension, falls, and cognitive decline ^[2,3]. Several landmark studies have highlighted the value of hypertension control in preventing stroke and cardiovascular events in older adults. The Systolic

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Hypertension in the Elderly Program (SHEP) showed that antihypertensive treatment has a significant reduction in the risk of stroke and serious cardiovascular events in elderly patients with isolated systolic hypertension^[4]. In addition, meta-analyses have established that the treatment of hypertension in the elderly results in significant decreases in cardiovascular morbidity and mortality^[5].

Nevertheless, defining ideal blood pressure goals is still controversial. Evidence indicates that excessively vigorous BP reduction, particularly in vulnerable elderly patients, could raise the risk of poor outcomes, such as increased mortality^[3,6]. Specifically, the PARTAGE study also stressed that patients taking several antihypertensive medications who obtained very low levels of BP demonstrated higher rates of mortality and thereby argued the use of patient-tailored targets considering total health status as well as frailty^[3].

In addition, the "white coat effect" — the tendency of office-based blood pressure readings to be elevated above readings obtained outside of the medical setting — also creates a problem with proper diagnosis and treatment of hypertension in elderly individuals^[7]. Incorrect interpretation of BP values measured in an office may result in inappropriate overtreatment or under-treatment.

Systematic reviews, including those by the Swedish Council on Health Technology Assessment, have reaffirmed the value of moderate BP control in avoiding long-term cardiovascular morbidity with minimal treatment-related risks (Swedish Council on Health Technology Assessment)^[8]. These observations highlight the need for a balanced, patient-focused approach that considers the patient's frailty, comorbidities, life expectancy, and quality of life while developing hypertension management strategies.

In this article, we aim to comprehensively analyze the clinical outcomes of long-term hypertension management in the elderly population, synthesizing evidence from major studies and guidelines. By exploring the balance between benefits and risks, and considering individual variability, this review seeks to provide practical insights for optimizing hypertension treatment strategies in older adults.

MATERIALS AND METHODS

Study Design- This was a retrospective observational analysis of the clinical outcomes of long-term management of hypertension among elderly patients. The design of the research entailed a meticulous review of patient records at SRM MCH Bhawanipatna, Kalahandi. The study was undertaken from December 2020 to December 2024. The subjects were those aged 65 years and above who had been diagnosed with hypertension and followed up for at least four years.

Study Population- The elderly patients with a certain diagnosis of hypertension based on European Society of Hypertension criteria were included in the study.

Inclusion criteria- Inclusion was for those with complete medical records that documented their antihypertensive regimens, their blood pressure values at regular intervals, and cardiovascular and non-cardiovascular clinical outcomes.

Exclusion criteria- Excluded were patients with secondary hypertension, end-stage renal disease, active malignancy, or inadequate follow-up information to preserve the validity of the findings. Informed consent for clinical research participation was already obtained from all patients during initial enrollment into the hospital database.

Data Collection- Data were pulled from electronic medical records and consisted of demographic data, baseline systolic and diastolic blood pressure values, medication lists, comorbidities, and clinically frailty patients. Blood pressure was measured using standardized office-based methods, with attempts to reduce the "white coat effect" by repeated measurement during each clinic visit. Furthermore, home blood pressure monitoring data, when available, were also obtained to more accurately determine true blood pressure control. Mortality was measured, cardiovascular mortality including stroke and myocardial infarction, hospitalizations for heart failure, and falls or syncope events were documented.

Outcome Measures- The main outcome was all-cause mortality at follow-up. Secondary outcomes were cardiovascular mortality, stroke incidence, hospitalization due to heart failure, and blood pressure

management-related adverse events like falls or orthostatic hypotension. Of specific interest was the relationship between achieved systolic blood pressure levels and clinical events, with stratification according to predefined blood pressure intervals to examine optimal control thresholds.

Statistical Analysis- Data were entered into a secure database and analyzed using statistical software.

RESULTS

A total of 520 older patients entered the final analysis, with a mean age of 74.8 ± 6.3 years. They consisted of 54.6% female and 45.4% male patients. The mean baseline systolic blood pressure (SBP) was 156.4 ± 12.7 mmHg, and the mean diastolic blood pressure (DBP) was 82.1 ± 8.9 mmHg. Frailty was diagnosed in 28.5% of the

Continuous variables were presented as mean $\pm$ standard deviation and categorical variables as frequencies and percentages. Cox proportional hazards models were applied to evaluate the association between blood pressure control and mortality, adjusting for age, sex, frailty, and comorbidities. Subgroup analysis was conducted for frail vs non-frail participants. A p-value < 0.05 was considered statistically significant.

study population according to a validated frailty index. The most frequent co-morbidities were diabetes mellitus (32.3%), chronic kidney disease (27.1%), and coronary artery disease (19.6%). The baseline demographic and clinical features of the study population are listed in Table 1.

