LITERATURE REVIEW

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Hypertension Causes, Impacts, and Control Strategies In The Modern Era

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ABSTRACT
Background: Hypertension, or high blood pressure, is a global health problem that affects about 1.13 billion people worldwide. According to the World Health Organization (WHO), hypertension is a major risk factor for cardiovascular disease, stroke, and premature death. The disease is often asymptomatic, so many individuals are unaware of their condition until serious complications occur. Therefore, a better understanding of the causes, impacts, and control strategies of hypertension is essential.
Objective: The aim of this study is to understand the causes, impacts, and control strategies of hypertension in order to reduce its prevalence and improve individuals' quality of life.
Methods: This literature review is conducted by collecting and analyzing relevant scientific studies and articles on hypertension. The sources used include medical journals, reports of health organizations, and clinical guidelines published between 2003 and 2024. The literature selection process was carried out using keywords such as "hypertension", "hypertension control", and "hypertension impact" in academic databases such as PubMed (57) and Scopus (279).
Results: There were 16 articles that were included in this literature and showed that the factors that cause hypertension include unhealthy lifestyles, genetic factors, and other medical conditions. Significant health impacts of hypertension include an increased risk of heart disease and stroke. Effective control strategies, such as dietary changes, increased physical activity, and the use of antihypertensive medications, have been shown to lower blood pressure.
Conclusion: Hypertension is a health problem that requires serious attention. By understanding the causes and impacts of hypertension, as well as implementing effective control strategies, we can reduce the prevalence of hypertension and improve the quality of life of individuals. Collaborative efforts between health workers, governments, and communities are essential to achieve this goal.
Keywords: Hypertension, Causes of Hypertension, Health Impacts, Control Strategies.

INTRODUCTION

Hypertension, or high blood pressure, is one of the most common health problems worldwide. According to the World Health Organization (WHO), hypertension affects about 1.13 billion people worldwide and is a major risk factor for cardiovascular disease, stroke, and premature death (World Health Organization, 2021). The disease is often asymptomatic, so many individuals are unaware that they are experiencing it, which can lead to serious complications if not treated properly (Kearney, Whelton, Reynolds, & others, 2005)

The causes of hypertension can be divided into two categories: primary (essential) and secondary hypertension. Primary hypertension, which is the most common form, has no obvious cause and is often associated with genetic factors, unhealthy diet, lack of physical activity, and stress (Mills et al., 2016). Meanwhile, secondary hypertension is caused by certain medical conditions, such as kidney disease, hormonal disorders, or the use of certain medications (Whelton, Carey, Aronow, & others, 2018)

The impact of hypertension is very broad and covers various aspects of health. Uncontrolled hypertension can cause damage to vital organs, including the heart, kidneys, and brain. Coronary heart disease, heart failure, and stroke are some of the serious complications that can occur due to hypertension (Chobanian, Bakris, Black, & others, 2003) In addition, hypertension also has significant social and economic impacts, including high health care costs and decreased work productivity (Bansal & Kaur, 2019)

In the modern era, hypertension control is becoming increasingly important. Various strategies have been developed to address this problem, including lifestyle changes, such as a healthy diet, increased physical activity, and stress reduction (Appel et al., 2011) In addition, pharmacological treatment also plays an important role in the management of hypertension, with various classes of drugs available to help lower blood pressure (Whelton et al., 2018) Public education about the importance of early detection and management of hypertension is also a crucial step in reducing the prevalence of this disease.

Therefore, this literature review aims to explore the causes, impacts, and strategies for controlling hypertension in the modern era, as well as provide deeper insights into how we can address these challenges to improve overall public health.

METHODS

This literature review uses a systematic approach to identify, evaluate, and analyze relevant research on hypertension, including its causes, impacts, and control strategies in the modern era. This study

applies inclusion criteria, namely articles published in peer-reviewed journals, discussing the causes, impacts, and control strategies of hypertension, and published in the period from 2003 to 2024. Meanwhile, the exclusion criteria include articles that are not available in English or Indonesian, studies that are not relevant to the topic of hypertension, and publications that are in the form of reviews or meta-analyses without primary data.

