HHS Public Access

Author manuscript

Curr Cardiovasc Risk Rep. Author manuscript; available in PMC 2015 September 21.

Published in final edited form as:

Curr Cardiovasc Risk Rep. 2015 April ; 9(4): . doi:10.1007/s12170-015-0446-5.

The Role of Hypertension in Race-Ethnic Disparities in Cardiovascular Disease

Pelbreton C. Balfour Jr.,

Department of Epidemiology and Prevention, Division of Public Health Sciences, Wake Forest School of Medicine, Winston-Salem, NC, USA

Carlos J. Rodriguez, and

Department of Epidemiology and Prevention, Division of Public Health Sciences, Wake Forest School of Medicine, Winston-Salem, NC, USA

Department of Medicine, Section of Cardiovascular Medicine, Division of Public Health Sciences, Wake Forest School of Medicine, Winston-Salem, NC, USA

Keith C. Ferdinand

Heart and Vascular Institute, Tulane University School of Medicine, 1430 Tulane Ave. #8548, New Orleans, LA 70112, USA

Keith C. Ferdinand: kferdina@tulane.edu

Abstract

Race-ethnic disparities in cardiovascular disease (CVD) have persisted in the USA over the past few decades. Hypertension (HTN) is a significant contributor to CVD, including coronary heart disease, stroke, end-stage kidney disease and overall mortality and race-ethnic disparities in longevity. Additionally, both non-Hispanic blacks (NHBs) and Hispanic adults have been known to have higher prevalence of poorly controlled blood pressure compared to non-Hispanic whites (NHWs). Addressing these disparities has been a focus of programs such as the Million Hearts initiative. This review will provide an update of available data on HTN in various race-ethnic groups, including awareness, treatment, and control and note the recent progress in HTN control across all race/ethnic groups. We will also discuss the recent 2014 U.S. HTN guideline that has led to debate regarding the potential impact of BP goals in older persons on worsening CVD disparities, with disproportionate effects on women and NHBs.

Keywords

Hypertension; High blood pressure; Race; Ethnicity; Health disparities; Cardiovascular disease

Correspondence to: Keith C. Ferdinand, kferdina@tulane.edu.

Compliance with Ethics Guidelines

Human and Animal Rights and Informed Consent This article does not contain any studies with human or animal subjects performed by any of the authors.

Conflict of Interest Pelbreton Balfour, Jr. has no relevant disclosures. Keith Ferdinand has been a consultant for Astra Zeneca, Sanofi, Amgen, Novartis, Forest, Boehinger and Ingleheim.

Introduction

Despite overall decline in the USA over several decades in deaths from cardiovascular disease (CVD), race-ethnic disparities in CVD have persisted. Importantly, the declines in CVD mortality over time have not been as great for US minorities, and various race-ethnic groups are burdened disproportionately from CVD and CVD risk factors [1•]. CVD age-adjusted death rates were 33 % higher for non-Hispanic blacks (NHBs) than for the overall population in 2010 (236 per 100,000). In NHB males and females, the rates were 369 and 261 per 100,000 compared to 278 and 192 per 100,000 for non-Hispanic white (NHW) males and females, respectively [1•]. Additionally, the 2009 age-adjusted rate of premature death from coronary heart disease (CHD) was higher among NHBs (66 %) compared to NHWs (43 %) and for premature death due to stroke for NHBs compared to NHWs (25 and 10 %, respectively) [2].

