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Demographic and developmental risk factors for hypertension: Disparities and implications for prevention

Christiana Olajumoke Oyekanmi [1,*], Christopher Obinna Anaduaka [2] and Tanimola Owolabi [3]

[1] *Department of Public Health and Epidemiology, University of Delaware, Newark, Delaware, United States.*
[2] *Department of Internal Medicine, University of Ilorin Teaching Hospital, Kwara, Nigeria.*
[3] *Department of Community Medicine, University of Abuja Teaching hospital, F.C.T., Nigeria.*

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Abstract

Hypertension is a major public health issue affecting nearly half of the adult population in the United States, with significant disparities across demographic groups. This review explores the demographic and developmental risk factors contributing to hypertension, focusing on racial, ethnic, and socioeconomic disparities, as well as age and gender differences. African Americans experience the highest rates of hypertension, influenced by genetic predisposition and socioeconomic challenges. Lower socioeconomic status is associated with increased hypertension prevalence and poorer blood pressure control. Age-related vascular changes and gender-specific hormonal influences also play crucial roles in hypertension risk. The review examines developmental risk factors, including childhood obesity, low birth weight, and maternal hypertension during pregnancy, which contribute to long-term cardiovascular health outcomes. Early-life interventions and addressing maternal health are emphasized as critical strategies for mitigating hypertension risk. The paper discusses the implications of these findings for prevention and intervention strategies, highlighting the need for targeted approaches that consider the unique needs of high-risk populations. By integrating insights from demographic and developmental research, this review aims to inform evidence-based strategies to reduce hypertension disparities and improve cardiovascular health outcomes across diverse populations.

Keywords: Hypertension; Disparities; Developmental Risk Factors; Demographic Factors; Cardiovascular Health

1. Introduction

1.1. Background on Hypertension - Definition and global prevalence

Hypertension, commonly known as high blood pressure, is a chronic medical condition characterized by persistently elevated pressure in the arteries. It is defined as having a systolic blood pressure ≥130 mmHg or a diastolic blood pressure ≥80 mmHg, according to the American College of Cardiology/American Heart Association (ACC/AHA) guidelines (ACC, 2017). Globally, hypertension is a leading risk factor for cardiovascular diseases, stroke, and kidney failure, contributing to an estimated 10.8 million deaths annually (Zhou et al., 2021). The prevalence of hypertension has risen significantly over the past few decades, with over 1.3 billion adults affected worldwide, particularly in low- and middle-income countries where healthcare access and preventive measures are limited (Mills et al., 2020). In the United States, nearly half of adults (47%) have hypertension, with significant disparities observed across racial, ethnic, and socioeconomic groups (Fryar et al., 2020). These disparities highlight the need to explore demographic and developmental risk factors to better understand and address the root causes of hypertension.

* Corresponding author: Christiana Olajumoke Oyekanmi

Demographic factors such as race, ethnicity, age, and socioeconomic status play a critical role in hypertension prevalence and outcomes. For instance, African Americans have the highest prevalence of hypertension in the U.S., at 56%, compared to 48% among White adults and 39% among Hispanic adults (Fryar et al., 2020). These disparities are driven by a combination of genetic predisposition, environmental exposures, and systemic inequities in healthcare access (Carnethon et al., 2017). Developmental factors, including childhood obesity, early-life stress, and low birth weight, further exacerbate hypertension risk across the lifespan (Falkner & Gidding, 2011). For example, children with obesity are more likely to develop hypertension in adulthood, perpetuating cycles of poor health outcomes (Song et al., 2019). Addressing these demographic and developmental risk factors through targeted public health interventions and policy changes is essential to reducing hypertension disparities and improving population health outcomes globally

1.2. Hypertension as a major public health issue in the U.S.

Hypertension, or high blood pressure, is a major public health issue in the United States, affecting nearly half of the adult population (CDC, 2023). It is a leading risk factor for cardiovascular diseases, including heart attack, stroke, and heart failure, which are among the top causes of mortality in the country (Virani et al., 2021). The prevalence of hypertension has been steadily increasing, driven by factors such as aging populations, rising obesity rates, and sedentary lifestyles (Muntner et al., 2020). Despite advances in medical treatment and public health awareness, a significant portion of individuals with hypertension remain undiagnosed or inadequately managed, highlighting the need for improved screening and intervention strategies (ACC, 2017). The burden of hypertension is not evenly distributed, with racial and ethnic minorities, low-income populations, and older adults disproportionately affected, underscoring the role of social determinants of health in shaping disease outcomes (Carnethon et al., 2017).

The economic impact of hypertension is substantial, with billions of dollars spent annually on healthcare costs and lost productivity (Kirkland et al., 2018). Beyond its direct health consequences, hypertension exacerbates health disparities, as marginalized groups often face barriers to accessing quality care and resources for prevention (Ferdinand et al., 2019). Public health initiatives aimed at reducing hypertension prevalence have emphasized lifestyle modifications, such as promoting healthy diets, physical activity, and stress management, as well as improving access to antihypertensive medications (Egan et al., 2010). However, addressing the root causes of hypertension requires a multi-faceted approach that tackles systemic inequities, such as poverty, food insecurity, and inadequate healthcare infrastructure (Booth et al., 2021). By prioritizing hypertension prevention and management, the U.S. can make significant strides in reducing cardiovascular disease burden and improving population health outcomes.