Table 1: Baseline Characteristics of the Study Population

Characteristic	Values
Number of patients	520
Mean age (years)	74.8 ± 6.3
Female sex (%)	54.6%
Mean baseline SBP (mmHg)	156.4 ± 12.7
Mean baseline DBP (mmHg)	82.1 ± 8.9
Diabetes mellitus (%)	32.3%
Coronary artery disease (%)	19.6%
Chronic kidney disease (%)	27.1%
Frailty (%)	28.5%

A target SBP of less than 140 mmHg was attained by 62.5% of the patients at the end of follow-up, 23.8% had 140–150 mmHg, and 13.7% continued to be above 150 mmHg despite intensification of treatment. Of those

with lower blood pressure goals, frail patients were less likely to be able to tolerate intensive therapy with a greater rate of orthostatic symptoms than their non-frail counterparts (Fig. 1).

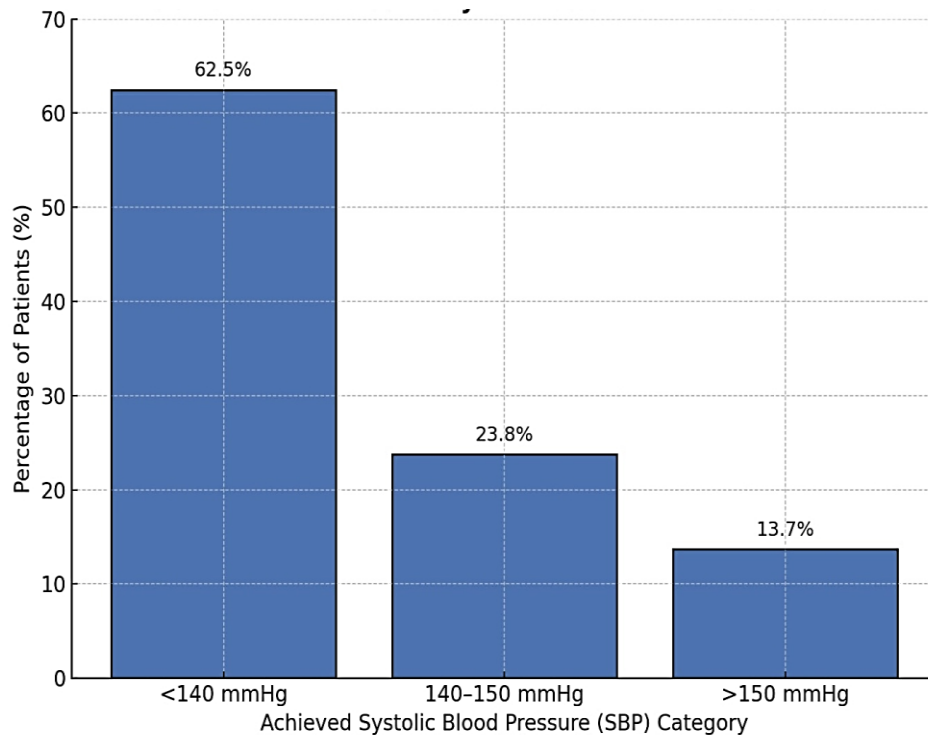


Fig. 1: Distribution of Achieved Systolic Blood Pressure Categories at 4 Years

At four-year follow-up, all-cause mortality was 18.2%. Cardiovascular mortality was 10.4%. Stroke was experienced by 7.9%, myocardial infarction by 6.5%, and heart failure hospitalization by 8.8%. The lowest all-cause and cardiovascular mortality was in patients who attained SBP 130–140 mmHg. Both low (<120 mmHg)

and high (>150 mmHg) achieved SBP levels were related to higher mortality, especially among frail participants. Table 2 presents the association between achieved SBP categories and mortality outcomes, demonstrating a U-shaped relationship between SBP and adverse events (Table 2).