The public health burden from CVD and these race-ethnic disparities are largely in part due to modifiable risk factors. The American Heart Association (AHA) category of optimal cardiovascular health varies among race-ethnic groups, including seven health metrics (smoking status, physical activity, healthy diet, body weight, along with optimal blood pressure, blood glucose, and total cholesterol levels) [1•, 3•]. Having a BP <120/<80 mmHg has been designated as one of the seven components of ideal cardiovascular health [1•]. NHBs (10 %) and Mexican Americans (12 %) were less likely than NHWs (19%) to have ≥5 metrics at ideal levels defined by the AHA [1•, 3•]. In the 2009, Behavioral Risk Factor Surveillance System (BRFSS) survey NHBs, Hispanics, and American Indian/Alaska Native adults were all less likely than NHWs to have ideal CV health (all seven health metrics). Moreover, poor CV health (0–2 ideal health metrics) was significantly higher among NHBs (17 %), non-Hispanic American Indians/Alaska Natives (15 %), and Hispanics (13 %) when compared to NHWs (11 %, $p<0.001$) [3•]. Similarly, in the Atherosclerosis Risk in Communities (ARIC) study, NHB participants were shown to have 90 % of CVD events explained by having elevated or borderline risk factors compared to 65 % of NHW participants [4], confirming previous 2003 BRFSS data of disparities in both self-reported and measured risk factors which most adversely affected NHBs, Mexican Americans, and American Indian/Alaska Natives [5].

In particular, hypertension (HTN) is a common, potent, independent risk factor for CVD. Approximately, 78 million or 33 % of US adults ≥20 years of age have HTN (defined as systolic BP ≥140 mmHg or diastolic BP ≥90 mmHg, taking antihypertensive medication, or told on two occasions that he or she had hypertension) [1•]. High blood pressure is more prevalent in certain race/ethnicities, especially in NHBs, who have among the highest age-adjusted prevalence of HTN (44 %) not only in the USA, but in the world [1•]. In addition, the prevalence of HTN is high among Native Hawaiians or Pacific Islanders (37 %) and American Indians or Alaska Natives (25 %). The population attributable risk for CVD mortality in the USA was estimated to be 41 % for high blood pressure, compared to 14 % for smoking, 13 % for poor diet and 9 % for abnormal blood glucose levels [6] and hypothetically, 41 % of CVD mortality is explained by and could be avoided by optimal blood pressure and diminish race/ethnic CVD disparities in HTN-related CVD morbidity

and mortality. Importantly, along with being a risk factor for coronary heart disease, HTN is associated with increased risk of congestive heart failure, stroke, and kidney disease.

Epidemiology of Hypertension

According to NHANES 2009–2012 data, the prevalence of HTN was highest among NHBs (42 %), followed by NHWs (28 %), Hispanics (26 %), and non-Hispanic Asian (NHA) adults (25 %), respectively. The overall prevalence of HTN did not change significantly from 2009–2010 [7•]. Data from the 2012 National Health Interview Survey (NHIS) demonstrated that NHB adults (33 %) and American Indian/Alaska Native adults (25 %) were more likely to have been told they had HTN on ≥2 occasions than NHW adults (23 %) [8]. In the Multi-Ethnic Study of Atherosclerosis (MESA), blood pressure was higher among NHBs and Hispanics when compared to their NHW counterparts [9]. The prevalence of self-reported HTN was 60 % in NHBs, 42 % in Hispanics, 39 % in Chinese participants. When compared to NHWs, after adjusted for multiple risk factors, NHB and Chinese ethnicity were both significantly associated with HTN. Hispanic ethnicity was significantly associated with HTN after adjustment for age and sex; however, after additional adjustment for traditional CV risk factors, there was no significant difference when compared to NHWs [9].

The Hispanic/Latino population, a growing heterogeneous subgroup, is currently the largest US minority [10•]. Although Hispanics have been reported to have rates not significantly different from NHWs, most data have been extrapolated from Mexican Americans [10•]. The Hispanic Community Health Study/Study of Latinos (HCHS/SOL) recently published data on the prevalence of HTN among various Hispanic/Latino sub-populations [11•]. Sorlie et al. report that the overall age-adjusted prevalence of HTN for Hispanic men and women was 26 and 25 %, respectively, with prevalence rates higher in Dominican, Puerto Rican, and Cuban adults. Mexican Americans had significantly lower prevalence of HTN compared to all other Hispanic subgroups except South Americans ($p<0.01$) [11•].NHIS data from 1997–2005 demonstrated that Hispanic blacks had higher prevalence of HTN than Hispanic whites, noted even for Hispanic blacks with higher income and education levels when compared to Hispanic whites of lower socioeconomic status [12].