Literature searches were conducted through several academic databases, such as PubMed, Scopus, using keywords such as "hypertension", "causes of hypertension", "hypertension impact", "hypertension control strategies", and "hypertension management". After the initial search, the articles found are filtered by their title and abstract. Articles that meet the inclusion criteria are then thoroughly read to ensure their relevance and quality, then relevant data are taken for further analysis.

The data collected were analyzed qualitatively to identify key themes related to the causes, impacts, and strategies for controlling hypertension. The results of the analysis are presented in the form of narratives and images to facilitate understanding. To ensure the validity and reliability of this study, the selection and analysis process was carried out by two independent researchers, where any differences in the assessment were resolved through discussion and consensus.

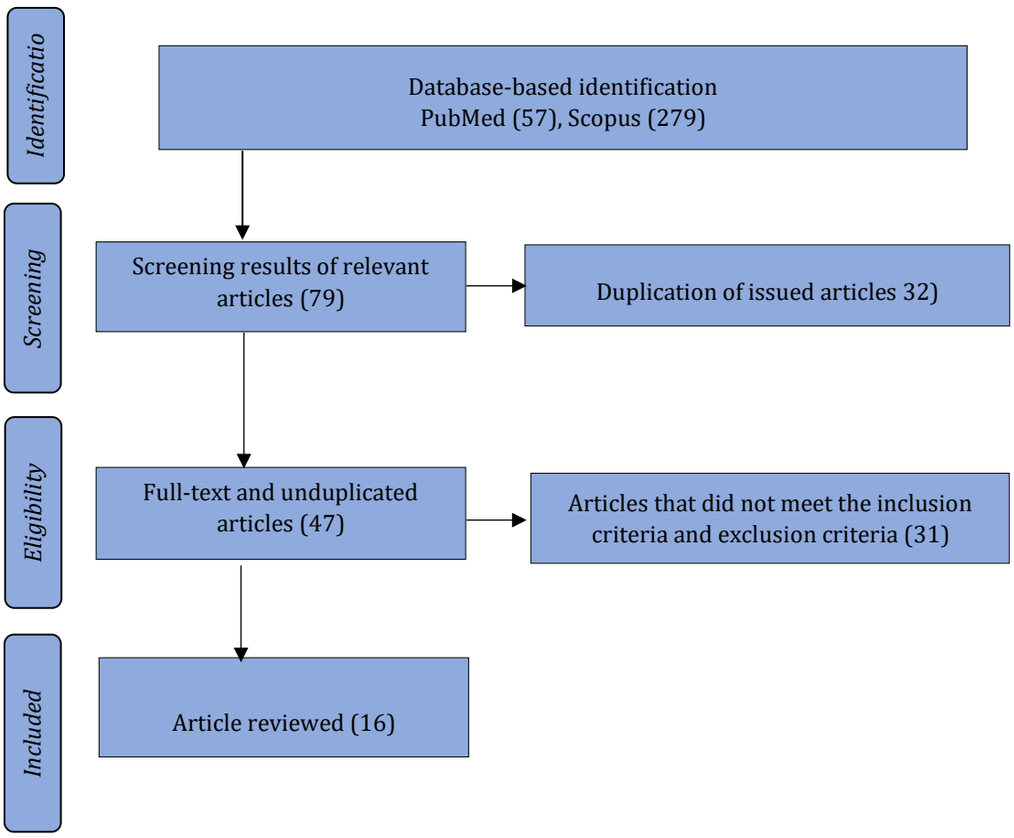

Figure 1. Flowchart

RESULTS

In an attempt to gain a deeper understanding of the causes, impacts, and strategies for controlling hypertension in the modern era, this literature summarizes the findings of 16 relevant articles. These articles provide comprehensive insights into the various factors that contribute to hypertension, as well as the health implications it causes. This review literature aims to present integrated and evidence-based information. The findings from these articles are presented in the form of the diagram below, which summarizes the causes of hypertension, its impact on public health, and control strategies that can be applied to reduce the prevalence of this disease.

