A CONCEPTUAL FRAMEWORK FOR PREHYPERTENSION AND EPIDEMIOLOGICAL INSIGHTS: A NARRATIVE REVIEW

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ABSTRACT

The term prehypertension was introduced in 2003 by the Joint National Committee (JNC-7) on Detection, Prevention, Estimation and High Blood Pressure Treatment. It states to BP readings in the range of 120-139 mmHg systolic and 80-89 mmHg diastolic. This middle stage shows important cautionary signals, meaningfully increasing risk of progressing to hypertension.

This article investigates the multifaceted nature of prehypertension, definitions, challenges in diagnostics, prevalence globally and the consistent risk factors, despite the introduction as a tool of identify risk of individuals and make early preventive measures. The classification and treatment of prehypertension still on debate. Inconsistent guidelines in all the regions creating uncertainty among medical professionals.

HTN affects about 36% of adults, in men, specific ethnic populations showed higher vulnerability. In the occurrence of other CVD risk factors like obesity, DM and dyslipidemia impact on health. Prehypertension diagnosis is not straightforward method. It required repeated blood pressure measurements to marked hypertension. Research indicates that simply labeling to one as prehypertensive make little with motivate behavioral changes. The importance of developed more considerable communication plans to boost meaningful lifestyle adjustments.

Conclusion: Prehypertension signifies a public health challenge, there is a persistent need for combined guidelines and further research to improve its management and control the rising global burden of hypertension and linked cardiovascular diseases.

INTRODUCTION

Prehypertension is a condition that the blood pressure (BP) is raised but not high sufficient to touch the criteria for hypertension[1, 2], despite dwindling short to a proper diagnosis, this state signs an increased risk to developing

HTN and CVD [3]. That term in first time was announced by the JNC-7, 2003 on it the management of High Blood Pressure in seventh report[4], research redefined the edge for normal BP, setting 120/80 mmHg, and presented the category of "prehypertension" for individuals who have BP readings is systolic 120–139 mmHg, 80–89 mmHg diastolic. This new classification merged two earlier categories in JNC-6 report: stable BP. 130–139/85–89 mmHg and normal BP 120–129/80–84 mmHg. In table 1 showed the classifications in details.

Table 1: Blood pressure classifications for values <140/90 mmHg according to various hypertension guidelines

Guideline	Classification (for BP <140/90 mmHg)
ESC/ESH 2023	Normal: <130/85 mmHg High-normal: 130–139/85–89 mmHg [5]
ACC/AHA 2017	Normal BP = <120/80 mmHg Elevated BP = 120–129/<80 mmHg Hypertension as Stage 1 = 130–139/80–89 mmHg [6]
NICE 2023 (UK)	Optimal BP = <120/80 mmHg Normal BP = 120–129/80–84 mmHg High-normal BP = 130–139/85–89 mmHg [7]
ISH 2020	Optimal BP = <120/80 mmHg Normal BP= 120–129/80–84 mmHg High-normal BP = 130–139/85–89 mmHg [8]
JNC 7 (2003)	Normal BP = <120/80 mmHg Prehypertension BP = 120–139/80–89 mmHg [9]
Canadian Hypertension 2020	Normal BP = <120/80 mmHg Elevated BP = 120–129/<80 mmHg High-normal BP = 130–139/85–89 mmHg [10]
WHO 2021	Normal BP = <130/85 mmHg High-normal BP 130–139/85–89 mmHg [11]

The creation of this category was driven by compelling evidence. For instance FH study revealed that individuals have normal BP in age 55 had the 90% risk in life to developing hypertension[12], according 61 prospective studies demonstrated the death risk from IHD and stroke increased progressively BP levels, starting as systolic 115 mmHg and diastolic 75 mmHg[13]. The WHO have further emphasized that suboptimal BP systolic >115 mmHg accounts for 62% of CVD and 49% of IHD worldwide[14], However, not for all organizations are in agreement with the JNC-7's procedure, in 2003 guidelines by European Society of Hypertension-European Society of Cardiology and

WHO International Society of Hypertension statement expressed worries about the variability of cardiovascular risk in individuals classified as prehypertensive[15]. They struggled, people which have blood pressure readings 130–139/85–89 mmHg are at may risk of developing HTN and CVD disease when comparing to those have BP was between 120–129/80–84 mmHg[16].