1.3. Importance of Demographic and Developmental Factors:

Demographic and developmental factors are critical in understanding hypertension disparities because they highlight the unequal distribution of risk and outcomes across different population groups. Demographic factors such as race, ethnicity, socioeconomic status, and age play a significant role in shaping hypertension prevalence and management. For instance, African Americans have one of the highest rates of hypertension in the U.S., with earlier onset and more severe complications compared to other racial groups (Carnethon et al., 2017). Socioeconomic disparities further exacerbate these inequities, as individuals with lower income and education levels often face barriers to accessing healthcare, healthy food options, and safe environments for physical activity (Booth et al., 2021). These factors create a cycle of disadvantage, where marginalized populations are disproportionately burdened by hypertension and its associated health consequences.

Developmental factors, particularly those occurring early in life, also contribute to hypertension disparities. Childhood obesity, prenatal exposure to maternal hypertension, and early-life stress have been linked to an increased risk of developing hypertension in adulthood (Falkner & Gidding, 2011). These developmental influences often intersect with demographic factors, as children from low-income families or minority backgrounds are more likely to experience adverse conditions such as poor nutrition, limited access to healthcare, and chronic stress (Chung et al., 2023). Understanding these interconnected factors is essential for designing targeted interventions that address the root causes of hypertension disparities. By focusing on both demographic and developmental determinants, public health efforts can work toward reducing inequities and improving cardiovascular health outcomes for all populations.

1.4. Objectives of the Review

The primary objective of this review is to explore the demographic and developmental risk factors that contribute to hypertension, with a focus on understanding the disparities in prevalence and outcomes across different population groups. Demographic factors such as race, ethnicity, socioeconomic status, and age significantly influence hypertension risk, with certain groups, like African Americans and low-income populations, experiencing disproportionately higher rates of the condition (Carnethon et al., 2017; Booth et al., 2021). Developmental factors, including childhood obesity,

early-life stress, and prenatal exposures, also play a critical role in shaping long-term cardiovascular health (Chung et al., 2023). By examining these factors, this review aims to provide a comprehensive understanding of how social, economic, and early-life conditions intersect to create disparities in hypertension.

A second key objective is to discuss the implications of these findings for prevention and intervention strategies. Addressing hypertension disparities requires targeted approaches that consider the unique needs of high-risk populations. For example, public health initiatives could focus on improving access to healthcare, promoting healthy lifestyle behaviors, and implementing community-based programs tailored to specific demographic groups (Egan et al., 2010). Additionally, early-life interventions, such as addressing childhood obesity and reducing prenatal and perinatal risk factors, could have long-term benefits in preventing hypertension (Chung et al., 2023). By integrating insights from demographic and developmental research, this review aims to inform evidence-based strategies that reduce hypertension disparities and improve cardiovascular health outcomes across the population.

2. Demographic Risk Factors for Hypertension

2.1. Racial and Ethnic Disparities

Hypertension prevalence varies significantly across racial and ethnic groups in the United States, with African Americans experiencing the highest rates. Nearly 56% of African American adults have hypertension, compared to 48% of White adults and 39% of Hispanic adults (CDC, 2023). This disparity is influenced by a combination of genetic, environmental, and socioeconomic factors. Genetic predisposition, such as a higher sensitivity to salt and a greater likelihood of endothelial dysfunction, has been identified as a contributing factor in African Americans (Ferdinand et al., 2019). Additionally, socioeconomic challenges, including limited access to healthcare, lower income levels, and residence in underserved neighborhoods, exacerbate the risk of hypertension in minority populations (Booth et al., 2021). These factors often intersect, creating a cycle of disadvantages that makes it difficult for individuals to manage or prevent hypertension effectively.

Hispanic populations also face unique challenges, including higher rates of obesity and diabetes, which are significant risk factors for hypertension (Ali, et al., 2021). Cultural and linguistic barriers further complicate access to healthcare and adherence to treatment regimens. For other minority groups, such as Native Americans and Asian Americans, disparities in hypertension prevalence are often linked to systemic inequities, including poverty, food insecurity, and limited access to preventive care (Carnethon et al., 2017). Addressing these disparities requires a multi-faceted approach that considers the unique cultural, social, and economic contexts of each population. Public health interventions must prioritize equitable access to resources, culturally tailored education, and community-based programs to reduce the burden of hypertension among racial and ethnic minorities.

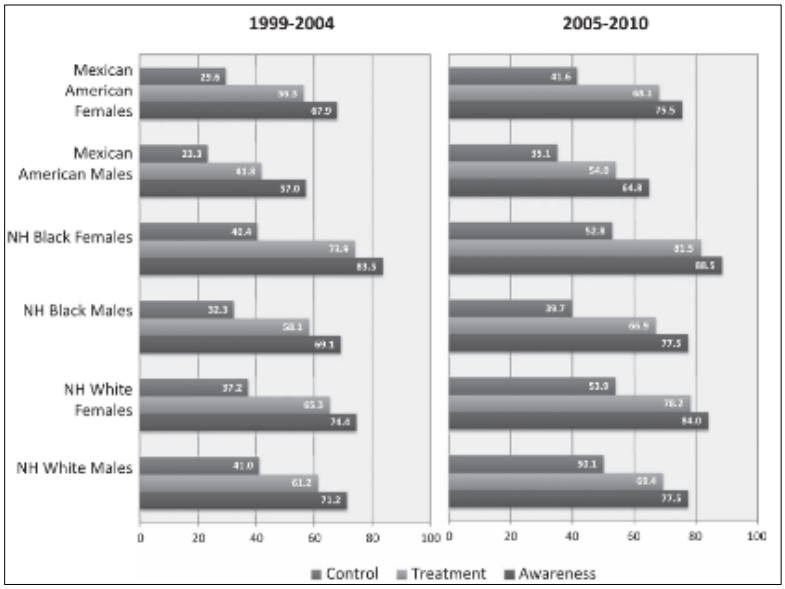

Figure 1 Hypertension awareness, treatment, and control rates varied significantly among different racial/ethnic groups and sexes according to NHANES data from 1999-2010. NH indicates non-Hispanic. (Data derived from Go et al., 2014)

