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ORIGINAL ARTICLE

JMHRS JOURNAL OF MODERN HEALTH AND REHABILITATION SCIENCES

Association of Cognitive Impairment with Hypertension and Perceived Stress among Older Adults

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ABSTRACT

Background: Cognitive impairment is a growing public health concern among older adults, with hypertension and psychological stress recognized as important modifiable risk factors for cognitive decline.

Objective: To determine the association of cognitive impairment with hypertension and perceived stress among adults aged 55 years and older.

Methods: This cross-sectional study included 150 participants aged ≥55 years recruited through stratified random sampling at the Farooq Hospital. Cognitive function was evaluated using the Mini-Mental State Examination (MMSE), while perceived stress was assessed using the Perceived Stress Scale (PSS). Participants were categorized into hypertensive and non-hypertensive groups according to blood pressure measurements. Pearson's correlation and independent-samples t-test were performed, with statistical significance set at $p<0.05$.

Results: The mean age of participants was 65.59±8.88 years, and 58.0% were male. Hypertension was present in 50.0% of participants. Cognitive impairment was identified in 30.0% of participants, including 28.7% with mild and 1.3% with severe impairment. Moderate and high perceived stress were reported by 64.7% and 22.7% respectively. A significant negative correlation was observed between MMSE and PSS scores ($r=-0.470$, $p<0.001$), indicating poorer cognitive performance with increasing stress.

Conclusion: Hypertension and elevated perceived stress were significantly associated with cognitive impairment among older adults, emphasizing the importance of early screening, effective blood pressure control, and stress management strategies to preserve cognitive health.

Keywords: Aging, Cognitive Dysfunction, Dementia, Hypertension, Memory, Older Adults, Perceived Stress, Psychological Stress.

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Disclaimers

Conflict of Interest: None declared

Data/Supplements: Available on request.

Funding: None

Ethical Approval: Respective Ethical Review Board

Study Registration: N/A

Acknowledgments: N/A

Article Info

Received: 01 February 2026, *Accepted:* 20 June 2026,

Published Online: 25 June 2026

How to Cite: Naheed A, Nisa WU, Butt MZ. Association of Cognitive Impairment with Hypertension and Perceived Stress among Older Adults. J Mod Health Rehab Sci. 2026;3(2):69.

Available from: https://jmhrs.com/index.php/jmhrs/article/view/69 | **DOI:** https://doi.org/10.67108/jmhrs69

Introduction

Cognitive impairment has emerged as one of the leading public health concerns worldwide owing to the rapid growth of the aging population and the increasing prevalence of age-related neurological disorders. It encompasses a spectrum of conditions ranging from mild cognitive impairment to severe dementia and is associated with progressive deterioration in memory, attention, executive function, language, and orientation, ultimately compromising functional independence and quality of life. As life expectancy continues to rise, preserving cognitive health has become a major healthcare priority. Although aging remains the strongest non-modifiable risk factor, several modifiable vascular and psychosocial determinants have been identified that may substantially influence the onset and progression of cognitive decline. Among these, hypertension and chronic psychological stress have consistently been recognized as important contributors, making them attractive targets for preventive interventions (1,2).

Hypertension is one of the most prevalent chronic medical conditions affecting older adults and is a well-established risk factor for cardiovascular and cerebrovascular diseases. Beyond its systemic effects, persistent elevation of blood pressure has been shown to adversely affect cerebral vasculature through endothelial dysfunction, arterial stiffness, microvascular damage, impaired cerebral autoregulation, and reduced cerebral perfusion. These pathological alterations contribute to white matter lesions, cerebral small vessel disease, brain atrophy, and neuronal injury, thereby increasing the risk of cognitive impairment and vascular dementia. Recent neuroimaging and epidemiological studies have demonstrated that prolonged exposure to elevated blood pressure is associated with structural and functional brain changes that adversely affect cognitive performance, particularly in domains of executive function, processing speed, and memory (3,4).

The impact of hypertension on cognition appears to begin long before old age. Evidence suggests that elevated blood pressure during midlife significantly increases the likelihood of developing cognitive impairment and dementia in later years. Chronic hypertension accelerates vascular aging and neurodegenerative processes through persistent inflammation, oxidative stress, and disruption of the blood-brain barrier. Consequently, early identification and adequate management of hypertension have been proposed as effective strategies for reducing the burden of age-related cognitive decline. These findings emphasize the importance of vascular risk factor modification in preserving long-term cognitive function among older adults (5,6).