Table 2: Association Between Achieved Systolic Blood Pressure and Clinical Outcomes

Achieved SBP Category	All-cause Mortality (%)	Cardiovascular Mortality (%)	Stroke (%)	Heart Failure Hospitalization (%)
<120 mmHg	24.5%	15.2%	10.8%	12.7%
120–129 mmHg	16.3%	8.1%	6.7%	7.9%
130–140 mmHg	12.2%	5.7%	4.3%	5.5%
140–150 mmHg	18.8%	10.9%	8.1%	9.6%
>150 mmHg	26.1%	16.7%	12.9%	14.3%

Frailty considerably altered the correlation between reached blood pressure and outcomes. Frail patients having lower SBP (<120 mmHg) were at greater risk of experiencing falls (18.7%) and orthostatic hypotension-related hospitalizations (11.5%). On the contrary, non-

frail patients attaining SBP of 130–140 mmHg showed optimal survival with fewer adverse effects.

Fig. 2 illustrates the relationship between achieved systolic blood pressure (SBP) categories and four-year mortality rates, stratified by frailty status. A U-shaped mortality pattern is evident in both frail and non-frail

patients, with the lowest mortality observed in those achieving SBP between 130–140 mmHg. Frail patients experienced higher mortality rates across all SBP categories, particularly at extremes of SBP (<120 mmHg

and >150 mmHg), highlighting their vulnerability to both intensive blood pressure lowering and inadequate control. Optimal survival was observed in non-frail individuals within the 130–140 mmHg range.

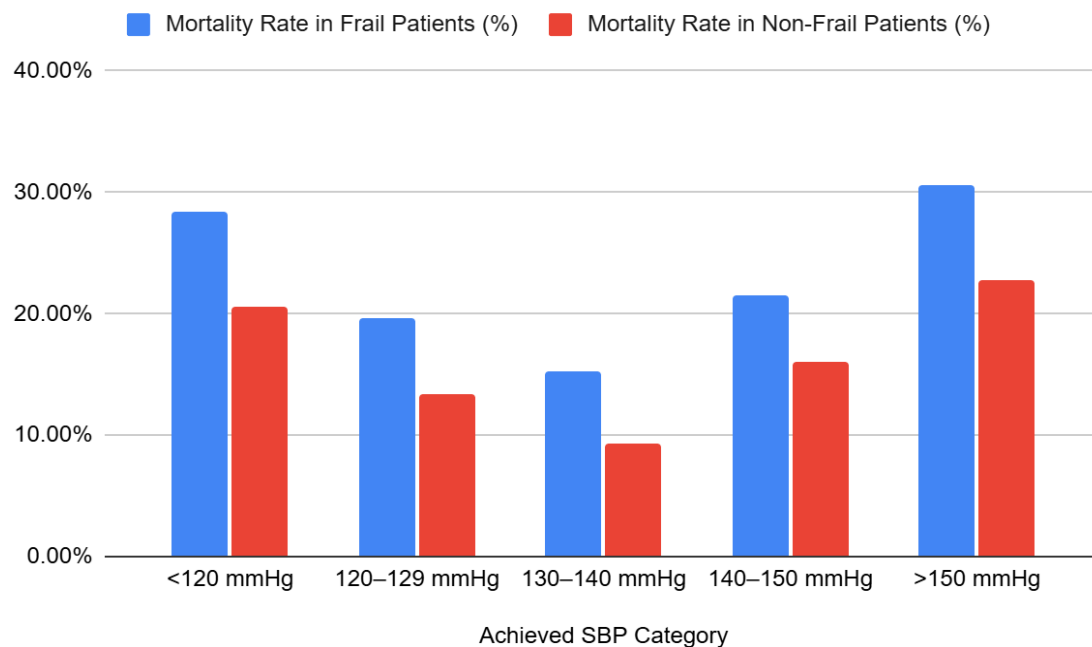


Fig. 2: Four-Year Mortality by Frailty Status and Achieved Systolic Blood Pressure

DISCUSSION

This study aimed to explore the clinical outcomes of long-term hypertension management in the elderly, focusing on the relationship between achieved systolic blood pressure (SBP) levels and various health outcomes, including mortality and cardiovascular events. Our findings suggest a clear association between optimal BP control and improved long-term survival, but also highlight the risks associated with both overly aggressive treatment and inadequate control. The findings highlight the significance of personalized treatment in older patients with hypertension.