2.2. Socioeconomic Disparities

Socioeconomic status (SES) is a significant determinant of hypertension risk, with individuals from lower income and education levels facing a disproportionately higher burden of the condition. Studies have consistently shown that lower SES is associated with increased hypertension prevalence, poorer blood pressure control, and higher rates of complications such as heart disease and stroke (Booth et al., 2021). For example, individuals with lower income levels are more likely to experience chronic stress, limited access to nutritious food, and unsafe environments that discourage physical activity—all of which contribute to elevated blood pressure (Egan et al., 2010). Additionally, lower educational attainment is linked to reduced health literacy, which can hinder individuals' ability to understand and manage hypertension effectively (Muntner et al., 2020). These socioeconomic factors create a cycle of disadvantage, where those with fewer resources are at greater risk of developing and struggling to control hypertension.

Access to healthcare and healthy lifestyle resources further exacerbates socioeconomic disparities in hypertension. Individuals with lower SES often face barriers such as lack of health insurance, transportation challenges, and limited availability of healthcare providers in their communities (Ferdinand et al., 2019). Even when healthcare is accessible, the cost of medications and follow-up care can be prohibitive, leading to poor adherence to treatment plans. Moreover, low-income neighborhoods are more likely to be "food deserts," with limited access to fresh fruits, vegetables, and other healthy foods, while also having a higher density of fast-food outlets and convenience stores that promote unhealthy diets (Kirkland et al., 2018). Addressing these disparities requires targeted public health interventions, such as expanding healthcare access, subsidizing healthy food options, and implementing community-based programs that promote physical activity and stress management. By tackling the root causes of socioeconomic inequities, it is possible to reduce the burden of hypertension in vulnerable populations.

2.3. Age and Gender Differences:

Age and gender significantly influence the prevalence of hypertension, with older adults and men generally exhibiting higher rates compared to younger individuals and women. Research indicates that the risk of hypertension increases with age, as vascular stiffness and reduced arterial elasticity become more common (ACC, 2017). Men tend to have a higher prevalence of hypertension in early adulthood and middle age compared to women, which may be attributed to differences in lifestyle factors, hormonal influences, and genetic predispositions (Mills et al., 2016). However, this gap narrows as women reach menopause, highlighting the protective role of estrogen in maintaining vascular health during their reproductive years.

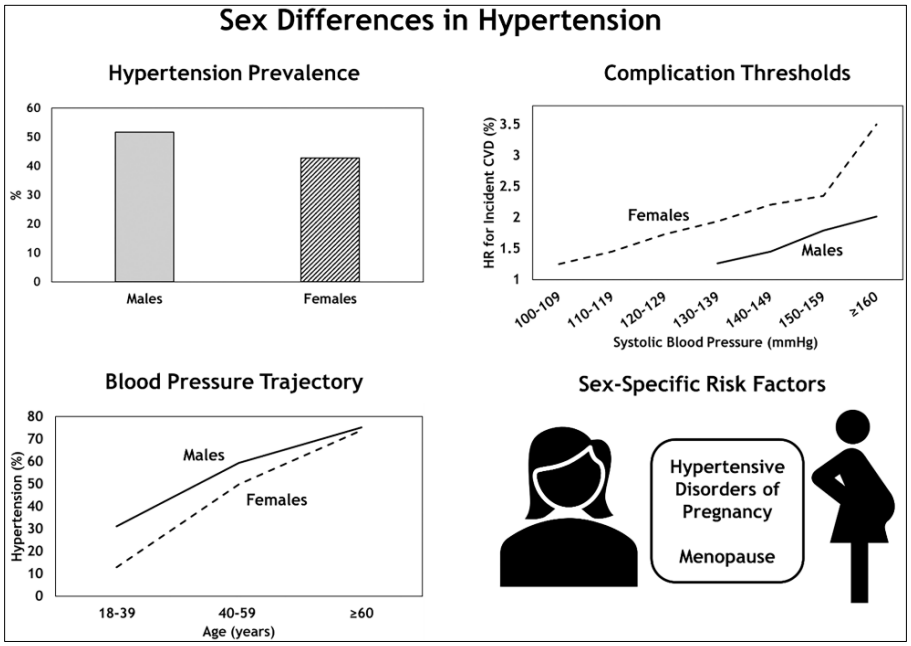

Figure 2 Hypertension differs by sex in prevalence, progression, and CVD risk. Males have higher rates, but females experience a steeper increase over time and develop CVD at lower pressures. These disparities, influenced by factors like pregnancy-related hypertension and menopause, highlight the need for sex-specific prevention strategies (Data retrieved from Connelly et al., 2022)

Postmenopausal women experience a notable increase in hypertension risk, largely due to the decline in estrogen levels, which contributes to endothelial dysfunction and increased arterial stiffness (Lima et al., 2012). This hormonal shift, combined with age-related physiological changes, places postmenopausal women at a higher risk for cardiovascular diseases. Additionally, weight gain and metabolic changes during this life stage further exacerbate hypertension risk (Janssen et al., 2008). These findings underscore the importance of targeted interventions for older adults and postmenopausal women to mitigate hypertension and its associated complications.