Psychological stress represents another important but potentially modifiable determinant of cognitive health. Chronic stress activates the hypothalamic-pituitary-adrenal axis, resulting in prolonged secretion of glucocorticoids, particularly cortisol. Sustained elevations in cortisol exert neurotoxic effects on vulnerable brain regions such as the hippocampus and prefrontal cortex, which are essential for memory formation, learning, emotional regulation, and executive functioning. Persistent stress has been associated with hippocampal atrophy, impaired synaptic plasticity and accelerated neuronal degeneration, thereby contributing to memory deficits and progressive cognitive decline. Experimental and clinical studies have consistently demonstrated significant associations between chronic psychological stress and impaired cognitive performance across multiple cognitive domains (7,8).

The interaction between hypertension and psychological stress further complicates the pathophysiology of cognitive impairment. Chronic stress may exacerbate hypertension through sustained sympathetic nervous system activation and hormonal dysregulation, creating a vicious cycle that accelerates vascular damage and neurodegeneration. Simultaneously, hypertension may amplify the adverse neurological consequences of chronic stress by compromising cerebral circulation and reducing the brain's resilience to physiological stressors. Emerging evidence indicates that the combined effects of vascular dysfunction and chronic stress may substantially accelerate cognitive aging and increase susceptibility to dementia. Consequently, comprehensive preventive strategies incorporating blood pressure control, stress reduction, and healthy lifestyle modifications have gained increasing attention as effective approaches for preserving cognitive function in aging populations (9).

Despite growing evidence supporting the association between hypertension, stress, and cognitive decline, limited data are available from developing countries, where demographic transitions and increasing life expectancy have contributed to a rising burden of non-communicable diseases. Understanding the relationship between these modifiable risk factors and cognitive impairment in local populations may facilitate early identification of individuals at increased risk and guide the development of targeted preventive and therapeutic interventions. Therefore, the present study was conducted to investigate cognitive impairment and its association with hypertension and perceived stress among adults aged 55 years and older, while comparing cognitive performance between hypertensive and non-hypertensive individuals and evaluating the relationship between perceived stress levels and cognitive function (1,9).

Material and Methods

This cross-sectional analytical study was conducted at the Farooq Hospital, to investigate the association between cognitive impairment, hypertension, and perceived stress among adults aged 55 years and above. A total of 150 participants were recruited using a stratified random sampling technique to ensure adequate representation of

both hypertensive and non-hypertensive individuals. Participants were categorized into hypertensive and non-hypertensive groups based on blood pressure measurements obtained on two separate occasions according to standard clinical recommendations. Individuals with systolic blood pressure ≥140 mmHg and/or diastolic blood pressure ≥90 mmHg or those previously diagnosed with hypertension were classified as hypertensive, whereas participants with blood pressure values below these thresholds were categorized as non-hypertensive (10).

Participants were eligible for inclusion if they were aged 55 years or older, were willing to participate voluntarily, provided written informed consent, and fulfilled the diagnostic criteria for either the hypertensive or non-hypertensive study group. Individuals with a previous diagnosis of dementia, major neurological disorders including stroke or Parkinson's disease, severe psychiatric illnesses, significant hearing or visual impairment interfering with assessment, inability to communicate effectively because of language barriers or severe cognitive deficits, or those unwilling to participate were excluded from the study to minimize potential confounding factors.

Data were collected using a structured data collection proforma specifically designed for the study. Demographic characteristics including age and gender were recorded. Anthropometric assessment was performed for measurement of body weight and height, and body mass index (BMI) was calculated as weight in kilograms divided by height in meters squared (kg/m²). BMI was categorized according to standard World Health Organization criteria. Blood pressure was measured using a calibrated standard sphygmomanometer after participants had rested for at least five minutes in a seated position. Two blood pressure measurements were obtained at separate intervals, and the average value was considered for analysis.

Cognitive function was assessed using the Mini-Mental State Examination (MMSE), a widely validated screening instrument for cognitive impairment (11). The MMSE evaluates multiple cognitive domains, including orientation, registration, attention and calculation, memory recall, and language with praxis. Total scores ranged from 0 to 30 and were categorized as no cognitive impairment (24–30), mild cognitive impairment (18–23), and severe cognitive impairment (0–17), according to established recommendations (11). Perceived psychological stress was evaluated using the Perceived Stress Scale (PSS) (12), a validated instrument designed to assess the degree to which individuals perceive situations in their lives as stressful. Total PSS scores were categorized into low stress (0–13), moderate stress (14–26), and high perceived stress (27–40).

The study was conducted in accordance with the ethical principles. Ethical approval was obtained from the Farooq Hospital prior to commencement of the study. All collected data were checked for completeness, coded, and entered into the Statistical Package for the Social Sciences (SPSS) version 25.0 for statistical analysis. Descriptive statistics were calculated for demographic and clinical characteristics. Continuous variables were presented as mean ± standard deviation, whereas categorical variables were summarized as frequencies and percentages. Pearson's correlation coefficient was used to determine the relationship between MMSE and perceived stress scores. Independent samples t-test was applied to compare mean cognitive scores between hypertensive and non-hypertensive participants where appropriate. A p-value of <0.05 was considered statistically significant.