1. Causes of Hypertension

Based on Diagram 1, it can be seen that the causes of hypertension can be categorized into several main factors. First, genetic factors play an important role, where advances in the field of genetics have identified several rare genetic causes of hypertension (Krakoff, 2005)In addition, lifestyle factors also contribute, with high sugar intake, air and noise pollution, and low birth weight as emerging risk factors (Qaissi et al., 2024) Furthermore, there are biochemical mechanisms involved, in which phospholipase C (PLC) and phospholipase D (PLD) play a role in the development of hypertension by affecting the strength of heart contractions (Hazarika, Bodosa, & Shankarishan, 2023) Finally, stress is also considered a significant factor in the development and progression of hypertension (Molerio Pérez, Arce González, Otero Ramos, & Nieves Achón, 2005)

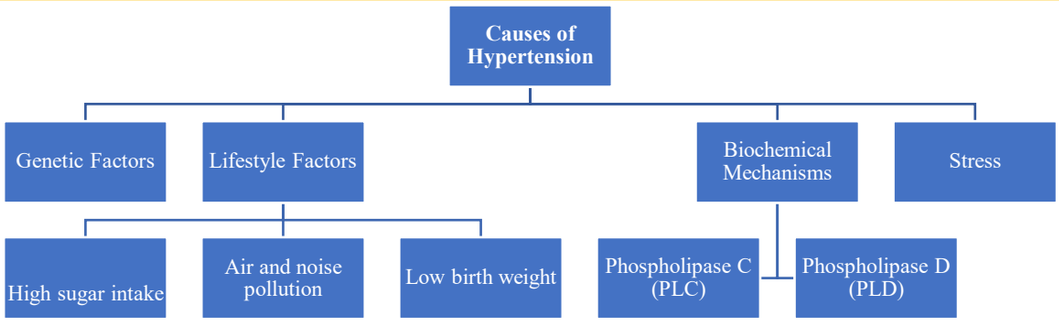

Diagram 1. Causes of Hypertension

2. Impacts of Hypertension

Diagram 2. Describe the significant impact of hypertension on health. First, hypertension is identified as a major risk factor for cardiovascular diseases, including myocardial infarction and stroke, which can be life-threatening (Guan et al., 2020; Moraes-Silva, Mostarda, Silva-Filho, & Irigoyen, 2017) In addition, organ damage is also a concern, where chronic high blood pressure can cause serious damage to various organs, including the heart, kidneys, eyes, and brain (Moraes-Silva et al., 2017) Finally, hypertension has a major impact on public health, contributing significantly to morbidity and mortality worldwide, especially in low- and middle-income countries (Khetan et al., 2019; Pavlović, Bačeković, & Pavlović, 2007)

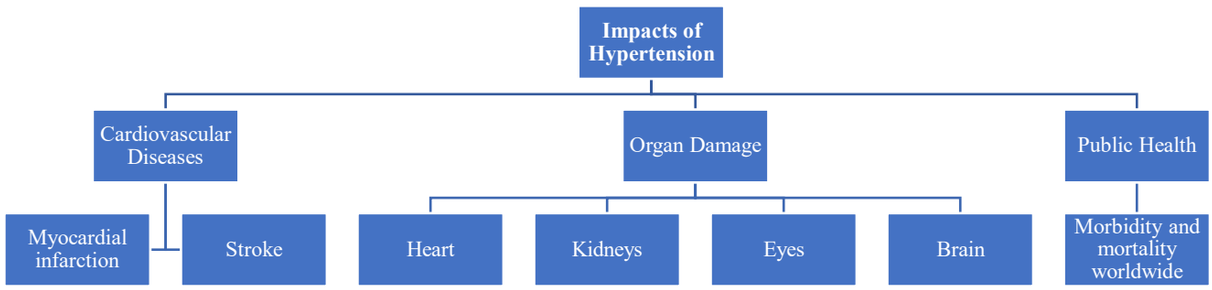

Diagram 2. Impacts of Hypertension

3. Control Strategies for Hypertension

Diagram 3. Showing that hypertension treatment strategies are divided into two main approaches, namely pharmacological and non-pharmacological approaches. The pharmacological approach includes the use of antihypertensive drugs such as calcium channel blockers and ACE inhibitors that have been shown to be effective in controlling blood pressure (Hazarika et al., 2023; Huang, Xu, Lv, & Jiang, 2011) In addition, the development of innovative drugs targeting the renin-angiotensin-aldosterone system as well as renalase analogues offers the potential for more effective therapies in the future (Borghi & Cicero, 2012) In some cases, combination therapy of various drugs is also applied to improve the effectiveness of treatment, especially in resistant hypertension (Lackland, 2013; Verdecchia, Cavallini, & Angeli, 2022)

