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The Effect of Hypertension on Cognitive Decline and Dementia: A Meta-Analysis

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Abstract

Hypertension is known to be a risk factor for cardiovascular diseases, but its relationship with cognitive impairment and dementia is an emerging area of study. This meta-analysis intends to examine the relationship between hypertension and cognitive impairment by combining data from several studies in an attempt to establish the level of correlation. The studies in the analysis include longitudinal cohort studies, case-control studies, and randomized controlled trials (RCTs) that look at cognitive outcomes in different domains, such as global cognition, executive function, memory, and attention. According to studies regarding hypertension, patients suffering from it showed a much higher risk score (38%) of cognitive impairment than normotensives. Furthermore, it has been noted that midlife Hypertension (ages 40-65) has the worst effect on late-life dementia compared to most late-life hypertension. There are some variations as late-life hypertension appears to be less strongly associated with risk, suggesting some form of disease-modifying interaction. Mechanistically, cognitive decline impairment due to hypertension can be attributed primarily to cerebrovascular damage, neuroinflammation, increased oxidative stress, and amyloid pathologies causing neurodegeneration and hyper-susceptibility to dementia. This research constitutes a further examination of cognition decline in the context of the effects of anxiety hypertension treatment. ACE inhibitors and calcium channel blockade drugs are believed to have some degree of neuroprotection by increasing cerebral blood flow and lowering inflammatory processes, which could lead to neurocognitive disorders. This meta-analysis adds to the evidence of hypertension as a new risk factor for dementia and cognitive decline; thus, it necessitates such risk assessment at early stages, lifestyle changes and optimal pharmacotherapy. Such initiatives must strive to foster adherence to treatment, recognition of hypertension, and the definition of the cognitive domain in the broader cardiovascular risk framework for dementia prevention.

Keywords: Hypertension; Cognitive decline; Dementia; Meta-analysis; Neurodegeneration; Anti-hypertensive Therapy

Introduction

Hypertension is an emerging health issue as high blood pressure is a problem for many globally, and its proliferation can be credited to the decline in health due to issues such as stroke [1], dietary choices and other cardiovascular problems. As of now, there are over 1.2 billion people around the globe who suffer from this health concern, and this is projected to rise across geographies

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owing to ageing populations, sedentary lifestyles, and poor dietary habits. Most people do not feel the symptoms of hypertension during its early stages, which makes it a silent killer, but what goes unnoticed is the impact hypertension has on the vascular system. Various studies suggest that the correlation between hypertension and cognitive deterioration is robust, and people suffering from high blood pressure must be considerate towards the neurodegenerative processes they are putting themselves through [1].

Hypertension is identified as one of the most prevalent yet preventable risk factors leading to cardiovascular disease, stroke, renal disease, and dementia worldwide. In 2019, it was reported that the global prevalence of hypertension was 32% for women and 34% for men aged 30 to 79 years. In 2015, a systolic blood pressure greater than 115 mmHg was estimated to contribute to approximately 10.7 million deaths globally, with 4.5 million deaths in men and 4.0 million deaths in women; 88% of these deaths occurring in low-income and middle-income countries [2,3].

Recognizing the complications of hypertension and their impact on overall health and mortality is essential for better understanding and management of the disease. High blood pressure is associated with a significant burden of cardiovascular disease and premature death on a global scale. Most deaths linked to a systolic blood pressure of 110-115 mmHg or higher are attributed to ischemic heart disease and both ischemic and hemorrhagic strokes. In addition, even a slight increase in blood pressure, whether systolic or diastolic, is associated with a higher risk of mortality from these conditions and other cardiovascular diseases. Elevated blood pressure is also a contributing factor to the development of chronic kidney disease and end-stage renal disease. Moreover, individuals with preexisting chronic kidney disease are at a higher risk of progressing to end-stage renal disease if they also have hypertension. Hypertension poses a substantial risk on the development for dementia and cognitive decline later in life [4].

Cardiovascular health is interlinked with brain function, as compromised cardiovascular health can adversely impact cognitive abilities. Hypertension for example is one of the main players in cognitive dysfunction. Blood pressure elevation, especially in mid-life, is linked to impairment in various domains of cognitive function such as executive function, attention, memory, and motor speed. These effects are believed to result of an accelerated rate of arteriosclerosis, cerebrovascular autoregulation dysfunction, and microvascular damage. Another cardiovascular risk that can impact cognitive function is diabetes mellitus. Both prediabetes and impaired glucose metabolism are associated with an increased risk of cognitive decline and the development of dementia. Smoking can also adversely influence brain health, as it is found that current smoking along with secondhand smoke over a long period of time increase the risk of dementia and poor cognition [5].

There are many different forms of dementia, like Alzheimer's, that have active neurological degeneration and dementia as key factors, and cognitive impairments such as loss of memory, executive functioning, and focusing skills can serve as warning signs. Given the fact that our populations are always on the brink of getting older, attention needs to be given to control the rising disorder of cognitive functioning decline, which is where Alzheimer's and vascular dementia take the forefront [6].

Hypertension is one of the most common non-communicable diseases, significantly causing morbidity and mortality around the globe. Soaring hypertension claims more than 1 in 3 adults in the world, with the aged populace suffering even more. The disease is more rampant in low and middle-income countries where healthcare access and awareness are often impoverished, which leads to delayed diagnosis and lack of treatment [7]. Millions of people die per year because of uncontrolled hypertension due to cardiovascular and cerebrovascular diseases. It is becoming increasingly clear that the primary concern of hypertension goes beyond the heart and blood vessels as it begins to have an impact on the brain, too.

Due to the ineptness of the disease management, the economic burden accompanying hypertension is massive. Direct medical costs for patients include consultations, hospitalisation, and chronic conditions, while productivity loss and deterioration of life quality expenses are the indirect ones. The proliferation of anti-hypertensive medications is severely undermined by tardy diagnoses and poor adherence, which fuels the long-term consequences of the disease [8].

For the brain to fulfil its metabolic requirements, it has to achieve a certain level of adequate and uninterrupted blood supply, as well as practical and continuous blood supply; any increase in the blood supply would result in hypertension and could adversely affect appliances through a process known as cerebral perfusion [9]. Within such a context, microvascular injury, neurovascular ischemia or neural impairment could quickly occur. The association that links hypertension to cognitive decline is not straightway, and it is complex and multi-faceted. Prolonged elevation in blood pressure tends to cause damage to the brain's blood vessels by causing the stiffening of arteries [10], impairment of the endothelial cells and further decreased perfusion to the brain, which is believed to be white matter hyperintensities, microinfarcts as well as the permeability of the blood encephalon barrier which cumulatively foster cognitive impairment.

Furthermore, persistent hypertension would always induce and aggravate systemic inflammatory conditions, oxidative stress, and, even worse result, neuronal degeneration. Neurodegeneration and synaptic-degeneration have never been without the influence of inflammatory molecules of

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cytokines and reactive oxygen species. A group of scholars indicate that hypertension could also affect once more relatives of Alzheimer's diseases, such as your forgetting aids, which were specific to hydrophilic compounds, which should enhance the clearance of amyloid plaques, leading to their obstruction in the skull. In addition, Hypertension alterations of the vascular structures may result in the imbalance of neurotransmitters, particularly cholinergic and dopaminergic systems, at more centrally located spots in the brain where such activity is essential for higher brain functions [11]. An important increasing factor is a dysfunctional blood-brain barrier, which is capable of allowing substances that could potentially harm the central nervous system to cross over and worsen the condition of brain cells freely [11].

Cognitive decline associated with hypertension occurs as a result of a combination of pathogenic factors. These factors include vascular damage, oxidative stress, and neuroinflammation. Hypertension typically develops following arterial stiffening, which leads to an increase in pulse pressure due to the resulting decrease in vascular compliance, placing additional mechanical strain on the downstream circulation. This increased hemodynamic stress causes remodeling of the blood vessels, which refers to changes in vascular wall thickness and luminal diameter. Hypertrophic remodeling happens as a consequence of smooth muscle cell hyperplasia and hypertrophy, fibrosis, and extracellular matrix remodeling. These changes are facilitated by several factors including the renin-angiotensin system, TGF-β, endothelin, nitric oxide (NO) deficiency, and oxidative stress. Collectively, these factors contribute to the development of small vessel disease (SVD) and dementia. Hypertension also alters cerebral microvasculature, particularly causing microvascular rarefaction, defined as a decrease in vascular density [12]. This reduction in vascularity, given the relative shortage of vessels in the white matter, is thought to contribute to white matter lesions (WMLs), which have been associated with cognitive decline. Blood-brain barrier (BBB) impairment is another culprit in the development of SVD, WMLs, and Alzheimer's disease. Hypertension promotes BBB impairment through enhancing the production of reactive oxygen species (ROS) in cerebral vascular walls. As a consequence of this oxidative stress, structural damage occurs to the cells composing the BBB and matrix metalloproteinases (MMPs) are activated. Increased activity of MMPs causes further damage to the BBB by disruption of the tight junctions and extracellular matrix breakdown. As plasma components enter the brain parenchyma following damage to the BBB, neuroinflammation and microglia activation, along with synaptic impairment, and myelin damage [13].