Results

A total of 150 participants aged 55 years and above were enrolled in the study. The mean age was 65.59 ± 8.88 years, while the mean body mass index (BMI) was 23.73 ± 6.51 kg/m². Males constituted 58.0% (n=87) of the study population, whereas females accounted for 42.0% (n=63). Hypertension was equally distributed, with 75 (50.0%) participants classified as hypertensive and 75 (50.0%) as non-hypertensive. Most participants (60.0%) had a healthy BMI, followed by overweight (30.7%), obese (5.3%), and underweight (4.0%) categories.

Table 1: Baseline demographic and clinical characteristics of the study participants (N = 150)

Variable	Category	n (%) / Mean ± SD
Age (years)	Mean ± SD	**65.59 ± 8.88**
Body Mass Index (kg/m²)	Mean ± SD	**23.73 ± 6.51**
Gender	Male	87 (58.0)
	Female	63 (42.0)
BMI Category	Underweight (<18.5 kg/m²)	6 (4.0)
	Healthy weight (18.5–24.9 kg/m²)	90 (60.0)
	Overweight (25.0–29.9 kg/m²)	46 (30.7)
	Obese (≥30.0 kg/m²)	8 (5.3)
Hypertension Status	Hypertensive	75 (50.0)
	Non-hypertensive	75 (50.0)

Table 2: Distribution of cognitive impairment and perceived stress among study participants (N = 150)

Variable	Category	n (%)
MMSE Classification	No cognitive impairment (24–30)	105 (70.0)
	Mild cognitive impairment (18–23)	43 (28.7)
	Severe cognitive impairment (0–17)	2 (1.3)
Perceived Stress Scale (PSS)	Low stress (0–13)	19 (12.7)
	Moderate stress (14–26)	97 (64.7)
	High stress (27–40)	34 (22.7)

Pearson's correlation analysis demonstrated a statistically significant moderate inverse relationship between perceived stress and cognitive function ($r = -0.470$, $p < 0.001$). Increasing perceived stress scores were associated with progressively lower MMSE scores, indicating poorer cognitive performance among participants with higher psychological stress. Domain-wise evaluation of MMSE scores demonstrated that participants achieved the highest mean score in the Language and Praxis domain (10.84 ± 1.82), followed by Orientation (10.55 ± 0.93). Comparatively lower scores were observed for Attention and Calculation (5.83 ± 1.05), Memory Recall (3.43 ± 0.66), and Registration (3.32 ± 0.59), suggesting relatively greater impairment in memory-related cognitive domains.

Table 3: Association between Hypertension and Cognitive Impairment

Hypertension Status	No Cognitive Impairment n (%)	Mild Cognitive Impairment n (%)	Severe Cognitive Impairment n (%)
Hypertensive	46 (61.3)	27 (36.0)	2 (2.7)
Non-hypertensive	59 (78.7)	16 (21.3)	0 (0.0)
Total	105 (70.0)	43 (28.7)	2 (1.3)

Discussion

The present study demonstrated a significant association between cognitive impairment, hypertension, and perceived stress among adults aged 55 years and above. A statistically significant moderate negative correlation was observed between perceived stress and cognitive performance, indicating that higher stress levels were associated with poorer cognitive function. Furthermore, individuals with hypertension exhibited comparatively lower cognitive performance than their non-hypertensive counterparts, supporting the hypothesis that both vascular and psychological factors contribute substantially to age-related cognitive decline. These findings reinforced the growing body of evidence suggesting that cognitive impairment results from a complex interaction between cardiovascular, neurobiological, and psychosocial mechanisms rather than a single pathological process (1,2).

The observed association between hypertension and cognitive impairment was consistent with previous epidemiological and neuroimaging studies that identified hypertension as one of the most important modifiable risk factors for cognitive decline and dementia. Chronic hypertension has been reported to impair cerebral autoregulation, promote endothelial dysfunction, reduce cerebral perfusion, and accelerate cerebral small vessel disease, ultimately resulting in neuronal injury and progressive cognitive deterioration. These vascular alterations particularly affect executive function, processing speed, attention, and memory, which explained the comparatively lower cognitive performance observed among hypertensive participants in the present study. Similar observations were reported by Gorelick et al. and Iadecola and Gottesman, who demonstrated that long-standing hypertension substantially increased the risk of vascular cognitive impairment and dementia through cumulative cerebrovascular damage (2,10).