3. Developmental Risk Factors for Hypertension

3.1. Early-Life Risk Factors:

Developmental risk factors for hypertension often originate early in life, with childhood obesity being a significant contributor to elevated blood pressure and long-term cardiovascular risk. Excess weight during childhood is associated with adverse metabolic changes, including insulin resistance, dyslipidemia, and vascular dysfunction, which can persist into adulthood (Falkner, 2015). Studies have shown that obese children are more likely to develop hypertension as adults, emphasizing the importance of early interventions to promote healthy weight management and prevent the progression of cardiovascular diseases (Falkner & Gidding, 2011). Addressing childhood obesity through lifestyle modifications, such as improved diet and increased physical activity, is critical to reducing the burden of hypertension in later life.

Prenatal and perinatal factors also play a crucial role in shaping an individual's risk of developing hypertension. Low birth weight, often indicative of intrauterine growth restriction, has been linked to higher blood pressure in childhood and adulthood, a phenomenon attributed to fetal programming and impaired organ development (Barker et al., 2009). Additionally, maternal hypertension during pregnancy can predispose offspring to elevated blood pressure, likely due to shared genetic and environmental factors, as well as the impact of maternal health on the fetal environment (Davis et al., 2012). These findings highlight the importance of maternal health and prenatal care in mitigating early-life risk factors for hypertension, underscoring the need for comprehensive strategies that address both maternal and child health.

3.2. Adolescence and Young Adulthood:

Adolescence and young adulthood are critical periods for the development of hypertension, with lifestyle factors playing a pivotal role in shaping cardiovascular health. A sedentary lifestyle, characterized by prolonged periods of physical inactivity, and poor dietary habits, such as high consumption of processed foods, salt, and sugary beverages, are strongly associated with early-onset hypertension (Chen & Wang, 2008). These behaviors contribute to weight gain, insulin resistance, and vascular dysfunction, which can accelerate the progression of hypertension even in young individuals (Dorgan et al., 2011). Encouraging regular physical activity and promoting balanced, nutrient-rich diets during these formative years are essential strategies to prevent hypertension and its long-term complications.

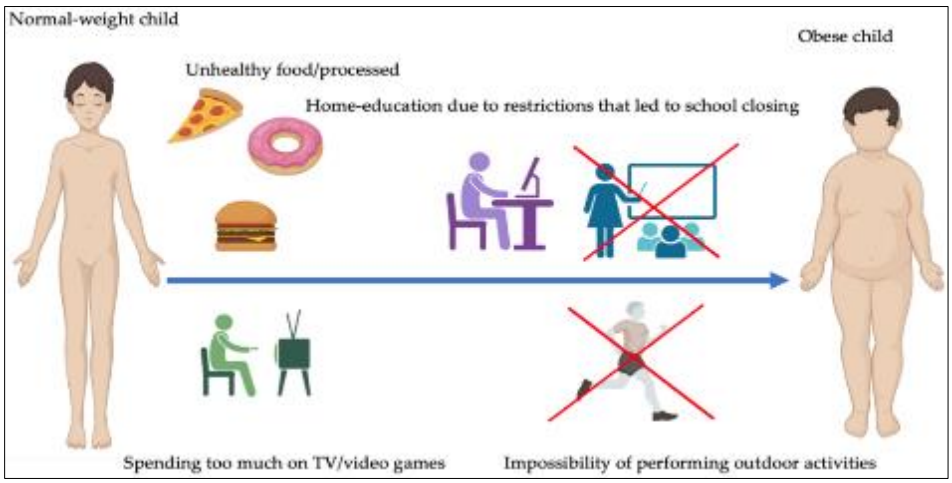

Figure 3 Key factors influencing childhood obesity during pandemics. (Vassile et al, 2023)

The impact of stress and mental health during adolescence and young adulthood further exacerbates the risk of hypertension. Chronic stress, anxiety, and depression can lead to dysregulation of the autonomic nervous system and

increased secretion of stress hormones like cortisol, which elevate blood pressure over time (Flynn, 2009). Additionally, poor mental health often correlates with unhealthy coping mechanisms, such as smoking, alcohol consumption, and poor sleep quality, all of which are independent risk factors for hypertension (Hamer et al., 2010). Addressing mental health challenges and providing stress management resources during these developmental years are crucial for reducing hypertension risk and fostering overall well-being.

3.3. Lifelong Cumulative Risk

Lifelong cumulative risk for hypertension is shaped by the interplay between early-life factors and adult lifestyle choices, creating a trajectory that significantly influences cardiovascular health. Early-life risk factors, such as childhood obesity, low birth weight, and maternal hypertension, can set the stage for metabolic and vascular dysfunction that persists into adulthood (Barker et al., 2009). When these early vulnerabilities are compounded by unhealthy adult behaviors—such as poor diet, physical inactivity, smoking, and excessive alcohol consumption—the risk of developing hypertension is substantially amplified (Lurbe et al., 2016). For example, an individual with a history of childhood obesity who adopts a sedentary lifestyle and consumes a high-sodium diet in adulthood is far more likely to experience elevated blood pressure and related complications than someone without these early risk factors.

The cumulative impact of these interactions underscores the importance of a life-course approach to hypertension prevention. Addressing early-life risk factors through targeted interventions, such as promoting healthy prenatal care, childhood nutrition, and physical activity, can mitigate the foundation of risk (Falkner, 2015). However, maintaining healthy lifestyle choices throughout adulthood is equally critical to breaking the cycle of cumulative risk. Public health strategies that emphasize continuity of care, education, and support for healthy behaviors across all life stages are essential to reducing the global burden of hypertension and its associated cardiovascular diseases (ACC, 2017).