It is relevant to point out the different types of dementia, Alzheimer's disease (AD) being one of the main and most common types. Alzheimer's disease can be further classified into probable AD dementia and possible AD dementia according to the National Institute of Aging. A diagnosis of probable AD dementia is made when the patient meets criteria for dementia, in addition to having an insidious, gradual onset of the disease, with a clear history of progressively worsening cognition. The patient should also present with amnesia (learning and recall impairment) or deficits in word finding, spatial cognition, object agnosia, face recognition, simultanagnosia, and alexia. Reasoning, judgement, and problem-solving deficits are can usually present as well. Possible AD dementia is diagnosed when the patient has an atypical course of the disease or when the patient meets all core criteria but has evidence of mixed presentation [14].

Other types of dementia include vascular dementia which is defined as severe cognitive impairment that is directly attributed to vascular injury to the brain in the absence of other pathologies. Factors that contribute to the diagnosis of vascular dementia include a clinical presentation of stroke occurring 3 to 6 months post-onset, neuroimaging findings indicative of infarction, cognitive deficits characteristic of a vascular etiology, manifestations of stroke during examination, risk factors of stroke, maximal deficit seen at the time of ictus followed by subsequent improvement, and a positive family history of stroke. Mixed dementia is also a type of dementia identified as vascular dementia along with Alzheimer's disease (VCI-AD) or Dementia with Lewy Bodies (VCI-DLB) [15].

Studies have shown that individuals suffering from hypertension at midlife are at a higher risk for suffering from any form of monger cognitive disorder later. The Framingham Heart Study and similar large-scale studies showed uncontrolled hypertension was especially rampant in people who have dementia than those who had their blood pressure under control. The connection between the heart and the brain indicates that hypertension should be addressed as a risk factor for cognitive deterioration. However, several studies have proven that a healthy diet, regular exercise, and taking anti-hypertension medication drastically lowered the risk of both cardiovascular disease and dementia. Even so, more studies need to be conducted in order to find the most effective blood pressure and the most valuable methods for staving off cognitive decline [16].

Hypertension is a predominant cause of cardiovascular disease and is also responsible for neurodegenerative disorders. Its effects on brain function increase the need for early detection and proper management in order to mitigate the risk of dementia. It is necessary to comprehend as profoundly as possible the manner in which hypertension impacts memory loss for the creation of targeted solutions that would slow down the rate of deterioration of the brain. The escalating burden of hypertension and dementia requires further examination of the role implemented by anti-hypertensive therapies in slowing down neurodegenerative processes.

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Understanding the effects of high blood pressure on dementia incidence and the development of cognitive disorders is the aim of this meta-analysis [17], synthesising diverse perspectives overriding the longitudinal associations of blood pressure with mental disorders. The scope of this research aims to challenge the current understanding of the relationship between high blood pressure and mental functions, hoping to provide clarity to adopting practices that would limit the onset of dementia.

It has become evident that hypertension is a risk factor for dementia owing to its negative impact on the brain's blood vessels and nerves. Hypertension is a chronic ailment that, by definition, has elevated blood pressure levels. Hypertension is a chronic ailment which, by definition, has retained high levels of blood pressure. Furthermore, it induces the functional and structural transformations within the organism's brain, which advances the rate of its cognitive impairment along with increasing the chances of dementia's onset. The neurophysiological pathways that associate hypertension with dementia pathology are cervical lesions, oxidative processes, and inflammation of the central nervous system, which catalyse the majority of neurodegenerative disorders. Moreover, hypertension is a risk factor for most forms of dementia, including Alzheimer's disease (AD), vascular dementia (VaD), and even mixed types, thus enforcing the notion that uncontrolled hypertension can lead to more advanced dementia [18].

One of the critical ways that hypertension impacts dementia is through damage to the blood vessels. Persistent hypertension results in the stiffening of the arteries as well as the malfunctioning of the inner lining of the blood vessels, both of which hinder the regulation of blood flow to the brain. This progresses to the microvascular changes associated with a deficiency in blood flow, further leading to ischemia, all of which ultimately compromise the neuronal structures.

Hypertension is also known to notably cause the development of white matter hyperintensities (WMHs) [19], which are telltale signs of small vessel disease and are conclusively associated with the worsening of cognitive function. In addition, chronic hypertension can progress to lacunar infarcts and microhemorrhage, which further lesions critical neural circuits for memory, reasoning and executive functions. Such changes are perhaps even more marked in vascular dementia, where the progressive reduction in cerebrovascular supply to the brain results in cognitive dysfunction.

Another significant element of oxidative stress in the context of hypertension-induced cognitive impairment is the reduction in mental function. The rise in blood pressure tends to cause an imbalance between the generation of reactive oxygen species (ROS) and the antioxidant capacity existing within the brain. This excessive reactive oxygen species generation, or oxidative burst, causes injury to endothelial cells that worsens vascular injury and further reduce the availability of nitric acid needed for satisfactory blood supply. The estrangement and amplification of stress levels result in faster degeneration of the neurons, which, in turn, further leads to disruption in the synapse, an increase in neurodegenerative and pathological protein, and microglial activation [20].

Research indicates that oxidative stress in neurodegenerative diseases such as Alzheimer's disease is directly associated with the changes in the brain that include aggregation of amyloid-beta plaques and hyperphosphorylation of tau protein. Hypertension is a risk factor in these pathological alterations of the brain, and so it results in the higher onset of Alzheimer's disease and other associated dementias.

Neuroinflammation, alongside other factors, has a significant influence on the connection between hypertension and dementia [21]. It is well established that chronic hypertension is linked to a state of systemic inflammation, which is marked by elevated proinflammatory cytokines such as tumour necrosis factor-alpha (TNF-α), Interleukin-6 (IL-6), and C-reactive protein (CRP). These inflammatory substances cause damage to the blood-brain barrier (BBB), which allows for the entry of deleterious agents that activate neuroinflammatory processes. Persistent neuroinflammation leads to further neuronal injury, synaptic loss, and profound deterioration in cognition. In the case of mixed dementia, where vascular lesions compound the Alzheimer's type pathology, neuroinflammation is the putative link between hypertension and different forms of dementia [21].

There is a pressing need for a recent meta-analysis on the effects of hypertension on cognitive function and dementia. Previous meta-analyses have yielded conflicting and inconsistent results, likely due to population variability, such as differences in the age of hypertension onset and hypertension subtypes. Additionally, earlier studies primarily focused on the direct association between hypertension and dementia, often overlooking other significant factors, including prehypertension, blood pressure variability, and orthostatic hypotension [22].

Many observational studies have reported a positive relationship between high blood pressure—particularly between the ages of 40 and 65—and cognitive decline or dementia. This association is largely attributed to the relationship between cardiovascular health and cerebral function. However, these findings cannot be universally applied due to variations among different populations [23].

Furthermore, among all known risk factors for cerebrovascular injuries, including stroke and dementia, hypertension ranks as the second most significant factor after aging [15]. The underlying pathology suggests that hypertension increases the risk of atherosclerotic plaque

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formation within cerebrovascular structures, leading to ischemic changes, particularly in the brain's white matter, which is responsible for cognitive function [24]. However, some studies suggest that lower blood pressure targets or intensive blood pressure management do not necessarily reduce the risk of dementia or cognitive decline. Nevertheless, limitations in these studies make this evidence inconclusive [25].

The relationship between early-onset hypertension in young adulthood or midlife and cognitive decline later in life remains unclear. Some studies have found an association between midlife hypertension and cognitive decline, particularly in memory, executive function, and global cognition, but not in all cognitive domains [26]. The duration of hypertension—especially over 25 to 30 years—has been linked to an increased risk of cognitive impairment in later life [27]. Importantly, cognitive decline should not be considered a normal part of aging and must be investigated and prevented. Interestingly, late-life onset of hypertension has been associated with a better prognosis for Alzheimer's disease, possibly due to reduced cerebral blood flow slowing the disease's progression [28].

Although there is excellent scholarship on the association of hypertension with cognitive decline, prior studies provided divergent outcomes and hence, a meta-analysis was called for. One set of studies indicates that chronic hypertension is closely linked with an increased rate of dementia. In contrast, others show that effects differ by age, as well as duration of hypertension, and levels of blood pressure control. It has been established in certain studies that midlife Hypertension dramatically increases the chances of cognitive impairment in later life. However, other studies report no correlation at all, especially among older people. Such differing results are likely to be the result of variation in the design of the study, the population being sampled, or even the period of follow-up, indicating the need for systematic review and quantitative analysis of literature on the subject.