The guidelines JNC-7 emphasized the Prehypertension was not as a disease but a risk group[17]. It aimed to identify individuals who could benefit from early lifestyle interventions to lower BP, slow the progression to hypertension, or prevent it altogether. While lifestyle changes have been proven effective in reducing BP and delaying hypertension, studies show that people are often reluctant to adopt healthier habits. For example, the PURE study found that less than 5% of patients with coronary heart disease or stroke adhered to healthy behaviors, even after a major cardiac event. Another concern was the potential burden on healthcare providers, who already struggle to manage hypertensive patients, if they were also tasked with addressing large numbers of prehypertensive individuals. In the different national and international hypertension guidelines showed considerable variation in their classification of BP readings in the 120–139/80–89 mmHg range, like JNC-7 and those from the American Society of Hypertension/International Society of Hypertension categorize all the readings called "prehypertension".

Others, such as the European, Canadian, Australian, and Japanese guidelines, distinguish between “normal BP” 120–129 / 80–84 mmHg and “high-normal” 130–139/85–89 mmHg, but British NICE guidelines simply categorize all readings in this range as “normal.” This inconsistency creates confusion among healthcare providers, particularly in countries without their own guidelines, as they must navigate conflicting recommendations from credible sources[17]. A unified consensus on BP classification would greatly benefit both physicians and patients.

There is limited information about the frequency with doctors use the prehypertension classification and how patients react on it. A study conducted in the University of North Carolina School of Medicine aimed to find how primary care providers discuss prehypertension with their patients. Total 1,008 non-hypertensive participants surveyed. 1.9% showed that they had informed about prehypertension status. Thats why between a smaller group of 102 participants with blood pressure readings in prehypertension range, 2% where informed[18]. This shows that physicians may hesitant to use the term prehypertension and discuss lifestyle alterations. Alternatively, they might be counseling patients on reducing hypertension risk without explicitly labeling them as prehypertensive.

There is also debate about the psychological impact of labeling patients as prehypertensive[19]. Some studies suggest that such labels could lead to unintended consequences, such as increased work absenteeism[19, 20], heightened physical symptoms, and reduced quality of life. However, research by Viera et al. found no significant differences in health perceptions or lifestyle changes between patients labeled as prehypertensive and those who

received generic advice[15], according a study no negative effects on prehypertension patients on their quality of life in patients informed of their prehypertension position[21], but these studies showed that labeling maybe not harmful. Further research needed to classify effective communication approaches to inspire lifestyle changes and progress health outcomes in the prehypertensive.

The Complexity of Diagnosing Prehypertension: Beyond a Single Blood Pressure Reading

The detecting Prehypertension early is crucial[13], the procedure of diagnosis of Prehypertension is not straightforward, for example a patient came into a clinic with a blood pressure reading above 140/90 mmHg[22]. Does this single measurement confirm hypertension? Not necessarily. Multiple readings over several visits are essential to establish a reliable diagnosis[23], for example guidelines of JNC-7 and ESH/ESC endorse the averaging at least two appropriately BP measured readings in two visits. The Canadian Hypertension Education Program (CHEP) have further requirements five visits with consistent high readings to labeling as hypertensive. The UK's NICE guidelines supports for ambulatory blood pressure monitoring (ABPM) to confirm hypertension[24],