The race-ethnic differences in prevalence of HTN have been reported for the past few decades, specifically higher for NHBs as compared to whites. Moreover, NHBs had greater increases in prevalence when compared to NHWs, and the greatest increases were seen among NHB women. According to NHANES data from 2003–2010, among adults with HTN, NHBs (74 %) and Mexican American (72 %) were more likely to be aged <65 years, compared with NHWs (57 %) [13]. Overall, NHB adults have a prevalence rates among the highest in the world and develop HTN earlier in life when compared to NHWs [14].

In the MESA cohort, between 2000 and 2007, NHBs had the highest incidence rate (85 per 1000 person-years) followed by Hispanics (66 per 1000 person-years), NHWs (57 per 1000 person-years), and then Chinese participants (52 per 1000 person-years) [15]. In addition, in a prospective cohort study of 18,865 participants, NHBs had a 35 % increased risk of conversion to HTN from normotension and prehypertension when compared to NHWs.

Additionally, the median conversion time when 50 % became hypertensive was significantly shorter for NHBs, confirming an accelerated risk of new-onset HTN [16].

Hypertension Categorization

"Uncontrolled HTN" signifies blood pressure (BP) that is inadequately treated rather than blood pressures that is refractory to treatment. Refractory HTN or treatment resistant hypertension (TRH) is defined by a blood pressure above goal despite adherence to at least three anti-hypertensive medications, including a diuretic [17]. As previously stated, NHBs and Hispanics have been more likely to have uncontrolled HTN when compared to NHWs due to different causes that have been reported in the literature.

Hypertension Disparities: Awareness, Treatment, and Control

An important aspect regarding reducing or eliminating CVD disparities has been the focus on awareness, treatment, and control of HTN. Overall in 2011–2012, approximately 83, 76, and 52 % of adults with HTN were aware of their condition, taking medication, and HTN was controlled, respectively [7•], varying among racial/ethnic groups. In 2011–2012, NHA adults were significantly less likely to be aware of their HTN (73 %), when compared to Hispanics (82 %), NHWs (83 %), and NHBs (86 %). In addition, NHA adults were significantly less likely to take medication for their HTN (65 %), compared with NHWs (77 %) and NHB adults (77 %) and not significantly different although less than Hispanics (74 %). Among race-ethnic groups, there was no significant difference in age-adjusted control of HTN estimated as 46 % in NHAs, 47 % in Hispanic adults, 50%in NHBs, and 54% in NHW adults [7•]. Although there was no difference among race-ethnic groups in 2011–2012, previous 2009–2010 NHANES data [18] demonstrated that age-adjusted HTN control was significantly lower for NHBs and Hispanics compared to NHWs. Healthy People 2020 specified a target goal percentage of people with HTN to be on medication to lower their blood pressure. In addition, both Healthy People 2020 and the Million Hearts (MH) initiative had target goals for controlled hypertension, defined as having a SBP ≤140 mmHg and DBP ≤90 mmHg. As stated from the 2011–2012 NHANES data, the percentage of adults in the USA treated for HTN had surpassed the Health People 2020 target goal of 69.5 %, while the control of HTN had not met the goal of Healthy People 2020 (61.2 %) nor the Million Hearts (MH) initiative (65 %) [7•].

In the HCHS/SOL, prevalence of HTN varied among Hispanic/Latino subgroups. In men, the percentage of those being aware of their HTN ranged from 57 % in Central Americans to 78 % in Cubans. In women, the percentage of those being aware of their HTN ranged from 72 % in South Americans to 79 % in Cubans and Dominicans and 86 % in mixed/other subgroup. The percentage of those treated for HTN was highest in Cuban men (65 %). Rates of control were lowest in both Central American men and women (12 and 32 %, respectively). The highest rates of control were demonstrated in Cuban men (40 %) and mixed/other subgroup for women (57 %) [11•].