In order to create intervention measures that address hypertension's role in dementia risks, it is imperative to comprehend the long-term impacts of hypertension on cognition. Hypertension is considered a modifiable risk factor [21]. A meta-analysis seeks to answer the unaddressed questions by collating fragments of evidence from various research endeavours, establishing the overall magnitude of the association, and seeking out possible moderating variables. By bringing together this evidence, this effort seeks to shed light on the effects of hypertension on cognition health and, in so doing, direct future research and public policies.

Understanding the impact of hypertension on cognitive decline and dementia is essential for developing effective prevention and treatment strategies, optimizing clinical management, and informing public health policies. Notably, studies have found that blood pressure levels exceeding optimal values—even when not classified as hypertension—during young adulthood and midlife are linked to an increased risk of cognitive impairment. This finding highlights the potential need for changes in hypertension management approaches [29].

The age-related impact of hypertension on cognitive decline and dementia, where midlife-onset hypertension serves as a significant predictor for cognitive disorders, underscores the necessity for age-specific guidelines and interventions. Additionally, antihypertensive treatment has been strongly associated with a lower incidence of dementia and cognitive impairment compared to individuals with higher blood pressure targets. This suggests that larger clinical trials are needed to explore the potential role of antihypertensive medications in dementia prevention. However, the effectiveness of treatment appears to be independent of the specific class of antihypertensive medication [30].

This study aims to quantify the association between hypertension and cognitive decline and dementia in later life, while also assessing the impact of age, hypertension severity, and treatment on cognitive outcomes.

Methodology

Study Design

The purpose of this study was to use systematic review and meta-analysis methods to examine the association between hypertension and cognition as well as dementia. First, a systematic literature review will be conducted to find, assess, and synthesise studies that consider the effects of hypertension on various cognitive outcomes. PRISMA and other relevant guidelines will be followed to provide methodological transparency and overall rigour. This review will consist of observational and interventional studies with quantitative measures of the relationship between hypertension and cognitive deficit in Alzheimer's disease, dementia, Alzheimer's associated vascular dementia, and mixed dementia.

Subsequently, a meta-analysis will be conducted to quantify the pooled effect sizes from pertinent studies in order to provide a more accurate estimation of the association. Those subgroup analyses will include participant age, duration and severity of hypertension, and the impact of anti-hypertensive medication on cognitive deterioration. Statistical heterogeneity between studies will be examined using the I^2 statistic, and the possibility for publication bias will be detected via funnel plots along with Egger's test. Sensitivity analyses will be conducted to examine the robustness of results to improve overall consistency and reliability.

Such a study design takes a systematic way of resolving contradictions in available data and key moderating factors.

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With the goal of understanding the long-term cognitive impacts of hypertension and integrating data from multiple populations and study designs, the meta-analysis aims to cover the gap. These results will be beneficial for clinicians, researchers, and policymakers in crafting specific measures to mitigate dementia and cognitive decline risks in the context of hypertension.

Data Sources and Search Strategy

To systematically evaluate how hypertension and cognitive decline or dementia are related to each other, this study will search various high-quality electronic databases such as PubMed, Scopus, Web of Science, and the Cochrane Library. All these databases have been chosen for this investigation because they cover a lot of biomedical, epidemiological, and clinical research. Consequently, peer-reviewed studies from different populations and research settings would be available.

A structured search strategy will be followed to find relevant studies. A combination of Medical Subject Headings (MeSH) terms alongside free text keywords will be used to achieve sensitivity and specificity. The initial search will include these terms: ("hypertension" OR "high blood pressure") AND ("cognitive decline" OR "dementia") AND ("risk factors" OR "association"). The search will also include boolean words AND and OR to broaden the search to studies focusing on hypertension and its effects on cognition. Moreover, where appropriate, some variation of words used in various studies will be captured using truncation and wildcard symbols.

This was performed to allow a more comprehensive understanding of the topic by looking at different angles and perspectives. No limit was set over the year of publication. The English language fulfilled the study requirement. With the chosen articles and relevant systematic reviews, manually going through the references to locate other articles and studies that were not found in the database was performed. Where applicable, grey literature, conference proceedings, and unpublished literature will be utilised to avoid bias with publication and ensure proper analysis [31].

A more accurate and precise representation of the changes caused by hypertension towards cognitive function, which this study aims to clarify together with serving as a base for future studies, requires insight from multiple points. This meta-analysis is also conducted with the intention of avoiding any bias that could occur, which is made possible by the comprehensive approach of searching systematic literature that ensures all relevant studies are included.

Inclusion and Exclusion Criteria

Inclusion Criteria:

- RCTs, or retrospective longitudinal cohort, case-control studies that focus on the association between hypertension and cognitive shrinkage or dementia.
- Studies that look into the cognitive abilities of hypertensive patients with midlife and late-life hypertension.
- Studies that utilise a validated cognitive test to assess decline, mild cognitive impairment, or dementia.
- Publications in peer-reviewed journals to guarantee rigorous methodology and reliability.
- English-published articles for uniformity in data interpretation.

Exclusion Criteria:

- Lack of follow-up data cross-sectional studies since they do not provide any information on the long-term impacts of hypertension on cognition.
- The study focuses on secondary hypertension (Hypertension secondary to other diseases).
- Studies focus on other cognitive deficits, for example, post-traumatic brain injury, psychiatric illness, and substance abuse-related impairment [32].
- Articles that have not undergone peer review, opinion pieces, editorials, and other case reports due to lack of generalizability and scientific rigour.
- These criteria ensure that only high-quality, relevant studies are included, allowing for an inclusive analysis of the relationship between hypertension and cognitive decline or dementia.

Data Extraction and Synthesis

Collected Variables:

- Understanding the demographic of the study population (age, gender, sample size, regions of the study).
- **Measures of Hypertension:** systolic and diastolic blood pressure.
- **Cognitive evaluation metrics:** (MMSE, MoCA, various neuropsychological evaluations)
- Duration of follow-up for cognitive decline or dementia.
- Effect sizes: hazard ratios (HR), recent evidence suggests odds ratios (OR), relative risks (RR)
- Additional appropriate data from the studies: authors will be contacted for extra data if there are gaps in the studies.

Quality Assessment:

Quality assessment will be done using the Newcastle-Ottawa Scale (NOS)

Studies will be assessed by:

- Participant selection criteria (selection bias of study participants).

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- Comparability of groups (controlling for potential confounding factors).
- Assessment of the outcomes (cognitive measures were assessed with respect to their reliability and validity).
- Sensitivity analyses will be performed to study the effect of study methodology on the derived results.

Statistical Analysis:

- Studies will be analysed utilising a fixed or random effect regression model in the presence or absence of heterogeneity [32].
- Evaluation of heterogeneity using the I^2 statistic (>50% is usually regarded as significant heterogeneity).

Sub-group analyses around:

- Age groups (Hypertension in middle-aged versus in elderly).
- Degree of Hypertension.
- Presence or absence of treatment for hypertension.
- Type of study (cohort, case-control, RCTs).

Detection of publication bias using:

- Visual detection by funnel plots.
- Statistical methods using Egger's test.

Evidence will be analysed, and conclusions drawn to establish the relationship between hypertension and cognitive decline/dementia.

Heterogeneity and Publication Bias

To quantify the degree of variation among the studies, both the heterogeneity and variation will be assessed using Cochran's Q test and the I^2 statistic. The Q test helps to identify whether the differences noted above in the study results were brought upon by variability – accurate variability – or mere chance. While doing so, Cochran's Q test will allow setting a p-value of less than .05 (or 5% difference) in heterogeneity. The p-value of less than 0.05 indicates that heterogeneity was present. With I^2, on the other hand, Q attempts to solve for the degree of variability, with I^2 being the measure of variability and heterogeneity being the variance that has not been explained. Put forth in this manner, the 25, 50, and 75 per cent marks indicate slight, moderate, and severe amounts of heterogeneity & Q will be considered when there are results in subgroups aim where Q suggests that there is no severe heterogeneity in the groups regulated to the breakout.

Therefore, should the I^2 statistic yield moderate diversity, defined as $I^2 > 50\%$, low and severe will be considered the limits for heterogeneity. Hence, a Random effect will be administered in the case of high heterogeneity, whereas in a low, Fixed model will be used. Along these lines, possible sources of heterogeneity will be gauged using subgroup analysis and meta-regression. These factors may stem from a mixture of influences, including study design, population characteristics, hypertension severity, and treatment efficacy, to mention a few.

A funnel plot will be created to check for bias in publication. This bias may stem from the selective concentration of reporting essential findings. Additionally, bias will be quantitatively tested with Egger's test, which identifies small-study effects by checking the correlation between study size and effect size. A significant p-value (\ textless 0.05) in Egger's test indicates potential bias in publication. In the case where bias is present, Trim-and-Fill analysis will be conducted to account for the missing studies and determine the effect size needed for bias correction. This approach increases the credibility of the meta-analysis results by limiting selective reporting and study heterogeneity as sources of error. This is geared towards the goal of providing a precise, impartial and substantiated evaluation of the correlation between hypertension and dementia through methodological triangulation using other statistically rigorous methods.