But ABPM may not feasible at home, monitoring blood pressure for at least four days provides a practical alternative. These out-of-office readings are now regarded as the gold standard for diagnosing, as they assist in identifying conditions such as white-coat hypertension like high readings in clinic environments but at home normal and masked hypertension and other hand normal in the clinic but elevated in other settings. The criteria to diagnosing hypertension at non-clinical settings are clearly established, home blood pressure readings of 135/85 mmHg or above, or 24-hour ambulatory measurements of 130/80 mmHg or more that signify hypertension[25], but, the guidelines fall short when it comes to defining thresholds for prehypertension or high-normal blood pressure in out-of-office settings[26]. The doubt can create confusion in clinical practice like if a patient's office reading averages 130/80 mmHg that is categorized as prehypertension but their home readings average 115/75 mmHg considered normal should we refer to "white-coat prehypertension"? Similarly, if office readings are normal 110/70 mmHg but home readings are high 130/80 mmHg[27], does this qualify as "masked prehypertension"? These scenarios highlight the need for clearer criteria to bridge the gap between office and out-of-office measurements. A study by Niiranen et al. analyzed data from 6,470 participants to establish outcome-driven reference points for home blood pressure, they identified thresholds of 120/75 mmHg and 125/80 mmHg[28], corresponding to the cardiovascular risks associated with stages 1 and 2 prehypertension in clinic readings, In another study, Head et al. assessed 8,575 patients, identify ambulatory blood pressure equivalents for different stages of clinic-based hypertension. The results showed with rising blood pressure the difference among ambulatory and clinic measurements becomes increasingly evident. The ambulatory equal of mild hypertension 140/90 mmHg in the clinic was recorded at 136/87 mmHg. On the other hand, severe hypertension 180/100 mmHg in the clinic linked

to 168/105 mmHg in ambulatory readings[29]. Research emphasized the implication of fine-tuning out-of-office thresholds. This mostly crucial for prehypertension to ensure exact diagnosis and active management.

Global Prevalence and Trends of Prehypertension

Prehypertension a predecessor to hypertension has extensively documented across the world[30]. Prevalence rates vary significantly across nations. According to the results from the 2011–2012 National Health and Nutrition Examination Survey around 28% of the U.S.A. population falls in that category[31]. Research of several areas presents a varied scenario like China 36.4%[32], Japan 33%[33], India 33.2%[34] UK 43.9%[15], Canada 27.2%[35], the Netherlands 32.8%[36]. In Africa the prevalence 29.8%[37], Brazil, Belarus report 36.1%[38] and 34.3%[39]. Iran at top list 47.3%. The differences linked to methodologies like variations in PB measurement techniques and the age ranges of participants. Those with pre-existing hypertension were excluded.

A meta-analysis of 26 studies with about twenty cross-sectional, six longitudinal studies, showed that the worldwide commonness of prehypertension is around 36%[40]. The constant in a results of the Prospective Urban and Rural Epidemiological (PURE) study that evaluated more than 153,000 individuals in 17 countries showed the prevalence of 36.8%[41]. That data underlines the important truth. Prehypertension is a common condition which have a significant impact on the worldwide population.

Research have confirmed the occurrence of prehypertension and hypertension had changed over the years. A inclusive analysis linking data from 90 countries showed the high-income countries showed 2.6% reduction in hypertension rates between 2000 and 2010[42], but lower and middle-income countries showed 7.7% rise[43]. The rise is mostly linked with elements like aging populations, rapid urbanization and poor lifestyle adoptions. Two surveys conducted in Beijing, China, one in 2001 and the other in 2010 showed the prehypertension rates between participants aged 60 and above reduced but hypertension rates increased[43]. The trend submits that many individuals with prehypertension will ultimately development the hypertension as they grow older.

In U.S.A different perspective appeared between 1999 and 2012, showing the presence of prehypertension between American adult fell 31.2% to 28.2%[44]. The complicated relationship between demographic, lifestyle and healthcare elements influences blood pressure trends on a worldwide scale. The worldwide burden of CVD remains elevated.

Gender, Age, and Ethnic Disparities in Hypertension and Prehypertension

Worldwide health statistics disclose significant patterns in the existence of hypertension and prehypertension between different genders, age groups and communities[45]. According the Worldwide Health Observatory report years 2015 to 2017. The age consistent prevalence of hypertension between adults aged 18 and older was 24.1% for male and 20.1% for female[46]. The mean systolic BP was ≥ in male 127.0 mmHg than in women 122.3 mmHg[47]. Hypertension is more prevalent in men in the mostly of countries. There are only a few exclusions like Ireland,

Tajikistan and Turkey where rates are comparable between genders[48]. The gender gap applied to prehypertension it is more common in men[49]. The variations are not consistent worldwide. As people age, the prevalence of prehypertension increases in both men and women until they reach their 60s. When hypertension develops more dominant intense prehypertension rates.