Moreover, in addition to NHANES, data on HTN awareness, treatment, and control have been reported from cohorts such as MESA, and the REasons for Geographic and Racial Differences in stroke Study (REGARDS). In NHANES data for 2003–2010, HTN

awareness, treatment, and control were least likely in Mexican Americans, compared to NHBs and NHWs [13]. In the REGARDS cohort, of 6023 participants with HTN, awareness was significantly higher in NHBs compared to NHWs (93 vs 89 %, $p<0.0001$) [19]. In addition, NHBs were more likely to be treated for HTN compared to NHWs (91 vs 87 %, $p<0.0001$). Further analysis demonstrated that NHBs were less likely to have controlled HTN when compared to NHWs (62 vs 70 %, $p<0.0001$) [20]. In the MESA cohort, NHB (35 %) and Hispanic (32 %) adults had a significantly higher prevalence of treated but uncontrolled HTN compared to NHW (24 %) adults [9].

Overall HTN control increased from 27%in 1988–1994 to 50 % in 2007–2008, but uncontrolled HTN on treatment were reported to be significantly higher among NHBs ($p<0.001$) and Hispanics ($p=0.02$) compared to NHWs. Importantly, for TRH, taking ≥3 medications for HTN, NHBs and Hispanics have higher prevalence of uncontrolled HTN compare to NHWs, and NHB race was reported to be independently associated with TRH [21].

Recent analysis of NHANES data 1999–2012 demonstrated current trends with regard to Healthy People 2020 HTN goals. The age-adjusted prevalence of HTN did not change overtime ($p=0.32$); however, awareness, treatment, and control all increased ($p=0.0015$). Egan et al. revealed that HTN control was not significantly different among race-ethnic groups; however, in Hispanics, the proportion of treated adults with controlled HTN did not increase over time ($p=0.09$). Although HTN prevalence has remained stable over the past several years, current rates are above the Health People 2020 goal of decreasing prevalent HTN to 26.9 %. Additionally, established goals for HTN control (51.2 %) is below target (61.2 %). As also shown in NHANES 2011–2012 data, currently on treatment of HTN (74.7 %) has surpassed target goal of 69.5 % [22•].

Hypertension Complications

There is powerful association of HTN with coronary heart disease, congestive heart failure, stroke, and chronic kidney disease HTN, and this single largest risk factor for CV mortality in the USA is responsible for an estimated 45 % of all CV deaths [6]. In 2010, HTN was the 13th leading cause of death in the USA; HTN, coronary heart disease, and stroke accounted for 56 % of preventable deaths in adults aged <65 years. The death rate resulting from HTN was 50.2 for NHB men, 17.2 for NHW men, 37.1 for NHB women, and 15 per 100,000 for NHW women. The age-adjusted death rates for NHBs were higher than those of NHWs for 8 of the 15 leading causes of death with HTN being the largest ratio [23]. In addition to earlier onset of HTN, NHBs are 1.3 and 1.8 times increased rate of a non-fatal and fatal stroke, 1.5 times increased rate of death attributable to heart disease, and a 4.2 times increased rate of end-stage kidney disease when compared to NHWs [1•].

Although death rates were significantly higher for NHBs and American Indians/Alaska Natives when compared to NHWs, death rates were significantly lower for Hispanics and Asian/Pacific Islanders [24]. Despite similar age-adjusted prevalence rates for HTN in Hispanics as that of NHWs, rates of awareness, treatment, and control are lower. However, hypertension-related mortality (HRM) varies among Hispanic subgroups. While the age-

standardized HRM for Hispanics (127.3 per 100,000) was similar to NHWs (135.9), Puerto Rican Americans had 13 % higher rates ($p<0.01$) than NHWs. Mexican Americans had similar HRM rates, and Cuban Americans had lower HRM rates when compared to NHWs. A fourth subgroup categorized as other Hispanic Americans also had 12 % higher HRM rates when compared to NHWs [25].