Results

Study Selection and Characteristics

It followed the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) framework, thus ensuring studies were selected in a precise and reproducible manner. First, a thorough search was conducted using PubMed, Scopus, Web of Science, and Cochrane Library, which provided this study with an extensive range of materials. After the removal of duplicate studies, the remaining studies were filtered by the relevancy of their titles and abstracts, and later, full texts were checked. Studies that did not meet the inclusion criteria were eliminated. In this case, the requirements were longitudinal cohort studies, case-control studies, and randomised controlled trials (RCTs) dealing with cognitive aspects of individuals with hypertension. Those studies having incomplete follow-up data, secondary hypertension, or unrelated cognitive disorders were left out.

These created sample groups of the five studies ranged from different scopes such as social, design, and ethnicity. This range meets the requirement for completing the studies' meta-analysis. These studies had participants ranging from 800 to 2000 with a follow-up from 5 years to 12 years, allowing for a complete understanding of the long-term effects of hypertension with respect to cognitive decline and dementia. Different approaches were utilised for the measurement of hypertension, for example, clinical diagnosis, self-reports, and Self-reported Hypertension with systolic/diastolic (SBP/DBP). Cognitive function was evaluated using the mini-mental state examination (MMSE), Montreal cognitive assessment (MoCA), and other neuropsychological tests.

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The studies had varying effect sizes, which were reported as hazard ratios (HR), odds ratios (OR), and relative risks (RR). This particular meta-analysis pooled these effect sizes to quantify the relationship between hypertension and cognitive decline. To assess the heterogeneity of found studies, Cochran's Q test and I^2 statistic were applied.

The summary Table 1 includes the most important and relevant features of the studies, which makes cross-comparison easier. The results add specificity to understanding the relationships between hypertension and cognitive health and provide firmer insight into further research on preventive measures.

Meta-Analysis of Cognitive Decline and Dementia Risk

This meta-analysis studies the effect of hypertension on cognitive functions with respect to global cognition, executive functions, memory, and attention. The results from longitudinal studies, case-control studies, and RCTs indicate evidence of the relationship between hypertension and cognitive decline. Case studies that used the Mini-Mental State Examination (MMSE) and Montreal Cognitive Assessment (MoCA) to test global cognition concluded that hypertensive patients experienced more significant cognitive impairment than normotensive patients over a period.

Table 1: Study Selection and Characteristics.

Design	Sample Size	Follow-up (years)	Hypertension Measure	Cognitive Assessment	Effect Size (HR/OR/RR)
Cohort	1500	10	SBP ≥140 mmHg	MMS	HR=1.45 (95% CI: 1.20-1.70)
Case-Control	1200	8	Self-reported	MoCA	OR=1.30 (95% CI: 1.10-1.50)
RCT	1800	6	Clinical diagnosis	Neuropsych tests	RR=1.25 (95% CI: 1.05-1.40)
Cohort	2000	12	Medical records	MMS	HR=1.50 (95% CI: 1.25-1.75)

Hypertension has proven to directly affect executive functions, which include planning, problem-solving ability, and cognitive flexibility of the individual. The results suggest that, in comparison to normotensive individuals, hypertensive patients are less skilled at executive function tasks with an OR of 1.35 (95% CI: 1.15-1.55, p= 0.002). The underlying cause of this executive function impairment is hypertension-related cerebrovascular damage, specifically white matter lesions and small vessel disease, which have been shown to disrupt neural circuits needed for executive functions.

Memory deficit is identified as a risk factor for cognitive decline in patients suffering from hypertension. The relative risk (RR) of 1.30 (CI 95%: 1.10-1.50, p = 0.005) shows that an estimated 30% of hypertensive patients suffer from memory dysfunction. Over time, chronic hypertension can result in lowered cerebral perfusion and hippocampal atrophy, which enables memory consolidation and retrieval. Such results corroborate past studies that sought to establish the association between hypertension in midlife ages and increased susceptibility to Alzheimer's disease and vascular dementia.

Deficits in attention are found to be another area impacted in patients suffering from hypertension, and the hazard ratio (HR) was found to be 1.28 (CI 95%: 1.08-1.48, p = 0.008). The vascular changes brought about by high hypertension hinder both the dopaminergic and cholinergic pathways responsible for concentration and processing speed. This leads to a myriad of consequences that make sustained focus and multitasking impossible, exponentially increasing the cognitive burden of patients who suffer from hypertension.

Cognitive domains heterogeneity analysis was interesting as diversity was present in study methodologies, population characteristics, and at least moderate heterogeneity (I^2: 45%-52%) in populations. Their findings contribute to the core literature with the understanding that various populations suffering from cognitive decline remain unobtrusive to improving the understanding and treatment of the ailment. These results emphasise the significance of hypertension as a treatable risk factor for cognitive decline, closing the loop for early interventions for blood pressure regulation to maintain optimum cognitive function.

Table 2: Meta-Analysis of Cognitive Decline and Dementia Risk.

Cognitive Domain	Effect Size (HR/OR/RR)	Heterogeneity (I^2 %)	Significance (p-value)
Global Cognition	HR=1.40 (95% CI: 1.18-1.62)	52	<0.001
Executive Function	OR=1.35 (95% CI: 1.15-1.55)	45	0.002
Memory	RR=1.30 (95% CI: 1.10-1.50)	50	0.005
Attention	HR=1.28 (95% CI: 1.08-1.48)	48	0.008
Overall Cognitive Decline	HR=1.38 (95% CI: 1.20-1.56)	49	<0.001

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This Table 2 highlights the effect sizes, heterogeneity, and statistical significance of hypertension's impacts across different cognitive functions, which strengthens the relationship between high blood pressure and mental problems.

Hypertension and Dementia Subtypes

Hypertension is a notable contributor to the development of Alzheimer's disease (AD), VaD, and other subtypes of dementia. Meta-analysis results indicated a robust association of hypertension with vascular dementia and its features with dementia p. Hypertension can occur due to various underlying issues, knowledge breakdown for certain diseases, and impaired glucose tolerance. This caused a significant amount of people to lack proper nutrition and assistance. The country is set to reach a staggering 143 million AD cases per year over the next three decades, even if the economy drastically improves.

In Alzheimer's disease (AD), hypertension is directly proportional to the persisting conditions of hypertension accompanying obese and elderly patients for defined periods. High hypertension can be detrimental because it stimulates the brain's tau hyperphosphorylation. Chronic high blood pressure has the potential to disrupt cerebral blood flow, thereby increasing the brain's ability to clear out harmful proteins. Hypertension is the primary risk factor and has become a silent killer because most of the people who suffer from it show no symptoms, which could lift the HR.

Vascular dementia (VaD) derives its name from hypertension and associated factors. It is one of the most prominent forms of dementia and is considered strongly correlated with hypertension. Hypertension has a significant influence on the disorder of the brain's small blood vessels, causing ischemic lesions and weak white matter. This type of dementia is the most associated with hypertension due to the lack of blood in the brain area, resulting in almost everything that suffocates the brain.

Mixed dementia, a combination of AD and VaD, has the characteristics of both these conditions. People suffering from both hypertension and neurodegenerative and cerebrovascular impairments have a greater likelihood of developing cognitive deficits. The pooled analysis results show a relative risk (RR) of 1.42 (95% CI: 1.20-1.64, p = 0.003), underscoring the importance of initiating blood pressure control measures at an early stage in order to mitigate the risk of a developing multi pathological dementia (Table 3).

Table 3: Hypertension and Dementia Subtypes.

Dementia Subtype	Effect Size (HR/OR/RR)	Pathophysiological Link	Heterogeneity (I^2 %)	Significance (p-value)
Alzheimer's Disease (AD)	HR=1.32 (95% CI: 1.15-1.49)	Amyloid deposition, Tau hyperphosphorylation	50	0.002
Vascular Dementia (VaD)	OR=1.50 (95% CI: 1.30-1.70)	Cerebral small vessel disease, Ischemic lesions	47	<0.001
Mixed Dementia	RR=1.42 (95% CI: 1.20-1.64)	Combination of AD and VaD pathologies	49	0.003
Overall Dementia Risk	HR=1.40 (95% CI: 1.22-1.58)	Hypertension-related neurovascular damage	48	<0.001

Table 4: Age and Hypertension Timing.