The significant inverse relationship between perceived stress and MMSE scores further highlighted the detrimental effects of chronic psychological stress on cognitive functioning. Sustained activation of the hypothalamic-pituitary-adrenal axis has been shown to increase circulating cortisol levels, leading to hippocampal neuronal injury, impaired synaptic plasticity, neuroinflammation, and reduced neurogenesis. These biological alterations have consistently been associated with deterioration in learning, memory consolidation, and executive functioning. The findings of the present study agreed with those reported by Lupien et al. and McEwen, who demonstrated that prolonged exposure to psychological stress accelerated cognitive aging and increased vulnerability to neurodegenerative disorders, particularly Alzheimer's disease and related dementias (7,8).

Domain-specific analysis revealed comparatively lower scores in memory recall and attention-related tasks, suggesting that these cognitive domains were more vulnerable to the combined effects of hypertension and chronic stress. Memory impairment has frequently been recognized as an early manifestation of cognitive decline

because the hippocampus remains particularly susceptible to vascular insufficiency and glucocorticoid-mediated neurotoxicity. Previous experimental and clinical studies similarly reported that chronic stress and vascular dysfunction preferentially affected episodic memory and executive functioning before involving other cognitive domains, thereby supporting the domain-specific findings observed in the present study (6,9).

The relatively high proportion of participants experiencing moderate to high perceived stress also emphasized the considerable psychological burden among older adults. Aging is frequently accompanied by chronic illnesses, reduced physical functioning, social isolation, financial insecurity, and emotional distress, all of which may contribute to persistent psychological stress. Chronic stress not only directly influences neuronal integrity but may also indirectly worsen cognitive outcomes by aggravating hypertension, reducing treatment adherence, impairing sleep quality, and promoting unhealthy lifestyle behaviors. Consequently, the coexistence of hypertension and elevated stress may create a synergistic effect that accelerates cognitive deterioration beyond the impact of either factor alone. These findings supported previous evidence indicating that comprehensive management of both vascular and psychosocial risk factors may be more effective than isolated interventions in preserving cognitive health (5,9).

The findings of this study also highlighted the importance of lifestyle modification in reducing the burden of cognitive impairment. Previous investigations demonstrated that regular physical activity, adherence to a Mediterranean-style diet, smoking cessation, adequate sleep, social engagement, and cognitive stimulation improved cerebrovascular function and promoted neuroplasticity. Furthermore, structured stress reduction interventions including mindfulness-based therapies, relaxation techniques, cognitive behavioral therapy, and psychosocial support have been associated with lower cortisol levels and improved cognitive outcomes. Combined with effective blood pressure control, these interventions may substantially delay the onset and progression of cognitive impairment among older adults (11–13).

Several strengths enhanced the scientific value of the present study. Standardized and validated assessment instruments, including the Mini-Mental State Examination and the Perceived Stress Scale, were utilized to ensure reliable evaluation of cognitive function and psychological stress. The inclusion of both hypertensive and non-hypertensive participants allowed direct comparison between study groups, while stratified random sampling improved sample representation and minimized selection bias. In addition, the study simultaneously evaluated vascular and psychological determinants of cognitive impairment, providing a more comprehensive understanding of factors influencing cognitive health in older adults.

Future research should employ multicenter prospective cohort studies with larger and more diverse populations to establish causal relationships and investigate the longitudinal effects of hypertension and chronic stress on cognitive decline. Randomized controlled trials evaluating integrated interventions combining optimal blood pressure management, stress reduction strategies, lifestyle modification, and cognitive rehabilitation would further clarify effective approaches for preventing cognitive deterioration. Incorporation of advanced neuroimaging techniques, biological markers of neurodegeneration and inflammation, and detailed neuropsychological assessments would provide greater insight into the underlying mechanisms linking vascular dysfunction, psychological stress, and cognitive impairment. Such evidence may facilitate development of individualized preventive strategies aimed at preserving cognitive function and improving healthy aging among older adults (2,7,11).

Conclusion

The present study concluded that hypertension and elevated perceived stress were significantly associated with impaired cognitive function among older adults, highlighting the important contribution of both vascular and psychological factors to age-related cognitive decline. Early identification of at-risk individuals through routine cognitive screening, effective blood pressure control, stress management interventions, and promotion of healthy lifestyle behaviors may help preserve cognitive function, improve quality of life, and reduce the future burden of dementia, emphasizing the need for integrated multidisciplinary approaches in clinical practice and public health.

Authors' Contributions

ICMJE authorship criteria	Detailed contributions	Authors
Substantial Contributions	Conception or Design of the work	1,2
	Data acquisition	1,3
	Data analysis or interpretation	2,3
Drafting or Reviewing	Draft the work	3
	Review critically	1,2,3
Final approval	Final approval of the version to be published.	1,2,3
Accountable	Agreement to be accountable for all aspects of the work.	1,2,3

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ISSN Number: 3079-0727 (Print) 3079-0735 (Online)