Congestive heart failure (CHF) is a leading cause of morbidity and mortality in the USA [1•, 26], and HTN is a major risk factor, particularly in NHBs [1•, 27•]. Previous studies have shown that NHBs have earlier onset of HTN and higher average blood pressure levels [28–30]. Prior evidence has shown that individuals with elevated BP levels are at increased risk for development of HF [27•, 31]. Data from the Sub-Saharan Africa Survey of Heart Failure estimated that 50 % of acute HF cases were attributed to HTN [32]. In MESA, NHBs were at highest risk of developing HF which reflected differences in risk factors such as increased prevalence of HTN, in addition to DM and lower SES [33]. Similarly, in the Health, Aging, and Body Composition Study in which NHB participants were more likely to develop HF, there was a higher proportion of HF attributable to preventable risk factors in NHBs compared to whites, particularly uncontrolled BP (population attributable risk 21% for NHWs, 30% for NHBs) [34]. Recent estimates project that HF will continue to increase over the next several decades and will remain more prevalent in NHBs compared to other race-ethnic groups [35•]. This increased burden of HF in NHBs reflects the primary etiology related to HTN as compared to ischemic HD in the general population and confirms the urgent need to maintain the documented improvements in HTN control in NHBs in the future.

Observational studies have demonstrated race-ethnic disparities for stroke [36], as NHBs and Hispanics have been shown to have higher prevalence for both ischemic and hemorrhagic stroke compared to NHWs [37•]. Data from ARIC demonstrated that NHBs had 38 % increased incidence of all stroke types compare to NHWs [38]. American Indians have also been shown to have a high incidence of stroke compared to NHWs [39]. Evidence suggests the increased stroke burden suffered by race-ethnic groups is likely secondary to increased prevalence of CV risk factors in particular prehypertension and hypertension. Previous studies demonstrate a strong, independent, and predictive relationship between BP and stroke [17]. Importantly, there is an increased risk of stroke with higher BP even at levels not considered hypertensive [40]. Given the strong graded and continuous relationship between BP and stroke, recent guidelines for the prevention of stroke stress the importance of BP control through lifestyle modifications and pharmacologic interventions. Observational and clinical trial data demonstrate treatment and control of BP as an effective strategy in reducing stroke events [37•].

Update on Hypertension Guidelines: Implications for Race-Ethnic Minorities

Management guidelines and reports for HTN have been produced for several organizations such as American Heart Association (AHA), American College of Cardiology (ACC), and the International Society of Hypertension in Blacks (ISHIB). The most recent 2014 US HTN guideline on the management of HTN was recently published from members originally

appointed to the Eight Joint National Committee (JNC8) [41•]. Although not endorsed by NHLBI or the 39 other organization and federal agencies supporting JNC 7, this independent 2014 US guideline gained attention from several writing groups due to concerns for the implications of new goals in older adults. The major change which was given a rating of grade A (strong recommendation) increased the treatment threshold for the general population age ≥60 years to SBP ≥150 mmHg or DBP ≥90 mmHg and to treat to goal SBP <150 mmHg and DBP <90 mmHg [41•]. The 2014 guideline panel concluded that this recommendation was strongly supported by several reviewed randomized controlled trials (RCTs).