Meanwhile, the non-pharmacological approach focuses on lifestyle changes and patient education. A healthy diet and regular exercise play an important role in the prevention and management of hypertension (Moraes-Silva et al., 2017) In addition, education for patients and their families can improve adherence to therapy and improve overall treatment outcomes ((Pavlović et al., 2007; Qaissi et al., 2024)

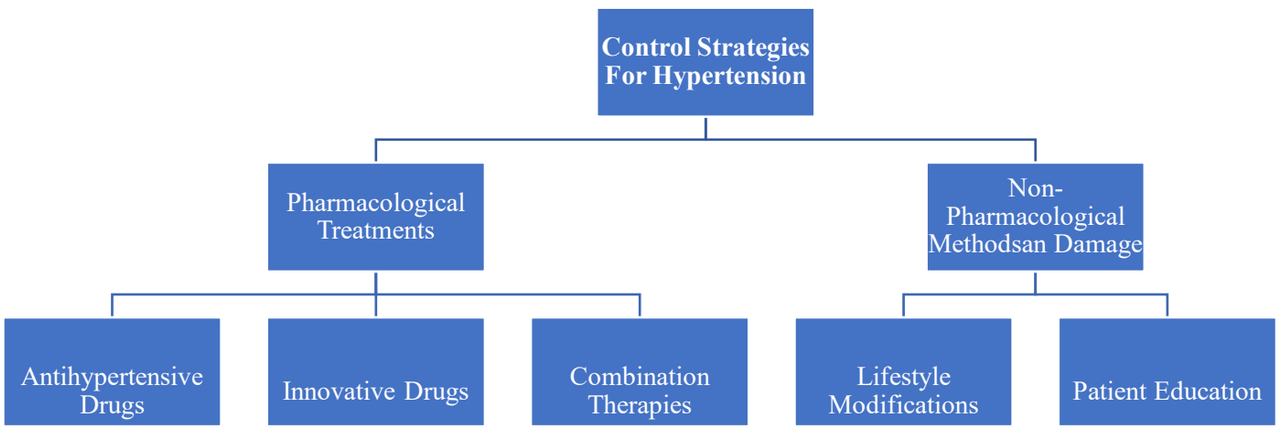

Diagram 3. Control Strategies For Hypertension

4. Technological and Community-Based Interventions

Diagram 4. Showing This diagram illustrates three key innovations in hypertension monitoring and management. First, 24-Hour Blood Pressure

Monitoring allows for continuous monitoring of blood pressure for 24 hours, providing more accurate data for diagnosis and evaluation of treatment effectiveness (Krakoff, 2005) Second, Community Health Workers play a role in integrated risk factor management, with a community-based approach that has proven effective in improving blood pressure control (Khetan et al., 2019) Third, Digital Health includes digital health technologies that are increasingly developing, allowing for more efficient and real-time monitoring and management of hypertension (Verdecchia et al., 2022)

Diagram 4. Technological and Community-Based Interventions

5. Public Health Strategies

Diagram 5 illustrates two main approaches to hypertension control. National Programs play an important role in improving awareness, diagnosis, and adherence to treatment through the implementation of structured national guidelines and programs (Campbell & Niebylski, 2014; Weber et al., 2019) Meanwhile, Multicomponent Interventions incorporate various strategies, such as patient education, lifestyle changes, and pharmacological therapies, to improve the effectiveness of hypertension management (Allen, Halaand, Shirore, & Jafar, 2021)