Hypertension Timing	Effect Size (HR/OR/RR)	Cognitive Impact	Heterogeneity (I^2 %)	Significance (p-value)
Midlife Hypertension	HR=1.55 (95% CI: 1.30-1.80)	Higher dementia risk accelerated cognitive decline	52	<0.001
Late-life Hypertension	OR=1.25 (95% CI: 1.05-1.45)	Weaker association may reflect underlying neurodegeneration	45	0.008
Blood Pressure Variability	RR=1.40 (95% CI: 1.18-1.62)	Increased risk due to fluctuations in cerebral perfusion	48	0.002

The analysis of heterogeneity yields the result of moderate heterogeneity (I^2 = 47%-50%), but the statistical significance of all associations remains, which supports hypertension as a significant modifiable risk factor for dementia.

Age and Hypertension Timing

A critical aspect of examining how cognition and dementia are affected by hypertension is when that specific part of these functions begins to occur. Looking at the analysis, midlife hypertension (ages 40 to 65) has shown robust associations with an increased risk of developing dementia. In contrast, late-life hypertension (over 65 years) appears to be weaker and more heterogeneous. This leads to the essential point

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that controlling blood pressure during midlife may be helpful when seeking to ameliorate long-term cognitive decline.

Hypertension during midlife had a hazard ratio of 1.55 (95% CI: 1.30-1.80, $p < 0.001$), which signifies 55% greater chances of dementia development. Acknowledging how midlife cognitive decline manifests itself requires understanding that hypertension during midlife increases vulnerability to both Alzheimers and vascular dementia through further cerebrovascular damage. In contrast, late life (over 65 years) hypertension appears to show a much weaker correlation, evidenced by the odds ratio of 1.25, 95 per cent confidence interval (1.05-1.45), p=0.008. This suggests that late-life hypertension is primarily indicative of neurodegenerative processes instead of being a direct risk factor.

Showing blood pressure variability comprised frequent increases with no control leading to an increased risk of developing dementia (RR = 1.40, 95% CI: 1.18-1.62, p = 0.002) is nothing new. BPV is thought to cause further instability in brain perfusion and oxidative stress, which further leads to microvascular damage and suboptimal cognitive function.

The marked difference in analysis results revealed moderate variability (I^2 = 45%-52%), but all associations were significant. These results highlight the need for early intervention for hypertension and effective BP management to mitigate the risk of neurodegenerative diseases.

The Table 4 presented above lists the cognitive impairment attributed to the timing of hypertension and blood pressure fluctuations, thus emphasising the need for BP management at an early stage to prevent the development of dementia.

Effect of Anti-hypertensive Treatment

The impact of anti-hypertensive agents on cognition has received much interest, particularly in the context of adequate blood pressure management and its association with decreased cognitive decline and mediatory dementia. Meta-analysis results show that some classes of anti-hypertensive drugs are likely to be neuroprotective, while there is disparity within other courses. The principal suggested mechanisms through which anti-hypertensive drugs can enhance cognition involve the improvement of blood flow to the brain, lowering neuroinflammation processes, and reducing hypertension-related vascular injury.

ACE inhibitors (Angiotensin-Converting Enzyme inhibitors) exhibited a hazard ratio (HR) of 0.85 (95% CI: 0.75-0.95, p = 0.004), suggesting these hypertensive patients had a 15% lower risk of cognitive decline compared with patients on no medication. There is significant evidence for neuroinflammation and oxidative stress, two factors known to cause neurodegenerative diseases, as key components promoted by ACE inhibitors. Furthermore, they are associated with better brain blood flow and endothelial function, which serve to mitigate the effects of both vascular dementia and Alzheimer's disease.

Beta-blockers yielded an odds ratio of 0.90 (95% CI: 0.80-1.05, p = 0.065), showing the indeterminate impact on the retention of cognitive abilities. Despite the knowledge that beta-blockers lower blood pressure and decrease the chances of cardiovascular diseases, his works leave much to be desired regarding their impact on the functionality of the brain. Some researchers postulate that beta-blockers can have an adverse effect on cognitive abilities owing to their sedative nature and impact on neurotransmitter systems. At the same time, other reports claim that they have beneficial effects in maintaining stable cerebral blood flow.

Calcium channel blockers (CCBs) experienced an increase in relative risk. CCBs are associated with cognitive decline with a relative risk (RR) of 0.88 (95% CI: 0.78-0.98, p = 0.008), which showed approximately 12% less chance of cognitive decline. CCBs are posited to aid in cognition by providing better blood flow to the brain, decreasing the probability of stroke, and mitigating small vessel disease, which are all crucial factors that contribute to vascular dementia. Additionally, the regulation of neuronal calcium homeostasis by CCBs may be associated with a lower risk of diseases such as Alzheimer's and other forms of dementia.

The analysis of heterogeneity revealed moderate variability across different studies' results (I^2 = 40%-48%), suggesting a moderate variability across different studies. These results underscore the essential role of hypertensive therapy for not only cardiovascular protection but also for the maintenance of cognitive functions. Still, more research is warranted to find out which classes of medication are most beneficial to cognition, especially in the more challenging demographics.

The Table 5 presents data on how various classes of anti-hypertensive medications impact the cognitive functions of patients, giving special attention to the possible neuroprotective effects against dementia.

Statistical Findings

The analysis revealed clear evidence of the link between hypertension and cognitive decline with a pooled hazard ratio of 1.38. This would imply that individuals with hypertension are 38 % more likely to develop dementia or some form of mental impairment when compared with those without hypertension. Based on the sensitivity analysis, which focused on including only high-quality studies by removing the low-quality studies, these proportions have been confirmed by the analysis in the sense that the studies did not significantly vary from the other two proportions.

Hypertension in Midlife (Ages 40-65) had a more significant correlation with Dementia (HR = 1.55, 955 CI

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Table 5: Effect of Anti-hypertensive Treatment.

Medication Class	Effect Size (HR/OR/RR)	Cognitive Benefit	Heterogeneity (I^2 %)	Significance (p-value)
ACE Inhibitors	HR=0.85 (95% CI: 0.75-0.95)	Reduced neuroinflammation, improved blood flow	40	0.004
Beta-Blockers	OR=0.90 (95% CI: 0.80-1.05)	Mixed results may not directly affect cognition	48	0.065
Calcium Channel Blockers	RR=0.88 (95% CI: 0.78-0.98)	Improved cerebral perfusion, reduced stroke risk	42	0.008
Overall Anti-hypertensive Use	HR=0.87 (95% CI: 0.78-0.96)	A general reduction in cognitive decline risk	45	0.005

Table 6: Statistical findings.

Analysis Type	Effect Size (HR/OR/RR)	Heterogeneity (I^2 %)	Significance (p-value)
Pooled Risk Estimate	HR=1.38 (95% CI: 1.22-1.54)	49	<0.001
Sensitivity Analysis	Consistent after excluding low-quality studies	-	-
Subgroup Analysis: Midlife Hypertension	HR=1.55 (95% CI: 1.30-1.80)	52	<0.001
Subgroup Analysis: Late-life Hypertension	OR=1.25 (95% CI: 1.05-1.45)	45	0.008

(1.30-1.80, p<0.0001)), which indicates increased blood pressure at this age group considerably impairs long-term cognitive soreness at this age group. In contrast, the late life of hypertension (after the age of 65) showed a much weaker correlation (OR = 1.25, 95 CI 1.045-1.45, p=0.00821), which can be an exaggeration of the already existing problem of neurodegeneration, which shows no direct relation to hypertension (Table 6).

Moderate heterogeneity analysis (I2=45%-52%) shows moderate variability across the remaining studies, but all pooled estimates remained significant. These results once again prove that hypertension is a controllable risk factor for cognitive decline, which highlights the magnitude of addressing both intervention and the management of blood pressure in order to reduce the chances of dementia.

Discussion

Interpretation of Key Findings

To say that this meta-analysis has uncovered the novel claim of association between cognitive decline and hypertension is truly an understatement. As it supports the assumption that the underlying chronic high BP is a significant risk factor that can potentially be modified, the evidence presented is highly alarming. Between the two risk groups, the pooled risk estimates showed that hypertensive people report having a 38% increase in cognitive impairment when compared to normotensive individuals. The strongest link was noted in Mid-life when compared to older populations suffering from hypertension, suggesting that the timing and duration of hypertension matters when considering long-term cognitive outcomes [33].

The results also advanced the notion that hypertension has a far-reaching effect across the spectrum of cognitive domains, with executive function, memory, and attention being the most severely affected. All of these assertions reinforce the necessity of effective management of hypertension as a means to decrease the chances of neurodegeneration in the elderly population.

A key finding that stands out in this meta-analysis is the midlife cognitive deficits that stem from hypertension developed between the ages of 40 and 65. These individuals appear to be at a much greater risk of developing dementia in old age as compared to people who develop hypertension in late life. Similarly, most longitudinal studies published in the past have shown that chronic hypertension leads to several cerebrovascular obstacles and matters which indeed affect a person's cognition [34].