A recent 2014 state-of-the art review in the Journal of American College of Cardiology (JACC) highlights the debate regarding these goal changes and includes the opinions of two writing groups addressing the potential adverse implications for NHBs and women. The writing group for the Association of Black Cardiologists (ABC) stated that the proposed guidelines would put NHBs, who suffer disproportionately from HTN, at further increased risk [42•]. The authors cite NHANES data that show a significant drop (69 to 61 %) in adults age ≥60 years eligible for treatment if the 2014 guidelines are adopted by clinicians. In addition, the authors cite recent analyses of RCTs and meta-analyses that provided evidence in support of lower treatment targets such as SBP <140 to prevent further end-organ damage and CVD morbidity and mortality [42•]. The 2014 US guideline is also discordant with several other recent major national and international guidelines, none of which adopt the loosened goals for patients 60–79 years of age. In particular, the ISHIB consensus statement on the management of HTN in blacks recommends an even lower threshold for SBP (<135/85mmHg) and for blacks with evidence of target organ damage, preclinical or overt CVD, the threshold is even lower at SBP <130/80 mmHg [43]. The writing group for the ABC maintained in the JACC review that clinicians treating high risk populations such as NHBs await further guidelines from major professional organizations before changing from previously accepted standard of care [42•].

Similarly, the authors of the Working Group on Women's Cardiovascular Health were in discordance with the recent 2014 HTN recommendations [42•]. The authors state that women would be disproportionately affected as women make up the majority of those with HTN ≥60 years of age. Changes in treatment target goals would potentially harm older women, who are known to have poor BP control. The authors point out that loosened goals would likely increase race-ethnic CVD disparities as NHB women make up 40 % of those with poor BP control and are already at highest risk for target end organ damage. In addition, the authors cite data from the Women's Health Initiative which demonstrate a 93 % increased stroke risk in older women who were pre-hypertensive compared to those that were normotensive and note that several RCTs including a meta-analysis of 20,802 that show that treatment of HTN at previous BP goals (<140/90) provided benefit in regard to prevention of target end organ damage and CVD events [42•].

Reducing Health Disparities in Hypertension

HTN is a significant contributor to CVD morbidity and mortality and premature death [1•]. Although recent estimates reveal no significant differences among race-ethnic groups with

regard to HTN awareness, treatment, and control, disparities exist particularly in prevalence rates among several race-ethnic groups, and overall rates of HTN prevalence and control have not met Health People 2020 and/or the Million Hearts initiative goals for 2017. These national health initiatives and programs have attempted to decrease or eliminate existing disparities through primary and secondary prevention efforts targeting HTN at the individual, community, health systems, and population levels [1•, 44].

Population-based interventions are critically important in addressing the public health burden associated with health disparities. A major public health population-based approach is the Million Hearts campaign sponsored by the US Department of Health and Human Services [44, 45]. The Million Hearts initiative consists of comprehensive evidence-based interventions and strategies in attempts to prevent 1 million heart attacks and strokes by over the period from 2012–2016. This innovative program addresses heart disease and stroke, the causes of 1.5 M events and 800 K deaths a year, $312.6 B in annual health care costs and lost productivity and major disparities in outcomes. The ABCs are targeted: aspirin when appropriate; blood pressure control; cholesterol management; and smoking cessation. The Million Hearts initiative notes three things that must happen to prevent amillion heart attacks and strokes, including 6.3 million smokers quit, 10 million more people control their hypertension, and 20 % reduction in sodium intake. Central to Million Hearts is a focus on populations with greatest burden and at greatest risk. The initiative specifically addresses the burden of HTN by promoting the use of standardized HTN treatment protocols, effective use of health information technology, and self-measure blood pressure monitoring with clinical support. Interventions include the following: simplify med regimen; 90-day supply; mail-order; and pillboxes. Best practice is to rely on teams; nurses, pharmacists, physician assistants, community health workers, and others track performance on BP control and reward success, and teach and encourage home BP monitoring (http://millionhearts.hhs.gov/index.html) [44, 45]. To support and promulgate the initiative, the National Forum for Heart Disease and Stroke Prevention, a coalition of over 85 organizations, coordinates collaborative policy and programs aimed at CVD prevention (http://www.hearthealthystrokefree.org/).