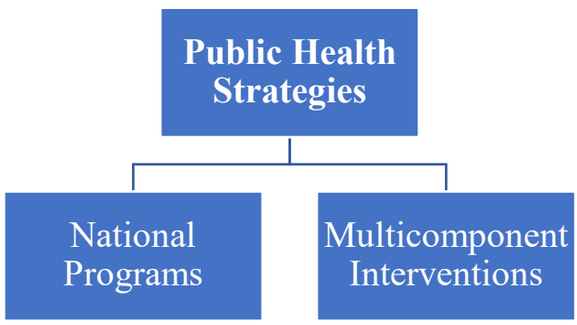

Diagram 5. Public Health Strategies

6. Challenges of Hypertension

Diagram 6 describes two main challenges in the management of hypertension. Low Treatment Adherence is a significant obstacle due to the lack of patient adherence to treatment and the presence of clinical inertia, which causes the effectiveness of therapy to decrease (Pavlović et al., 2007; Sharma & Hakim, 2011) In addition, Resource Limitations reflect limited health services and disparities in access to care, especially in areas with limited resources, which further complicates hypertension control efforts (Guan et al., 2020; Qaissi et al., 2024)

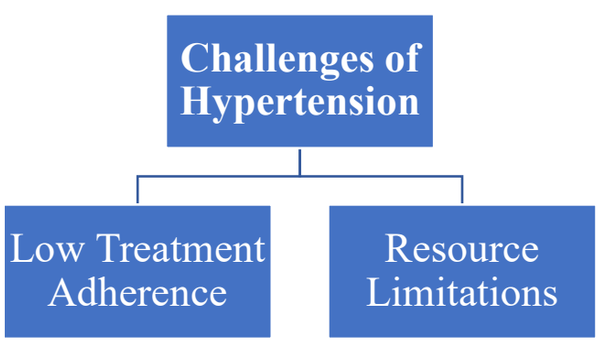

Diagram 6. Challenges of Hypertension

DISCUSSION

Causes of Hypertension:

Findings regarding the causes of hypertension suggest that genetic factors, lifestyle, biochemical mechanisms, and stress play an important role in the development of this condition. Genetic factors have been identified as one of the causes of hypertension, where advances in genetics have allowed the identification of some rare mutations that contribute to increased blood pressure. Genes that regulate sodium balance, kidney function, as well as the renin-angiotensin-aldosterone system are known to have a role in the pathogenesis of hypertension(Krakoff, 2005)

In addition to genetic factors, lifestyle is also the main cause of hypertension. Excessive sugar consumption, exposure to air and noise pollution, and low birth weight are now recognized as risk factors that are gaining increasing attention. A diet high in sugar can lead to insulin resistance and inflammation, which contributes to an increase in blood pressure. Meanwhile, air pollution and noise can cause oxidative stress and dysregulation of the autonomic nervous system, which ultimately affects blood pressure (Qaissi et al., 2024)

In terms of biochemical mechanisms, studies show that the enzymes phospholipase C (PLC) and phospholipase D (PLD) play a role in the development of hypertension by affecting heart contractions. These two enzymes are involved in the transduction of cellular signals that can alter the function of the heart muscle and blood vessels, leading to an increase in blood pressure. This mechanism further confirms that hypertension is not only a problem of blood circulation, but also a disorder at the molecular level that affects heart and vascular function (Hazarika et al., 2023)

In addition, stress is also recognized as a significant factor in the development and progression of hypertension. Chronic stress can activate the sympathetic nervous system and increase the release of stress hormones such as cortisol and adrenaline, leading to a prolonged increase in blood pressure. Physiological responses to stress, such as vasoconstriction and increased heart rate, contribute to increased cardiac workload as well as the risk of long-term hypertension (Molerio Pérez et al., 2005)

Impacts of Hypertension

Hypertension has a far-reaching impact on the health of individuals and society, especially in relation to cardiovascular disease, organ damage, as well as the global health burden. As one of the main risk factors for cardiovascular disease, hypertension contributes to the incidence of myocardial infarction and stroke. Chronically high blood pressure can cause damage to the artery walls, increase the risk of atherosclerosis, and accelerate the occurrence of coronary heart disease and impaired brain circulation. These complications often lead to life-threatening conditions, such as heart failure and ischemic or hemorrhagic stroke (Guan et al., 2020; Moraes-Silva et al., 2017)

