SEMINARS IN
NEPHROLOGY

Systemic Hypertension: An Endemic, Epidemic, and a Pandemic

Daniel T. Lackland

Disease epidemics have influenced world history throughout time. Although disease patterns such as the plague and smallpox historically have been infectious in nature, chronic diseases such as cardiovascular disease, stroke, congestive heart failure, and end-stage renal disease have become the new global epidemics. The effects of these conditions affect nearly all populations of the world. Although high blood pressure has been implicated as the common link of these pandemic patterns only for less than half a century, the impact of hypertension treatment and control has become a documented population-based response with the greatest potential for global impact. For example, an estimated 45% of the deaths among African-American men could be prevented with treatment of high blood pressure to goal level. However, population demographics and risk factors predict a worsening effect as the populations of the world increase in age, racial disparities in access to medical care widen, and comorbid conditions such as obesity and metabolic syndrome continue to increase at epidemic rates. The economic impact of hypertension-related conditions, end-stage renal disease, and congestive heart failure is staggering, such that health care delivery systems will fail if the current trends are not changed. Hospitalization rates of hypertension-related conditions are increasing along with an aging population. The number of at-risk individuals in the population also is increasing. As the definition of hypertension changes with lower levels of blood pressure, the proportion of the population considered to have hypertension increases substantially. These trends and disease patterns clearly identify the essential need to implement population and clinical strategies for high blood pressure prevention, treatment, and control.
Semin Nephrol 25:194-197

Diseases have influenced life and world events throughout history. The spatial and time-trend patterns of disease rates that affect segments of the population differently have had the greatest impact on society. These classifications of disease patterns include the following: endemic, in which the usual prevalence of a disease or condition is within a given population or geographic area; epidemic, in which the new causes of a disease or condition exceed the normal prevalence in a given population or geographic area; and pandemic, which is an epidemic that crosses geopolitical boundaries and sometimes is global in scope. These pattern observations typically are used in epidemiology to develop a public health response for disease control.

Hippocrates certainly could be considered the first epidemiologist with an emphasis on the importance of epidemiologic observation. In fact, his recommendations based on observations such as the higher occurrences of malaria and yellow fever in swampy areas are considered more sound than his medical treatment and therapy advisement.[1,2] Disease epidemics have prompted drastic responses to the disease risk. During the black plague in medieval Europe, towns and homes were abandoned in an effort to flee the devastating disease. The exodus caused less garbage and excrement on which the rats could feed, and thus disease rates decreased. Snow[3] observed the patterns of cholera in London and associated the pattern with a water source. He removed the pump handle of the Broad Street pump and prevented access to the contaminated water, and thus lowered the disease risks. More recently, epidemics of smallpox, polio, and influenza have been addressed with the development and use of population-based vaccination programs. These organized programs greatly have affected the epidemiology of the world. In the past, chronic diseases have replaced infectious diseases as the epidemic focus.[4,5] Although maternal/child health nutrition and sanitation remain major public health

Department of Biostatistics, Bioinformatics, and Epidemiology, Medical University of South Carolina, Charleston, SC.

Address reprint requests to Daniel T. Lackland, Dr PH, Department of Biostatistics, Bioinformatics and Epidemiology, Medical University of South Carolina, 135 Cannon St, Charleston, SC 29425. E-mail: lackland@musc.edu

 0270-9295/05/$-see front matter
doi:10.1016/j.semnephrol.2005.02.003

Table 1 30-Year Mortality Population, attributable Risk Proportions for Hypertension (140/90 mm Hg) by Race-Sex Groups)

Race/Sex	Population-Attributable Risks
Caucasian men	23.8%
Caucasian women	18.3%
African-American men	45.2%
African-American women	39.6%

Data from Lackland et al.[20]

concerns, chronic diseases including cardiovascular disease and stroke are the major global health burdens in both developing and developed regions of the world.[6] These disease patterns are evident in the United States where nearly half of all deaths can be attributed to cardiovascular disease, stroke, diabetes, and end-stage renal disease.[7] Within the boundaries of the United States, smaller epidemics are evident with significant racial and geographic disparities identified. For example, African Americans maintain a significantly greater burden of disease risks than their Caucasian counterparts, and residents of the southeastern United States have long been recognized as having greater risks for death from these chronic diseases.[8-10] Nativity also plays a role, with individuals born in the southeast United States having a significantly greater risk for dying of a stroke.[11] In fact, African-American residents of the southeast United States, born outside of the Southeast, have a 50% less risk for dying of a stroke compared with African Americans born in the Southeast. In addition to the geographic and racial disparity in disease rates, the age of onset of disease is earlier for African Americans and residents of the southeast United States.[12] Considering the disease rates by age, an African-American man residing in the southeast United States who is 45 years of age has the stroke risk for a Caucasian man who is 55 years of age, and a Caucasian man born in iMinnesota who is 65 years of age. These results suggest a 20-year accelerated rate in the disease process for African Americans.

High Blood Pressure

The major common factor associated with the patterns of cardiovascular disease, stroke, and end-stage renal disease is high blood pressure. Numerous cohort and epidemiology studies have identified hypertension as a major risk factor for cardiovascular disease, end-stage renal disease, and stroke.[13-19] Hypertension accounts for a significant population-attributable risk. After controlling for serum cholesterol level, body mass index, smoking, and socioeconomic status, hypertension was the major predictor of 30-year mortality in the Charleston Heart Study for all 4 race-sex groups (Table 1).[20] In addition to the significant attributable risks, the population-attributable risk estimates for African-American men and women were twice the estimate of Caucasian men and women, suggesting that uncontrolled blood pressure may account for the racial disparity in mortality.