Once it comes to racial and ethnic differences research produced mixed findings like the REGARDS study. It included 5,553 individuals with prehypertension[50], found that African-American participants have higher rates of prehypertension across all age and gender groups[50]. The Bogalusa Heart Study reported that Black individuals were more likely to have prehypertension linked to other[51]. The Women Health Initiative study highlighted a more complex picture. Prehypertension rates changing significantly between ethnic groups 39.5% in White women, 32.1% in Black women, 42.6% in Hispanic women, 38.7% in American Indian women and 40.3% in Asian women[52]. The Multi-Ethnic Study of Atherosclerosis showed racial differences Black and Hispanic individuals aged 45–74 have experienced a greater prevalence of hypertension than white counterparts but no prominent difference was found between Chinese and white participants[52].

In findings NHANES III showed that no important change in the prevalence of prehypertension among other ethnic groups[53]. A study from China a nation with various ethnicities and unique dietary and lifestyle practices showed important differences in prehypertension rates between different ethnic groups[54]. In European research showed that prehypertension prevalence was similar across ethnic groups for men[44, 55]. African Surinamese and Hindustani Surinamese women experienced high rates in comparison to White Dutch women[56]. The conflicted results underline the complexed racial and ethnic influences on blood pressure, pointing to the interplay of genetic, cultural and environmental factors.

Incidence and Progression of Prehypertension

The prevalence of prehypertension has been widely studied[57], far less is understood about its incidence how often new cases develop over time, a research from a Middle Eastern population-based cohort sheds some light on this progression in median follow-up of 9.2 years almost 50% of those who initially have normal BP moved to prehypertension with a more significant shift observed was observed in men associated to women[58]. In the Women's Health Initiative study showed that 27.3% of Hispanic women experienced prehypertension in a mere three years underscoring how quickly this condition arise in specific groups[59].

A study by Hardy et al. offer deeper insights into how age, race, ethnicity, and gender influence the likelihood of transitioning from normal blood pressure to prehypertension[60]. Using data from three NHANES cross-sectional samples, the study found that between the ages of 8 and 30, young men have more than twice as compare to young women to progress from normal blood pressure to prehypertension[16]. Between African American young men, the transition rates are the high but the Mexican American young women showed the lowest rates. The dynamics

change as age increases, when reaching 40, the probability of the transition soothes or may decreases in men. But it rises in women. Mexican American women age over 60 have seen significant rates of progression from normal BP to prehypertension[16].

Prehypertension and Its Multifaceted Associations

Hypertension and prehypertension mostly coexist with some other cardiovascular risk factors[61]. It encompasses conditions like obesity, dyslipidemia and DM. Study presented about 90% have prehypertension exhibit minimum one additional traditional risk factor for heart disease[62]. The strong link between prehypertension and other factors can sometimes produce unpredictable findings. It contains indicators of inflammation when microalbuminuria is present, as well as socioeconomic status, educational level and dietary practices. The other consideration that individuals live in urban or rural settings. Like some studies propose that lifestyle and environment such as diet and geographic location can affect BP levels, although the evidence still inconsistent. The association between prehypertension and these metabolic and socioeconomic factors is complex.

Conclusion

The prehypertension refers to BP readings the array from 120 - 139 mmHg for systolic and 80 to 89 mmHg for diastolic. In condition serves as a critical warning sign for hypertension and cardiovascular diseases. Around 36% of adults worldwide are impacted. There is a high prevalence between men and certain ethnic groups. Prehypertension commonly coexists with other risk factors like obesity, diabetes and dyslipidemia. It was introduced to help recognize individuals at risk and to boost early intervention. Managing prehypertension is challenging due to inconsistent guidelines with diagnostic problems. There is a important need for effective communication approaches. Creating standardized guidelines is important to promote lifestyle changes and ease the increasing burden of hypertension and related cardiovascular problems.

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