In addition, hypertension can cause significant organ damage if left uncontrolled in the long term. The heart has to work harder to pump blood against the increased pressure in the blood vessels, which can lead to left ventricular hypertrophy and eventually heart failure. The kidneys are also one of the organs that are susceptible to high blood pressure, with an increased risk of hypertensive nephropathy that can develop into chronic kidney failure. Hypertension also affects eye health by increasing the risk of hypertensive retinopathy, which can lead to visual impairment to blindness. In addition, high blood pressure can cause structural and functional changes in the brain, increasing the risk of vascular dementia and cognitive impairment (Moraes-Silva et al., 2017)

From a public health perspective, hypertension is a leading cause of morbidity and mortality worldwide, especially in low- and middle-income countries. Limited access to health services, delays in diagnosis, and lack of public awareness about blood pressure control are factors that exacerbate the impact of hypertension at the global level. The disease not only burdens the affected individual, but also increases healthcare costs and lowers economic productivity due to the complications that come with it. (Khetan et al., 2019; Pavlović et al., 2007)

Control Strategies

Hypertension control strategies include pharmacological and non-pharmacological approaches to manage blood pressure and prevent long-term complications.

The pharmacological approach plays an important role in lowering blood pressure by using various classes of antihypertensive drugs. Calcium channel blockers and angiotensin-converting enzyme inhibitors (ACE inhibitors) are two groups of drugs that are widely used due to their effectiveness in lowering blood pressure and protecting the heart and kidneys from further damage (Hazarika et al., 2023; Huang et al., 2011) In addition, the development of innovative drugs targeting the renin-angiotensin-aldosterone system and renalase analogues provides new hope in the management of hypertension, especially for patients who do not respond to standard therapies (Borghi & Cicero, 2012) Drug combination strategies are also increasingly being applied, where several types of antihypertensive drugs are used together to improve the effectiveness of treatment, especially in cases of resistant hypertension that is difficult to control with monotherapy (Lackland, 2013; Verdecchia et al., 2022)

On the other hand, non-pharmacological approaches also play an important role in the management of hypertension. Lifestyle modifications, such as maintaining a healthy diet and exercising regularly, are the main strategies in preventing and controlling high blood pressure. A diet low in salt, high in fiber, and rich in potassium and magnesium has been shown to help lower blood pressure. Regular physical activity, such as brisk walking or aerobic exercise, also contributes to improving cardiovascular function and lowering blood pressure naturally (Moraes-Silva et al., 2017)

In addition, patient education is a very important aspect in the success of hypertension therapy. Providing patients and their families with an understanding of the importance of adherence to medication and the practice of a healthy lifestyle can improve overall therapy outcomes. Better awareness of risk factors, benefits of treatment, and consequences of uncontrolled blood pressure can encourage patients to be more disciplined in carrying out therapy and prevent further complications (Pavlović et al., 2007; Qaissi et al., 2024)

Technological and Community-Based Interventions

Technology and community-based interventions are increasingly playing a role in the diagnosis, monitoring, and management of hypertension. Advances in medical technology allow for more accurate and efficient approaches to detecting and controlling blood pressure, while community involvement contributes to improved access to health services and public awareness.

One of the innovations in hypertension monitoring is the use of 24-hour blood pressure monitors (Ambulatory Blood Pressure Monitoring / ABPM). This technology allows for continuous blood pressure measurements throughout the day, providing a more accurate picture than in-clinic measurements. ABPM helps in detecting masked hypertension or hypertension due to the white coat effect, which is often undetected by conventional blood pressure measurements. With more accurate monitoring, doctors can design more appropriate treatment strategies for each patient (Krakoff, 2005)

In addition, the involvement of Community Health Workers (CHWs) has been shown to be effective in improving blood pressure control, especially in areas with limited access to medical services. CHWs play a role in providing health education, detecting risk factors, and helping patients comply with treatment. This community-based approach not only strengthens the health system, but also increases public awareness of the importance of a healthy lifestyle in preventing and managing hypertension (Khetan et al., 2019)

The development of digital health technology is also increasingly supporting the independent management of hypertension. Health apps, wearables, and telemedicine allow patients to monitor their blood pressure in real-time and get early intervention when blood pressure increases. The digitization of health services also allows patients to communicate directly with medical personnel without having to come to a health facility, thereby increasing access and effectiveness in hypertension management, especially in remote areas (Verdecchia et al., 2022)

Public Health Strategies

Public health strategies play an important role in efforts to prevent and manage hypertension at large. Through national policies and interventions that cover multiple aspects, public health programs can improve awareness, early diagnosis, and adherence to treatment, thereby reducing the incidence and complications of hypertension in the general population.