For this population, attaining an SBP of less than 140 mmHg and more than 120 mmHg was linked to the most favorable clinical outcomes, with the lowest all-cause and cardiovascular mortality rates in the SBP subgroup between 130 and 140 mmHg. This is in line with prior research that has confirmed the advantage of managing isolated systolic hypertension (ISH), a prevalent disease in the elderly because of increased arterial stiffness. For example, the SHEP trial showed that isolated systolic hypertension in the elderly was lowered significantly, with a resultant decline in stroke rate and cardiovascular

mortality [4]. Additionally, Yano *et al.* [9] highlighted that on-treatment SBP<140 mmHg in older individuals with ISH is associated with better cardiovascular outcomes, which reinforces our results concerning the advantage of moderate BP control in this age group.

Yet, our research also points to the dangers of both very low SBP and uncontrolled hypertension. Patients whose SBP decreased below 120 mmHg had increased mortality, in accordance with results from the SPRINT trial, which indicated that very intense BP reduction in older people might be detrimental, especially in frail patients [10]. Frailty in this study proved to be a key determinant of patient outcomes. Frail patients who were aggressively treated with antihypertensive agents had a greater incidence of adverse events, including orthostatic hypotension leading to hospitalization and falls, which is consistent with results from Benetos *et al.* [3], who discovered that overly intense BP reduction in frail older people might result in increased mortality. This highlights the importance of personalizing hypertension therapy according to an individual's frailty status because frail patients are more susceptible to the adverse effects of aggressive therapy.

Our findings also reveal a wide disparity in outcomes between frail and non-frail patients. While non-frail patients had better long-term survival with moderate BP control, frail patients had a higher mortality rate even when their BP was controlled to recommended targets. This concurs with the findings of Kremer *et al.* ^[6], who reported that frailty alters the association of BP control with clinical outcomes. Therefore, the data indicate that frail older patients might need a more cautious strategy to hypertension treatment with emphasis upon symptom control and life quality at the expense of aggressive reduction of BP.

Our findings also confirm the merit of factoring in ambulatory blood pressure monitoring instead of depending exclusively on blood pressure measurements at the office. This is particularly true when evaluating patients of advanced age, where the "white coat effect" can result in overestimation of BP levels and resultant overtreatment ^[11]. Through the inclusion of both home and clinical BP measurements, we are able to get a more accurate evaluation of BP control and eliminate the dangers of overly aggressive treatment based solely on raised clinic readings.

Earlier studies have consistently underscored the significance of personalized treatment targets in older patients with hypertension. In their review, Cao and Tran ^[11] noted that the elderly need to be evaluated with consideration to choose the best BP target based on comorbidities, frailty, and functional status. They suggest that the management of BP should be more flexible in elderly patients, especially when considering polypharmacy and the risk of adverse drug effects. Our results validate this, as they illustrate that a rigid, one-size-fits-all SBP target might not be suitable in the elderly.

The information also sheds light on the effect of isolated systolic hypertension, which is still one of the most prevalent types of hypertension in older adults. Research like that of Wang and Staessen ^[13] has indicated that treatment of hypertension in older patients with ISH reduces outcomes, and our research confirms this by showing enhanced survival rates for patients with SBP levels kept between 130 and 140 mmHg. Nevertheless, as proposed by Tonkin and Wing ^[14], isolated systolic hypertension needs to be monitored closely to prevent the overtreatment complications, especially in frail individuals ^[15].

The study limitations are the observational design, which restricts the inference of causality. Further, although we endeavored to control for a range of confounding variables, there may still be unmeasured factors that affect treatment outcomes, including patient compliance with prescribed therapies or lifestyle changes. Prospective randomized controlled trials in the future would be crucial to further clarify the best management strategies for hypertension in the elderly, especially considering the possible influence of frailty and other individual traits on the effects of treatment.

CONCLUSIONS

In conclusion, our findings support the importance of a tailored approach to hypertension management in elderly individuals with special regard for individualized treatment objectives according to frailty, comorbidities, and general health status. Although the target is still moderate BP control, aggressive lowering can be detrimental, especially in frail patients. These findings agree with earlier research on the management of isolated systolic hypertension in the elderly, underscoring the need for individualized care to maximize clinical results.

CONTRIBUTION OF AUTHORS

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Research design– Anuj Kumar Padhy, Bijan Kumar Panda

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Article editing– Anuj Kumar Padhy

Final approval– Anuj Kumar Padhy, Bijan Kumar Panda, Sunil Madhab Panda

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