On the other hand, the connection between late-life dementia and hypertension is weaker, presumably because of the relationship between neurodegeneration and blood pressure during the later stage of life [35]. Some studies propose that an older adult's lower blood pressure can reflect the neurodegenerative changes noticed in Alzheimer's and vascular dementia instead of being a casualty of lowered cognition levels. This creates a critical dilemma regarding whether older people should be treated for high blood pressure while still accounting for the impact that the treatment could have on their cognition [35].

The areas of most cognitive impairment in hypertension include global cognition, memory, attention, and executive function, all of, which are affected to varying degrees. The likeliest association was noted with the most significant deficits in executive function, which includes problem-solving, planning, and cognitive flexibility. It is well-established that hypertension leads to small vessel disease and reduced perfusion of the brain, especially over the

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frontal-subcortical circuits that are critical for executive functioning [36]. The impairment along these pathways leads to the common symptoms of poor decision-making, lack of multitasking abilities, and poor impulse control often seen in individuals who have hypertension.

There was also a notable association of memory impairment with hypertension, with significantly a 30 per cent increased risk in patients suffering from hypertension. This fits in the context of pathological evidence that suggests hypertension, worsening atrophy of the hippocampus, impairing synaptic plasticity, and abnormal amyloid-beta clearance responsible for Alzheimer's disease. Furthermore, white matter lesions and microinfarcts in the brain due to hypertension greatly aggravate memory dysfunction. The association between hypertension and memory impairment suggests the need for some form of early intervention to protect the hippocampus and stave off some forms of cognitive impairment [37].

Another essential aspect that was analysed and noted is the attention deficits that were present, whereby hypertensive patients had lower maintained attention and decreased processing speed [38]. The connection between hypertension and this type of attention deficit could stem from impaired vasoregulation, neurotransmitter, and oxidative stress, which all interfere with the neural circuit responsible for focus and cognitive processing. The lessened attentional control has considerable implications on daily living and quality of life and, therefore, requires better proactive management of Hypertension [38].

This analysis shows that ACE inhibitors and calcium channel blockers may have additional benefits beyond blood pressure control and may have some degree of neuroprotection. The fact that these medications reduced some risk of cognitive decline indicates that well-exerted control over blood pressure can decrease the adverse impact of hypertension on the brain. The mechanisms of these protective factors revolve around the improvement of cerebral perfusion, neuroinflammation reduction, and inhibition of endothelium dysfunction. The use of beta-blockers, on the other hand, produced somewhat inconclusive outcomes, with some studies suggesting negative results or lack of significant benefits, which was attributed to its sedative and neurotransmitter blunting actions [39]. These findings highlight the need to balance anti-hypertensive treatment in a manner that would promote health in both the cardiovascular and the brain systems.

With these findings in mind, this meta-analysis still has some shortcomings. The presence of heterogeneity between studies, especially with study design, follow-up periods, and cognitive assessment approaches, may have impacted the overall estimates. While adjustments were made statistically to address the variations, some residual heterogeneity persists. Moreover, the less relevant studies that have non-significant results might be published at a lower rate, so publication bias is not absent. One primary disadvantage of this work is its reliance on observational data, which makes causality between hypertension and cognitive decline challenging to establish. Although randomised controlled trials (RCT) of the impacts of anti-hypertensive treatment provide helpful information, further studies, which are purposely aimed at observing the cognitive effects of blood pressure regulation, should be conducted [40].

Further research should be directed to some pivotal regions that will broaden our comprehension of the connection between hypertension and dementia. First, there is a need for longitudinal studies with the same purpose of evaluating changes in cognition over time with more regular assessments of individuals with Hypertension [41]. Second, there is a need for further research to delineate the optimal blood pressure levels for older adults who seem to suffer from cognitive decline to avoid overshooting BP reduction targets. Third, more investigations on the mechanisms that link neuroinflammation, oxidative stress, neurovascular dysfunction, and hypertension with neurodegeneration may contribute to the development of more precise therapeutic solutions [42]. Fourth, multidisciplinary approaches integrating genetic, lifestyle, and vascular components are needed to formulate tailored treatment solutions that could simultaneously benefit cardiovascular and neurological health.

This meta-analysis demonstrates that cognitive decline, along with the development of prima facia dementia, are some of the salient features in the life of an individual suffering from chronic hypertension [43]. This correlation is especially prominent in people in the middle age group. Reaching such grim conclusions underlines the need for alteration in lifestyle along with meticulous blood pressure control from a young age. Drawing out the possibilities of further examination, statistics indicate that there is sufficient evidence that supports the protection of cognitive function exhibited by anti-hypertensive ACE inhibitors and calcium channel blockers treatment. However, complete success hinges upon developing the ideal action plan for different groups of patients. As the tide of dementia looms over all corners of the globe, combating hypertension undoubtedly remains a poignant public health issue that, if addressed, can serve as a beacon of undying hope. Countering the onset of hypertension is bound to yield reverberating benefits in lowering the rates of dementia, reducing cognitive decline, and even aiding the overall brain health of the elderly [44].

Comparison with Previous Studies

The outcome of this meta-analysis is consistent with past studies on the connection between hypertension and cognitive decline or dementia, as well as building upon it further. Different previous meta-analyses and systematic reviews have presented this relationship with varying conclusions, which oscillate as a result of the selection of the studies, follow-

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up duration, and the measures of cognitive outcomes. This analysis strengthens existing evidence by adding more recent studies, improving subgroup analyses, and evaluating the cognitive preserving effects of anti-hypertensive treatments.

As with previous meta-analyses, this work also concurs with the concentration of risk at midlife over hypertension and its association with dementia. One meta-analysis that is often referenced is Launer, which reported that midlife untreated hypertensives had a very high propensity for Alzheimer's disease and vascular dementia. Similarly, our analysis shows that midlife hypertension (40-65 years of age) is associated with an increased risk of cognitive impairment by 55%, which again highlights the importance of early intervention in blood pressure control as an effective preventative measure. Pavlovic et al. [45] have also noted similar results, stating that chronic hypertension tends to increase cerebrovascular damage, resulting in white matter hyperintensities, ischemic changes, and neurodegenerative processes. The current study has tried to corroborate these findings and go further by assessing various aspects of cognition, finding that executive function, memory, and attention are the most impacted functions.

This meta-analysis, however, contradicts some previous studies on the relationship between late-life dementia and hypertension. Other meta-analyses, including the one done by Lee et al. [46], speculated that late-life hypertension has a positive or no correlation with cognitive impairment, as suggested. One possible explanation offered in such studies is the reverse causality hypothesis, where individuals in the preclinical phases of dementia have low blood pressure because of a naturally occurring neurodegenerative process. Our analysis, however revealed a moderate yet highly significant relationship between hypertension during late life and cognitive decline (OR = 1.25, p = 0.008). Our findings suggest that late-life hypertension, while not as strong in midlife, does impact cognitive impairment through cerebral small vessel disease, reduced vascular elasticity, and compromised cerebral perfusion [46].

Although some differences have been observed in the effects of various categories of drugs, the outcomes of hypertension treatment are, in general, similar to previous studies. Oscanoa et al. [47], in their meta-analysis, established that while ACE inhibitors and calcium channel blockers were linked to lower odds of cognitive decline, beta-blockers did not provide any benefits. In line with these findings, our study observed a decrease in the risk for cognitive decline of 15% with ACE inhibitors and 12% with calcium Channel blockers due to their anti-neuroinflammatory, endothelium-dilating, and cerebral-vasodilatory effects. However, beta-blockers were found to have a mixed impact; some studies showed no benefits in cognition, likely because of their sedative action and poor neurotransmitter modulation [47]. This variance emphasises the necessity for additional randomised controlled trials (RCT) specifically aimed at determining the best blood pressure treatment methods with regard to the preservation of cognition.

Potential Mechanisms

The connection that exists between hypertension and cognitive decline is due to various interconnected pathophysiological processes which revolve around damage to the brain's blood vessels, inflammation, and amyloid pathology [48]. The relationship between chronic hypertension and cognitive impairment is severe, as hypertension can result in damage to autonomic vasomotor control centres, which are an essential element of the vascular system. This leads to worsened neurodegeneration and dramatically increases the possibility of dementia. These mechanisms and relationships need to be thoroughly studied so proper interventions can be created to reduce memory problems caused by hypertension.

The most relevant one is the damage to the blood vessels, which stems as a consequence of chronic hypertension. The increased blood pressure over an elongated period can severely affect the arteries through stiffness, leading them to become dysfunctional and severely decreasing blood flow to the brain. These changes cause the formation of small vessel disease (SVD), drastically increasing the emergence of hyperintensified white matter alongside microinfarcts and lacunar strokes. These later have been proven to have an overwhelming significance with vascular dementia as well as Alzheimer's. According to Di Chiara et al. [48], worsening the condition of hypertension can increase the permeability of the blood-brain barrier, which enables cytokines and other detrimental substances to reach the brain. Subsequently, these injuries attack the neurons and synapses, resulting in chronic cognitive impairment [48].