4. Mechanisms Linking Demographics and Development to Hypertension

4.1. Biological Mechanisms

Biological mechanisms play a central role in linking demographic and developmental factors to hypertension, with genetic predisposition and epigenetic changes being key contributors. Genetic factors account for approximately 30-50% of blood pressure variability, with numerous genes implicated in regulating vascular tone, sodium balance, and hormonal pathways (Ehret & Caulfield, 2013). Additionally, epigenetic modifications, such as DNA methylation and histone modification, can be influenced by early-life exposures, including maternal health, nutrition, and environmental stressors, leading to long-term changes in gene expression that predispose individuals to hypertension (Liang et al., 2018). For example, low birth weight and maternal hypertension have been associated with epigenetic alterations that affect renal and cardiovascular function, increasing hypertension risk later in life (Barker et al., 2009). These mechanisms highlight the complex interplay between inherited traits and environmental influences in shaping hypertension risk.

Chronic stress is another critical biological mechanism that impacts cardiovascular health and contributes to hypertension. Prolonged exposure to stress activates the hypothalamic-pituitary-adrenal (HPA) axis and the sympathetic nervous system, leading to elevated levels of stress hormones like cortisol and catecholamines (Flynn, 2009). These hormonal changes promote vasoconstriction, sodium retention, and increased heart rate, all of which elevate blood pressure. Over time, chronic stress can also induce inflammation, endothelial dysfunction, and arterial stiffness, further exacerbating hypertension risk (Hamer et al., 2010). Demographic factors, such as socioeconomic status and race, often influence stress exposure, with marginalized populations experiencing higher levels of chronic stress and, consequently, a greater burden of hypertension (Sims et al., 2020). Addressing these biological mechanisms through targeted interventions, such as stress management programs and equitable access to healthcare, is essential for reducing hypertension disparities.

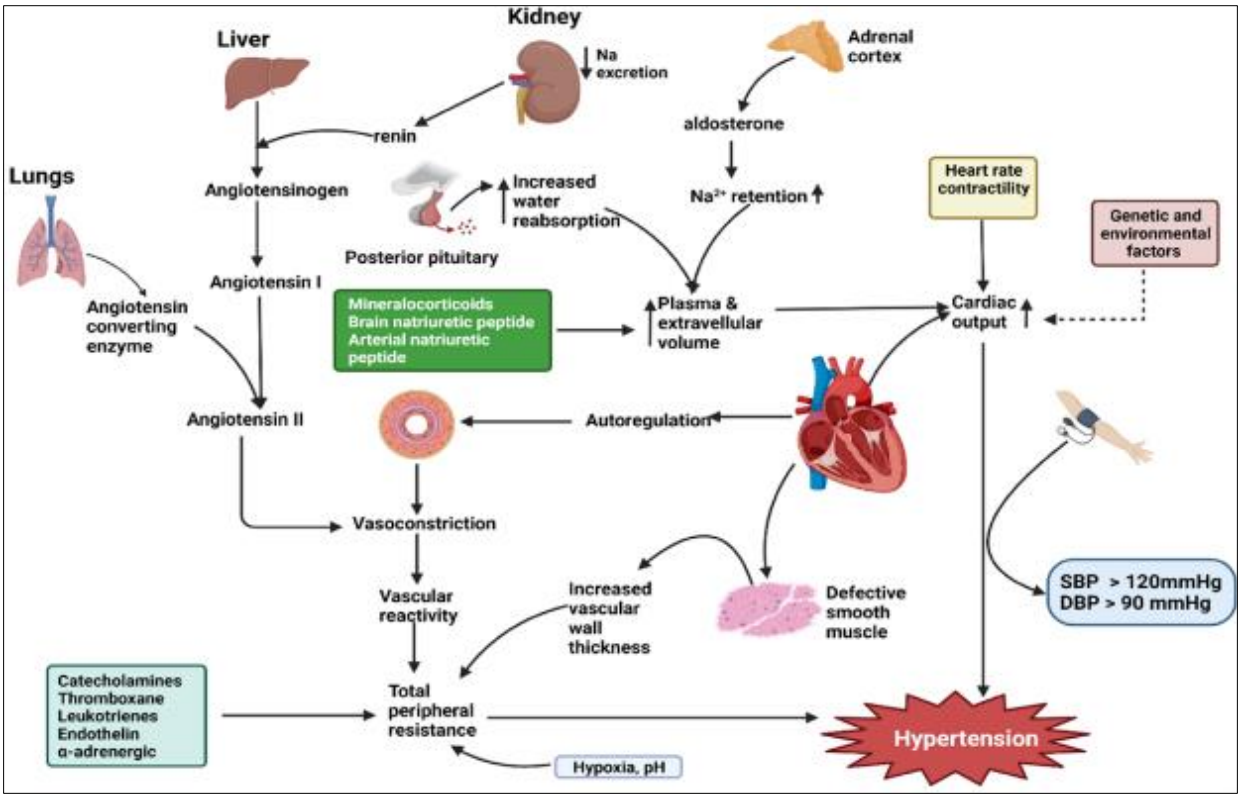

Figure 4 The role of multiple factors in the regulation of blood pressure (Data from Adua, 2023)

4.2. Environmental and Social Mechanisms

Environmental and social mechanisms significantly influence hypertension risk, with neighborhood factors playing a critical role in shaping health outcomes. Food deserts, characterized by limited access to affordable, nutritious foods, and the absence of safe spaces for physical activity, such as parks or recreational facilities, contribute to unhealthy diets and sedentary lifestyles (Walker et al., 2010). These conditions are particularly prevalent in low-income and marginalized communities, where residents often rely on convenience stores offering processed, high-sodium foods and lack opportunities for regular exercise (Casagrande et al., 2009). Over time, these environmental barriers increase the likelihood of obesity, insulin resistance, and hypertension, perpetuating health disparities across socioeconomic and racial groups.