One of the main approaches is the implementation of a national program that focuses on raising awareness, early detection, and adherence to hypertension treatment. Many countries have adopted national guidelines that guide healthcare workers in the diagnosis and management of hypertension, including mass screening policies, education campaigns, and the integration of hypertension services into primary health systems. With a strong national program, the public can more easily access health information and services that support the effective prevention and treatment of hypertension (Campbell & Niebylski, 2014; Weber et al., 2019)

In addition, multicomponent interventions have been shown to be more effective than a single approach to hypertension. These interventions include a combination of patient education, lifestyle changes, and pharmacological treatment tailored to individual needs. For example, community-based programs that teach healthy eating, physical activity, and stress management can be combined with easier access to affordable medical services and antihypertensive medications. This approach not only targets individuals who already have hypertension, but also focuses on prevention by reducing risk factors at the population level (Allen et al., 2021)

Challenges

Although various strategies have been implemented to control hypertension, there are still a number of challenges that hinder the effectiveness of managing this disease. The two main obstacles in controlling hypertension are low patient adherence to treatment and limited health resources, especially in areas with limited access to medical services.

One of the biggest challenges in managing hypertension is the low adherence of patients to recommended therapies. Many patients fail to follow treatment consistently, either due to a lack of understanding of the importance of long-term therapy, drug side effects, or economic factors that limit access to antihypertensive drugs. In addition, clinical inertia or the indecisiveness of medical personnel in adjusting therapy is also a barrier in achieving optimal blood pressure control. Some doctors may be reluctant to increase the dose or change the drug, even though the patient's blood pressure is still uncontrolled, thus slowing the effectiveness of treatment (Pavlović et al., 2007; Sharma & Hakim, 2011)

Inequality of access to health services is another challenge in the management of hypertension, especially in developing countries and remote areas. Limited medical infrastructure, lack of health workers, and high drug costs are the main factors that hinder patients from getting the right diagnosis and treatment. In addition, health systems that have not been fully integrated with prevention and education programs make many individuals unaware of the risk of hypertension until the disease has progressed to

serious complications (Guan et al., 2020; Qaissi et al., 2024)

To address these challenges, a more holistic approach is needed, such as increasing patient education on the importance of therapy adherence, strengthening the primary health care system, and expanding the scope of public health programs to be more inclusive and accessible to all levels of society. These efforts can help reduce disparities in the management of hypertension and increase the effectiveness of disease control strategies globally.

CONCLUSION

Hypertension is caused by genetic factors, lifestyle, biochemical mechanisms, and stress. Genetic factors affect sodium balance, kidney function, and the renin-angiotensin-aldosterone system. Lifestyles such as excessive sugar consumption, pollution, and oxidative stress also contribute. Biochemical mechanisms involve enzymes that affect heart contractions, while chronic stress increases the release of hormones that raise blood pressure. The effects of hypertension include an increased risk of cardiovascular disease, damage to organs such as the heart, kidneys, and eyes, and cognitive problems. Globally, hypertension causes a huge economic and health burden due to delays in diagnosis and suboptimal management. Control strategies include pharmacological therapy with antihypertensive drugs as well as non-pharmacological approaches such as healthy diet, exercise, and patient education. Technologies such as digital-based blood pressure monitoring and telemedicine are increasingly supporting hypertension management. Public health approaches, including national programs, education, and community-based interventions, are effective in increasing patient awareness and compliance. However, challenges such as low treatment adherence, limited access to health services, and lack of public awareness still need to be addressed for more effective hypertension control.

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