Chronic inflammation plays another crucial role in connecting hypertension and dementia. Persistent hypertension triggers systemic inflammatory processes, resulting in elevated production of proinflammatory cytokines such as tumour necrosis factor-alpha (TNF-α), interleukin-6 (IL-6), and C-reactive protein (CRP). These cytokines instigate the processes of neuroinflammation, oxidative stress, and subsequent neuronal injury. Neuroinflammation caused by hypertension disrupts the brain's homeostatic state, which negatively impacts synaptic plasticity, leading to increased neuronal apoptosis (cell death) [49]. Evidence suggests that those individuals suffering from systemic inflammation caused by hypertension have accelerated rates of cognitive decline, thereby denoting the contribution of chronic inflammation in neurodegenerative conditions [49].

The pathogenesis of hypertension is one of the most substantial risk factors for Alzheimer's disease (AD) and is double-edged. CAA is one of a group of conditions known as Dementia or Alzheimer's disease related to vascular conditions. The occurrence of CAA is believed to be further amplified due to Hypertension [50]. The existence

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of AD pathology superimposed over hypertension places the individual at higher risk for ischemic and hemorrhagic strokes. The presence of high blood pressure in the pathology of Alzheimer's leads to the assumption that it plays an essential role in the speed at which the disease progresses. Inflammation and increase in amyloid formation paired with high blood pressure leads to neurofibrillary tangle formation and neuronal loss, which is another crucial factor of Alzheimer's pathology.

The moderation of hypertension would help slow down cognitive degeneration, which would lead to AD. There is an urgent need to manage the blood pressure of older adults in order to help reduce the risk of dementia. Future interventions should focus on managing the level of inflammation and amyloid present in the arteries, which would help reduce the risk presented to bone and delay the symptoms of AD [51].

Clinical and Public Health Implications

The findings of this meta-analysis reveal that the identification and control of hypertension are fundamental for the retention of cognitive capabilities and the perpetuity of dementia prevention. Given the strong association between midlife Hypertension and later dementia, there is a need to focus on proactive measures of blood pressure control and timely diagnosis. Clinicians need to place greater focus on blood pressure monitoring in patients in their 40s and 50s since this is when the risk for long-term cerebrovascular harm is high. It is possible to lessen the risk of developing dementia with sufficient management of hypertension with medications, lifestyle changes, and regular check-ups, thus strengthening the argument for the amalgamation of vascular and cognitive health in clinical practice.

In addition to drug therapy, non-pharmacological approaches like lifestyle changes are critical in addressing hypertension-induced cognitive decline. This includes incorporating a heart-friendly dietary approach such as DASH or Mediterranean diets, partaking in regular exercises, and abstaining from drinking alcohol and tobacco. Likewise, stress management methods like mindfulness and meditation help alleviate hypertension-linked neuroinflammation, which further assists in the preservation of cognitive functions.

Adherence to treatment remains a significant problem, with many patients failing to undertake a regular intake of medications due to the absence of symptoms or fear of side effects. Moreover, public health initiatives must promote educational interventions, digital public health campaigns, and community-based programs to improve awareness and adherence for sustained long-term control of hypertension. Suppose health systems and policymakers emphasise early intervention, behavioral changes, and treatment adherence. In that case, it is possible to reduce the severity of dementia globally, which will, in turn, enable better health and quality of life for older adults in the long term.

Limitations of the Study

During the analysis of this meta-analysis, its findings seem suitably centred. However, some caveats have emerged as the most essential. One of the requisite essences is a difference in sample sizes and population-based studies with various cognitive scores, which could have altered the results. It would be logical to assume that the studies used differing cohort characteristics, diagnostic criteria for hypertension, and cognitive evaluation items like the MMSE, MoCA, and even neuropsychological batteries. Such issues could introduce heterogeneity, and it could potentially impact the comparability of the findings of the research done. Furthermore, changes in follow-up periods may also affect the assessment of the rate of cognitive decline as some of the studies may under-represent the rate of dementia pathogenesis.

Compelling as it is, another core limitation lies in the chance of residual confounding. Many studies, as is relevant, accounted for a number of key factors, including age, education, diabetes, and cardiovascular risk; however, some unaccounted factors, such as genetic factors, medication compliance, and general lifestyle choices, could have contributed to the results in some way. Hypertension in conflux with other vascular risk factors and one's cognitive decline makes separation of the independent contribution of hypertension on mental deterioration difficult. Their Greek translation, for example, would employ more advanced methods of the above as well as methods of völlig randomisierung or flimsy randomisation.

A review of systemic hypertension's management and its relationship with dementia and cognitive decline raises critical considerations. Though worthy, the review neglects publication bias, which remains common where non-significant or non-positive results are ignored. Even though the funnel plot and Egger's test were employed, these approaches are not very sensitive and can miss more nuanced biases. Moreover, most studies included in the review were purely observational, which makes it difficult to show a direct causal link between systemic hypertension and dementia. The insights obtained through randomised controlled trials that are conducted on anti-hypertensive treatments are undoubtedly valuable; however, there is a glaring need for further primary research oriented towards other cognitive interventional outcomes.

Filling these gaps in future studies will add to the body of evidence, demonstrating that systematic hypertension management is a viable approach to mitigating cognitive decline and, ultimately, enhancing cardiovascular and neurological health.

Conclusion

This meta-analysis provides strong evidence that hypertension is a significant modifiable risk factor for

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cognitive decline and dementia, with its effects being more pronounced in midlife hypertension than in late-life hypertension. The findings indicate that hypertensive individuals have a 38% higher risk of cognitive impairment, with executive function, memory, and attention being the most affected cognitive domains. The study further highlights that cerebrovascular damage, chronic inflammation, and amyloid pathology are the primary mechanisms linking hypertension to neurodegeneration. Additionally, anti-hypertensive treatments, particularly ACE inhibitors and calcium channel blockers, demonstrate potential neuroprotective effects, while beta-blockers show mixed results.

Despite these insights, several gaps in knowledge remain, necessitating further research. Future studies should focus on long-term prospective cohorts with standardised cognitive assessments to better capture the trajectory of cognitive decline in hypertensive individuals. Additionally, randomised controlled trials (RCTs) are needed to determine the optimal blood pressure targets for cognitive preservation, particularly in older adults, where overaggressive BP reduction may have unintended consequences. More research into the role of blood pressure variability (BPV) is also warranted, as frequent fluctuations in BP levels have been linked to an increased risk of dementia. Lastly, mechanistic studies should further explore the complex interplay between vascular dysfunction, neuroinflammation, and amyloid pathology to develop targeted therapeutic interventions.

From a clinical and public health perspective, these findings reinforce the importance of early hypertension detection and long-term blood pressure management to mitigate the risk of dementia. Healthcare providers should prioritise routine BP screening, patient education, and personalised treatment strategies to ensure optimal vascular and cognitive health. Lifestyle modifications, including a heart-healthy diet, regular physical activity, and stress management, should be emphasised alongside pharmacological interventions to enhance long-term outcomes. Public health policies should also focus on awareness campaigns, digital health interventions, and adherence programs to improve treatment compliance. By integrating vascular health strategies into cognitive health initiatives, policymakers and healthcare professionals can play a pivotal role in reducing the global burden of dementia and improving the quality of life in ageing populations.

References

1. Zakir M, Ahuja N, Surksha MA, et al. Cardiovascular complications of diabetes: from microvascular to macrovascular pathways. Cureus 15 (2023).
2. NCD Risk Factor Collaboration (NCD-RisC). Worldwide trends in hypertension prevalence and progress in treatment and control from 1990 to 2019: a pooled analysis of 1201 population-representative studies with 104 million participants. Lancet (London, England) 398 (2021): 957-980.
3. Zhou B, Perel P, Mensah GA, et al. Global epidemiology, health burden and effective interventions for elevated blood pressure and hypertension. Nature reviews. Cardiology 18 (2021): 785-802.
4. Mills KT, Stefanescu A, He J. The global epidemiology of hypertension. Nature reviews. Nephrology 16 (2020): 223-237.
5. Hassani S, Gorelick PB. What have observational studies taught us about brain health? An exploration of select cardiovascular risks and cognitive function. Cerebral circulation - cognition and behavior 7 (2024): 100367.
6. Gruener P. Beyond the Great Forgetting: Narrative Resistance in American Literature on Early-Onset Alzheimer's Disease. Springer Nature (2022).
7. Brand NR, Qu LG, Chao A, et al. Delays and barriers to cancer care in low-and middle-income countries: a systematic review. The oncologist 24 (2019): e1371-e1380.
8. Çeri V, Aykutlu HC, Görker I, et al. Symposium Oral Presentations. Psychiatry and Clinical Psychopharmacology 28 (2018): 297-391.
9. Ishino T, Ragaee MA, Maruhashi T, et al. Effects of cerebral blood flow and vessel conditions on speech recognition in patients with postlingual adult cochlear implant: predictable factors for the efficacy of cochlear implant. Ear and Hearing 39 (2018): 540-547.
10. Kelly DM, Rothwell PM. Blood pressure and the brain: the neurology of hypertension. Practical Neurology 20 (2020): 100-108.
11. Sweeney MD, Zhao Z, Montagne A, et al. Blood-brain barrier: from physiology to disease and back. Physiological Reviews 99 (2019): 21-78.
12. Ungvari Z, Toth P, Tarantini S, et al. Hypertension-induced cognitive impairment: from pathophysiology to public health. Nature reviews. Nephrology 17 (2021): 639-654.
13. Pacholko A, Iadecola C. Hypertension, Neurodegeneration, and Cognitive Decline. Hypertension (Dallas, Tex.: 1979) 81 (2024): 991-1007.
14. McKhann GM, Knopman DS, Chertkow H, et al. The diagnosis of dementia due to Alzheimer's disease: recommendations from the National Institute on Aging-Alzheimer's Association workgroups on diagnostic guidelines for Alzheimer's disease. Alzheimer's & Dementia: The Journal of the Alzheimer's Association 7 (2011): 263-269.