Discrimination, whether based on race, ethnicity, gender, or socioeconomic status, is another powerful social mechanism that exacerbates hypertension risk. Experiencing discrimination induces chronic stress, which activates the hypothalamic-pituitary-adrenal (HPA) axis and sympathetic nervous system, leading to elevated blood pressure and cardiovascular strain (Williams & Mohammed, 2013). Additionally, discrimination can negatively impact health behaviors, such as increasing smoking, alcohol consumption, and poor dietary choices, as coping mechanisms (Paradies et al., 2015). Marginalized individuals who face systemic discrimination are also more likely to encounter barriers to healthcare access, further compounding their risk of hypertension and related complications. Addressing these environmental and social mechanisms requires comprehensive policy interventions, such as improving access to healthy foods, creating safe recreational spaces, and implementing anti-discrimination measures to promote health equity.

5. Implications for Prevention and Intervention

5.1. Public Health Strategies

Public health strategies are essential for preventing and managing hypertension, particularly through community-based programs that promote healthy lifestyles. Initiatives such as nutrition education workshops, exercise classes, and smoking cessation programs can empower individuals to adopt healthier behaviors and reduce hypertension risk (Flynn, 2009). For example, community health workers can play a pivotal role in delivering culturally tailored interventions that address the specific needs of diverse populations, including those in low-income or marginalized

communities (Hebert et al., 2008). Additionally, partnerships with local organizations, schools, and businesses can amplify the reach and impact of these programs, fostering environments that support long-term behavior change and cardiovascular health.

Policies aimed at addressing food insecurity and improving access to healthcare are equally critical in reducing hypertension disparities. Implementing policies that increase the availability of affordable, nutritious foods in underserved areas—such as subsidies for farmers' markets or incentives for grocery stores to open in food deserts—can help mitigate dietary risk factors for hypertension (Walker et al., 2010). Furthermore, expanding access to healthcare services, including preventive screenings and hypertension management programs, ensures that individuals at risk receive timely and effective care (ACC, 2017). Policies that address social determinants of health, such as housing stability and economic security, can also indirectly reduce hypertension risk by alleviating chronic stress and improving overall well-being. A multifaceted approach that combines community engagement with systemic policy changes is essential for achieving equitable hypertension prevention and control.

5.2. Targeted Interventions for High-Risk Groups

Culturally tailored education and outreach programs are essential for addressing hypertension disparities among high-risk groups, such as racial and ethnic minorities and low-income populations. These programs are designed to resonate with the cultural values, beliefs, and practices of the target community, thereby improving engagement and effectiveness. For example, community-based interventions that incorporate culturally relevant dietary recommendations, language-specific materials, and trusted local leaders have been shown to improve hypertension awareness and management in African American and Hispanic communities (Bovell-Benjamin et al., 2013; Mengesha et al., 2024). Additionally, programs that address barriers to healthcare access, such as transportation and cost, while providing education on the importance of regular blood pressure monitoring, have demonstrated success in reducing hypertension prevalence in underserved areas (Ferdinand et al., 2012). By tailoring interventions to the unique needs of high-risk groups, these programs can foster trust, enhance health literacy, and promote sustainable lifestyle changes.

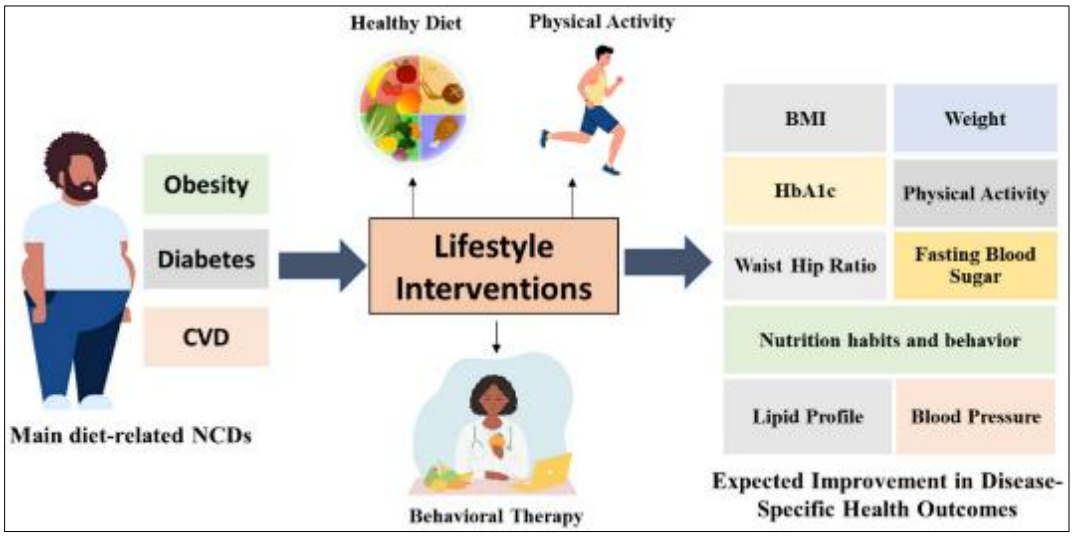

Figure 5 The effects of lifestyle interventions on managing diet-related non-communicable diseases (NCDs) and health outcomes. (Tariq et al, 2022)

Early screening and intervention for children and adolescents are critical for preventing the development of hypertension in adulthood. Childhood obesity, poor diet, and physical inactivity are significant risk factors for elevated blood pressure, and early identification of these issues can lead to timely interventions (Falkner, 2015). School-based health programs that incorporate routine blood pressure screenings, nutrition education, and physical activity initiatives have been effective in reducing hypertension risk among youth (Lurbe et al., 2016). Furthermore, interventions that involve parents and caregivers in promoting healthy behaviors at home can amplify the impact of these efforts (Rosner et al., 2000). By focusing on early-life risk factors and implementing preventive measures, healthcare providers and public health professionals can disrupt the trajectory of hypertension and reduce its long-term burden on individuals and healthcare systems.