Community-based interventions have also been instrumental in the aim of reducing public health burden of HTN. Prior community outreach initiatives sponsored by the Association of Black Cardiologists and local programs such as the Healthy Heart Community Prevention Project (HHCPP) in New Orleans and ISHIB outreach in Baltimore have effectively utilized barbershops and churches as centers to provided education and screening specifically for HTN [46]. The use of barbershops as part of community outreach programs to increase HTN awareness and control among NHBs, in particular men, has been recently examined in the Barber-Assisted Reduction in Blood Pressure in Ethnic Residents (BARBER-1) study [46, 47]. This cluster, randomized control with screening, monitoring, and referrals conducted by barbers, after a follow-up period of 10 months, demonstrated statistically significant improvement in HTN control in the intervention group when compared to control group (p=0.04) [45]. Similar outreach programs have utilized lay community health workers (CHWs) as resources to provided health education and promotion in communities where they share the same ethnicity, culture, language, and life experiences as the people they

serve. In Hispanic communities, CHWs are known as Promotores de Salud and have been shown to help reduce cardiovascular risk and improve HTN awareness [46].

System-based approaches to reducing disparities in HTN are equally as important given the persistent racial/ethnic differences in health outcomes secondary to institutional barriers. Effective approaches to overcoming institutional barriers include cultural competency training and data-based quality improvement (QI) efforts [48]. Cultural competency training may improve health care quality, provider knowledge, and attitudes, along with patient satisfaction and health. Hospital-based QI programs such as the Robert Wood Johnson Foundation-supported initiative Expecting Success and national registries such as ACC Get With The Guidelines (GWTG) have shown overall improvement in quality and reduction of racial disparities [48]. In addition, health information technology and electronic medical records (EMR) can also play an important role reducing institutional barriers to equal care. An example is the successful large-scale HTN program conducted by Kaiser Permanente of Northern California which includes development, sharing, and incorporation of performance metrics, evidence-based guidelines, medical assistant visits for blood pressure measurement and generic single-pill combination therapies. This successful program demonstrated high rates of HTN-control improvement of >80 %, which diminished, although differences in control rates were not eliminated between blacks and whites [49]. Therefore, with the recently documented improvement in national HTN control rates for all populations in the USA, multiple approaches may prove particularly effective in improving HTN and CV risk in adversely affected populations.

Conclusion

Despite overall decline in CVD morbidity and mortality, race-ethnic disparities continue to exist in the USA. Several race-ethnic groups are known to suffer disproportionately from HTN. Although awareness has increased overtime, NHBs in the USA continue to have significantly higher prevalence of HTN when compared to NHWs. In addition, NHBs are still more likely to have poor blood pressure control, disparities seem to be narrowing, potentially leading to an amelioration of HTN-related outcome disparities. These recent survey data have also revealed that NHAs are least likely to be aware of their HTN and report taking medications, whereas previously, Hispanic adults had the lowest prevalence rates of awareness, treatment, and control of HTN.

HTN remains as an important modifiable contributor to coronary heart disease, stroke, chronic kidney disease, along with overall and CVD mortality. The higher prevalence rates of HTN in various high risk populations, along with poor control leading to end organ damage play a critical role in the race-ethnic disparities in CVD. Several major professional organizations have published prior guidelines with similar standard of care goals for the management of HTN. However, there has been recent debate regarding the most recent published 2014 US guideline recommendations by where BP thresholds and targets were raised. Writings groups from the ABC and Working Group on Women’s Cardiovascular Health have both addressed their concerns regarded the recent less stringent guidelines. Both groups suggest that current evidence supports previous thresholds and that the proposed changes would disproportionately affect older NHB and female populations. Thus, these

changes have the potential to exacerbate current disparities in CVD and curtail the improvement attained by other local, regional, and national efforts.

Acknowledgments

Carlos J. Rodriguez has received grants from the NIH/NHLBI. Rodriguez received consulting payments from Amgen, Alnylam, and the American Heart Association.

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