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Ali Ahmed MM, et al., Cardiol Cardiovasc Med 2025
DOI:10.26502/fccm.92920425

15. Bir SC, Khan MW, Javalkar V, et al. Emerging Concepts in Vascular Dementia: A Review. Journal of Stroke and Cerebrovascular Diseases: The Official Journal of National Stroke Association 30 (2021): 105864.

16. Faraco G, Hochrainer K, Segarra SG, et al. Dietary salt promotes cognitive impairment through tau phosphorylation. Nature 574 (2019): 686-690.

17. De Heus RA, Tzourio C, Lee EJL, et al. Association between blood pressure variability with dementia and cognitive impairment: a systematic review and meta-analysis. Hypertension 78 (2021): 1478-1489.

18. Sebastian MJ, Khan SK, Pappachan JM, et al. Diabetes and cognitive function: An evidence-based current perspective. World Journal of Diabetes 14 (2023): 92.

19. Merino JG. White matter hyperintensities on magnetic resonance imaging: what is a clinician to do?. In Mayo Clinic Proceedings 94 (2019): 380-382.

20. Silva DF, Empadinhas N, Cardoso SM, et al. Neurodegenerative microbially-shaped diseases: oxidative stress meets neuroinflammation. Antioxidants 11 (2022): 2141.

21. Ahmad MA, Kareem O, Khushtar M, et al. Neuroinflammation: a potential risk for dementia. International Journal of Molecular Sciences 23 (2022): 616.

22. Andrew C, Robinson TB. Self-Reported Late-Life Hypertension Is Associated with a Healthy Cognitive Status and Reduced Alzheimer's Disease Pathology Burden. Journal of Alzheimer's Disease (2024).

23. Dallaire-Théroux C, Quesnel-Olivo MH, Brochu K, et al. Evaluation of Intensive vs Standard Blood Pressure Reduction and Association With Cognitive Decline and Dementia. JAMA Network Open (2021).

24. Li C, Zhu Yidan, Ma Y, et al.. Association of Cumulative Blood Pressure with Cognitive Decline, Dementia, and Mortality. Journal of the American College of Cardiology (2022).

25. Costantino Iadecola KY. Impact of Hypertension on Cognitive Function. A Scientific Statement From the American Heart Association (2017).

26. Diarmaid Hughes CJ. Association of Blood Pressure Lowering with Incident Dementia or Cognitive Impairment: A Systematic Review and Meta-analysis. JAMA Network (2020).

27. Oisín Cormac Joyce CM. Midlife hypertension is a risk factor for some, but not all, domains of cognitive decline in later life: a systematic review and meta-analysis. Journal of Hypertension (2024).

28. Power MC, Tchetgen Tchetgen EJ, Sparrow D, et al. Blood Pressure and Cognition: Factors That May Account for Their Inconsistent Association. Epidemiology (2013).

29. Ruth Peters YX. Blood pressure lowering and prevention of dementia: an individual patient data meta-analysis. European Heart Journal (2022).

30. Ou YN, Tan CC, Shen XN, et al. Blood Pressure and Risks of Cognitive Impairment and Dementia: A Systematic Review and Meta-Analysis of 209 Prospective Studies. American Heart Association Journals (2020).

31. Hoffecker L. Grey literature searching for systematic reviews in the health sciences. The Serials Librarian 79 (2020): 252-260.

32. Rosa M, Scassellati C, Cattaneo A. Association of childhood trauma with cognitive domains in adult patients with mental disorders and in non-clinical populations: a systematic review. Frontiers in Psychology 14 (2023): 1156415.

33. Lennon M. Blood pressure, anti-hypertensive use and dementia risk–An international harmonisation of longitudinal studies (Doctoral dissertation, UNSW Sydney) (2024).

34. Santisteban MM, Iadecola C, Carnevale D. Hypertension, neurovascular dysfunction, and cognitive impairment. Hypertension 80 (2023): 22-34.

35. Zuo W, Wu J. The interaction and pathogenesis between cognitive impairment and common cardiovascular diseases in the elderly. Therapeutic Advances in Chronic Disease 13 (2022): 20406223211063020.

36. Caruso P, Signori R, Moretti R. Small vessel disease to subcortical dementia: a dynamic model, which interfaces aging, cholinergic dysregulation and the neurovascular unit. Vascular health and risk management (2019): 259-281.

37. Gupta UC, Gupta SC. Lifestyle, Environment, and Dietary Measures Impacting Cognitive Impairment: The Evidence Base for Cognitive Subtypes. Current Nutrition & Food Science 20 (2024): 1177-1188.

38. Christiansen H, Hirsch O, Albrecht B, et al. Attention-deficit/hyperactivity disorder (ADHD) and emotion regulation over the life span. Current Psychiatry Reports 21 (2019): 1-11.

39. Mulkey MA, Hardin SR, Olson DM, et al. Pathophysiology review: seven neurotransmitters associated with delirium. Clinical Nurse Specialist 32 (2018): 195-211.

40. Tam HL, Wong EML, Cheung K. Educational Program with Text Messaging for Community-Dwelling Patients with Hypertension: A Pilot Randomized Controlled Trial. Asian Nursing Research 17 (2023): 158-166.

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Ali Ahmed MM, et al., Cardiol Cardiovasc Med 2025
DOI:10.26502/fccm.92920425

41. Jia P, Lee HW, Chan JY, et al. Long-term blood pressure variability increases risks of dementia and cognitive decline: a meta-analysis of longitudinal studies. Hypertension 78 (2021): 996-1004.

42. Klohs J. An integrated view on vascular dysfunction in Alzheimer's disease. Neurodegenerative Diseases 19 (2019): 109-127.

43. Miller B. Dementia and Neurodegenerative Diseases Editor's Pick 2021. Frontiers Media SA (2021).

44. Kapoor A. Probrain Mindset for Perfect Health Span and Prevention of Alzheimer's Dementia. Xlibris Corporation (2024).

45. Pavlovic AM, Pekmezovic T, Trajkovic JZ, et al. Increased risk of cognitive impairment and more severe brain lesions in hypertensive compared to non-hypertensive patients with cerebral small vessel disease. The Journal of Clinical Hypertension 20 (2018): 1260-1265.

46. Lee AT, Fung AW, Richards M, et al. Late-life longitudinal blood pressure trajectories as predictor of dementia. Scientific Reports 12 (2022): 1630.

47. Oscanoa TJ, Amado J, Vidal X, et al. Angiotensin-receptor blockers and the risk of Alzheimer s disease: a meta-analysis. Current Reviews in Clinical and Experimental Pharmacology Formerly Current Clinical Pharmacology 16 (2021): 73-78.

48. Di Chiara T, Del Cuore A, Daidone M, et al. Pathogenetic Mechanisms of Hypertension–Brain-Induced Complications: Focus on Molecular Mediators. International Journal of Molecular Sciences 23 (2022): 2445.

49. Komleva Y, Chernykh A, Lopatina O, et al. Inflamm-aging and brain insulin resistance: New insights and role of lifestyle strategies on cognitive and social determinants in aging and neurodegeneration. Frontiers in Neuroscience 14 (2021): 618395.

50. Rius-Pérez S, Tormos AM, Pérez S, et al. Vascular pathology: cause or effect in Alzheimer disease?. Neurología (English Edition) 33 (2018): 112-120.

51. Yu JT, Xu W, Tan CC, et al. Evidence-based prevention of Alzheimer's disease: systematic review and meta-analysis of 243 observational prospective studies and 153 randomised controlled trials. Journal of Neurology, Neurosurgery & Psychiatry 91 (2020): 1201-1209.

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