5.3. Integrating Developmental and Demographic Insights into Clinical Practice

Integrating developmental and demographic insights into clinical practice is essential for addressing the root causes of hypertension disparities and improving patient outcomes. One critical step is training healthcare providers to recognize and address the social determinants of health (SDOH) that influence hypertension risk. SDOH, such as poverty, housing instability, food insecurity, and lack of access to healthcare, disproportionately affect marginalized populations and contribute to higher rates of hypertension (Adler & Stead, 2015). By equipping providers with the knowledge and tools to assess these factors during patient visits, healthcare systems can better identify barriers to care and connect patients with community resources. For example, incorporating SDOH screening tools into electronic health records (EHRs) can help providers tailor interventions to meet the specific needs of their patients (Whitman et al., 2022). Training programs that emphasize cultural competency and patient-centered care can further enhance providers' ability to deliver equitable and effective care to diverse populations (Betancourt et al., 2016).

Personalized prevention plans based on individual risk profiles are another key strategy for integrating developmental and demographic insights into clinical practice. Hypertension risk is influenced by a complex interplay of genetic, environmental, and lifestyle factors, which vary significantly across different demographic groups and developmental stages. For instance, African Americans are more likely to have salt-sensitive hypertension, while individuals with a history of childhood obesity or early-life stress may require targeted interventions to mitigate long-term risks (Falkner, 2015; O'donnell et al, 2013). By leveraging data from patient histories, genetic testing, and community-level risk assessments, clinicians can develop personalized prevention plans that address the unique needs of each patient. These plans may include tailored dietary recommendations, exercise programs, stress management techniques, and medication regimens, all designed to reduce hypertension risk and improve overall cardiovascular health (Flynn, 2009).

Furthermore, integrating developmental and demographic insights into clinical practice requires a shift toward a more holistic and preventive approach to healthcare. This includes fostering collaboration between healthcare providers, public health professionals, and community organizations to address the broader social and environmental factors that contribute to hypertension. For example, partnerships with local schools, workplaces, and faith-based organizations can help promote early screening and lifestyle interventions for at-risk populations (Mengesha et al., 2024). Additionally, leveraging technology, such as telehealth and mobile health apps, can improve access to care and support ongoing patient engagement in hypertension prevention and management (Fujiwara et al., 2022). By adopting these strategies, healthcare systems can move beyond traditional models of care and create a more equitable and effective approach to reducing hypertension disparities.

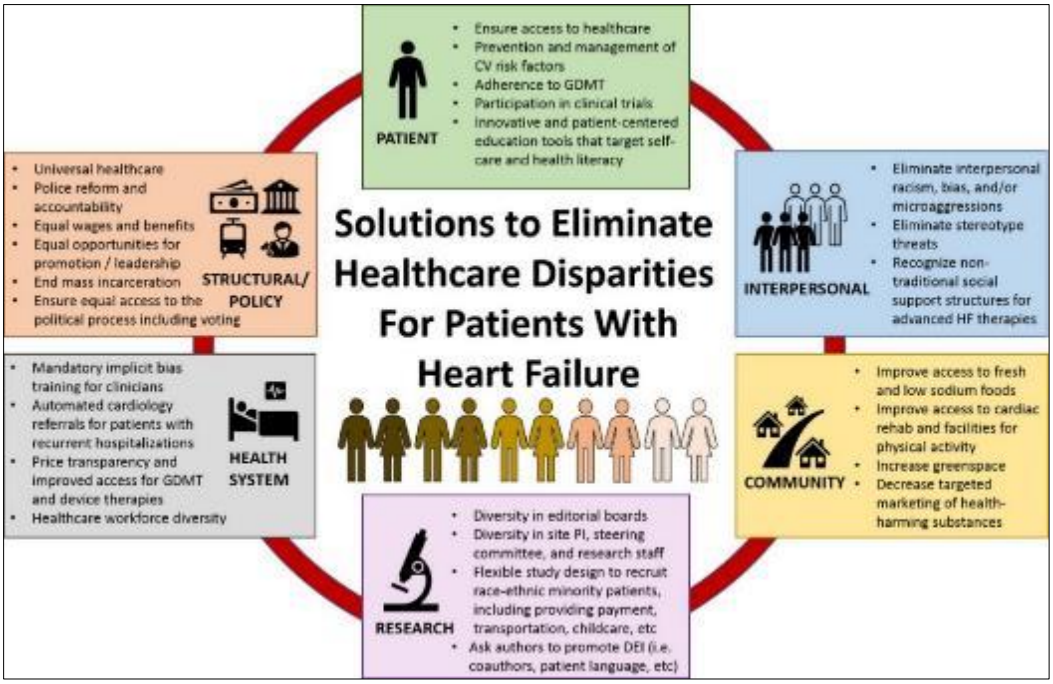

Figure 6 Strategies to eliminate healthcare disparities in heart failure patients, focusing on CV care, DEI initiatives, GDMT implementation, and PI-led research. (Morris et al, 2022)

6. Challenges and Future Directions

6.1. Barriers to Addressing Disparities

Addressing hypertension disparities is fraught with systemic inequities and limited resources in underserved communities, which hinder effective prevention and management efforts. Structural barriers, such as poverty, inadequate housing, and food insecurity, disproportionately affect marginalized populations and contribute to higher rates of hypertension (Braveman et al., 2011). For example, low-income neighborhoods often lack access to affordable, nutritious food and safe spaces for physical activity, making it difficult for residents to adopt healthy lifestyles (Walker et al., 2010). Additionally, systemic racism and discrimination within healthcare systems can lead to mistrust and reduced engagement with medical services among minority populations, further exacerbating disparities (Williams & Mohammed, 2013). These inequities are compounded by limited funding and resources for public health initiatives in underserved areas, creating a cycle of disadvantages that is challenging to break.

Implementing large-scale public health interventions to address hypertension disparities also presents significant challenges. One major obstacle is the complexity of coordinating efforts across multiple sectors, including healthcare, education, and community organizations, to create sustainable and impactful programs (Collins et al., 2009). For instance, while community-based interventions have shown promise in reducing hypertension rates, scaling these programs to a national level requires substantial financial investment, political will, and infrastructure support (Still et al., 2020). Furthermore, cultural and linguistic differences among diverse populations can complicate the design and delivery of interventions, necessitating tailored approaches that may be resource-intensive to develop and implement (Barr, 2008). These challenges highlight the need for innovative strategies and collaborative efforts to overcome barriers and ensure equitable access to hypertension prevention and care.

6.2. Future Directions

Despite these challenges, there are opportunities to advance efforts to reduce hypertension disparities through targeted policies and community-driven initiatives. Policymakers can play a critical role by advocating for increased funding for public health programs, expanding Medicaid coverage, and implementing policies that address social determinants of health, such as improving access to healthy food and affordable housing (Magnan, 2017). Community-based participatory research (CBPR) approaches, which involve community members in the design and implementation of interventions, can also enhance the relevance and effectiveness of public health programs (Israel et al., 1998). By addressing systemic inequities and fostering collaboration across sectors, it is possible to create a more equitable healthcare system that reduces the burden of hypertension in underserved populations.

6.3. Research Gaps

Addressing current research gaps necessitates conducting longitudinal studies to examine developmental risk factors comprehensively. Such studies are crucial for understanding how early-life exposures and conditions influence health trajectories over time. For instance, disparities in cognitive development have been observed as early as 24 months, underscoring the need for early interventions. Additionally, there is a pressing need to explore the intersection of race, socioeconomic status (SES), and hypertension. Research indicates that individuals from socioeconomically disadvantaged and predominantly Black neighborhoods experience a disproportionate burden of hypertension. This suggests that both racial and socioeconomic factors contribute to health disparities in hypertension prevalence and management. By addressing these research gaps, we can develop targeted interventions to mitigate health disparities and improve outcomes across diverse populations.

6.4. Opportunities for Innovation

Leveraging technology presents a significant opportunity to innovate hypertension prevention and management, particularly in underserved communities. Telehealth and mobile health apps have emerged as powerful tools for improving access to care, enabling remote monitoring of blood pressure, and providing personalized health education (Shaw et al., 2018). For example, mobile apps that track dietary habits, physical activity, and medication adherence can empower individuals to take control of their health, while telehealth platforms allow healthcare providers to reach patients in remote or resource-limited areas (Fujiwara et al., 2022). These technologies can also facilitate real-time data collection, enabling providers to identify trends and intervene early in high-risk populations. By integrating technology into hypertension care, healthcare systems can overcome traditional barriers to access and deliver more equitable, patient-centered services.

Collaborative efforts between policymakers, healthcare providers, and communities are essential for driving innovation and addressing the root causes of hypertension disparities. Policymakers can create an enabling environment by advocating for policies that expand access to telehealth services, fund community health programs, and address social determinants of health, such as food insecurity and housing instability (Magnan, 2017). Healthcare providers, in turn, can partner with community organizations to design culturally tailored interventions that resonate with the unique needs of diverse populations (Israel et al., 1998). For instance, community health workers can serve as liaisons between healthcare systems and underserved communities, providing education, support, and resources to promote hypertension prevention and management (Kangovi et al., 2017). By fostering collaboration across sectors, stakeholders can develop holistic, sustainable solutions that reduce hypertension disparities and improve population health outcomes.

7. Conclusions

This study highlights critical demographic and developmental risk factors associated with hypertension, underscoring the need for targeted interventions to address these disparities. Key findings reveal that socioeconomic status, age, ethnicity, and lifestyle factors significantly influence hypertension prevalence. Additionally, developmental factors such as early-life stress and poor nutrition further exacerbate risks.

To effectively reduce hypertension rates, it is imperative to address these disparities through equitable access to healthcare, education, and resources. Emphasis must be placed on preventive measures, particularly in underserved populations, to mitigate the long-term burden of hypertension.

A call to action is issued for integrated, multi-level approaches to prevention. This includes policy changes, community-based programs, and individual-level interventions that collectively address the social determinants of health. By fostering collaboration across sectors, we can create sustainable strategies to combat hypertension and improve overall public health outcomes.

Future Research Possibilities

- Psychological and Behavioral Factors in Hypertension: Pathways and Interventions for Stress-Related Hypertension"
- Lifestyle Modification as a First-Line Treatment for Hypertension: Evidence, Challenges, and Implementation in the U.S."

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

Statement of informed consent

Informed consent was obtained from all individual participants involved in the study.

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