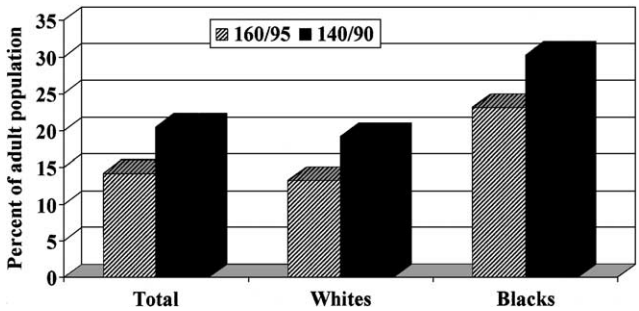

Figure 1 The percentage of the adult US population with hypertension defined as 160/95 mm Hg and/or medically treated and 140/90 mm Hg and/or medically treated for Caucasians and African Americans. ▨, 160/95 mm Hg; ■, 140/90 mm Hg. Data from Burt et al.[23]

Although high blood pressure has been recognized for decades as a major factor for adverse outcomes, the levels of blood pressure identified with risks have changed over time. Early hypertension epidemiology recognized severe and malignant hypertension as the level requiring treatment.[21,22] Although such levels clearly are associated with excess disease rates, these hypertension classifications affect a relatively small proportion of the population. In 1960, stage 4 hypertension (≥210/120 mm Hg) was found in 1.1% of Caucasian men, 1.9% of Caucasian women, 6.9% of African-American men, and 11.2% of African-American women in the southeastern United States.[20]

With the development of hypertension treatment guidelines in the 1970s based on epidemiologic study results, the definition of hypertension incorporated lower systolic and diastolic blood pressure values. Hypertension was defined as 160/95 mm Hg and/or medically treated, and later with the definition of 140/90 mm Hg and/or medically treated.

With each modification of the definition of hypertension, from 160/95 mm Hg to 140/90 mm Hg, an increased proportion of the population is affected (Fig 1). For both categories of high blood pressure, the prevalence of hypertension was significantly greater for African Americans.

The definition of 140/90 mm Hg and/or medically treated for high blood pressure has become the standard definition

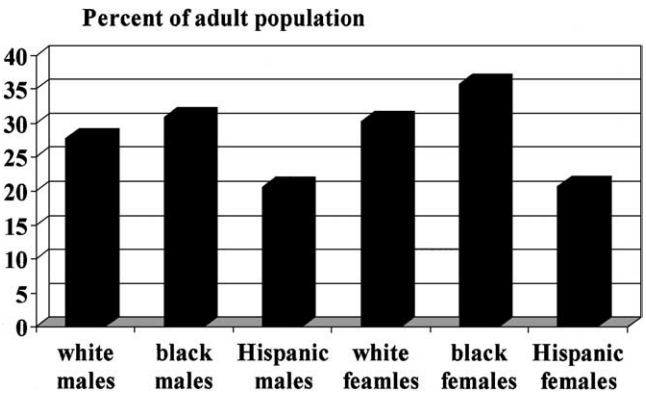

Figure 2 The percentage of the adult US population with hypertension defined as 160/90 mm Hg and/or medically treated for the 6 race/sex groups. Data from Hajjar and Kothen.[24]

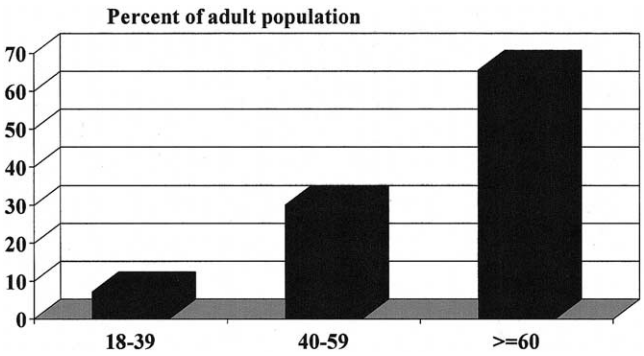

Figure 3 The percentage of the adult US population with hypertension defined as 140/90 mm Hg and/or medically treated for the different age groups. Data from Hajjar and Kothen.[24]

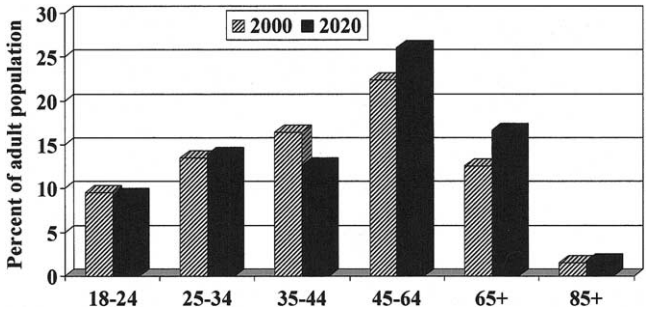

Figure 5 The projected proportion of the US population by age category for the years 2000 and 2020. ▨, 2000; ■, 2020. Data from Day.[26]

used during the past decade. With this definition, the patterns of hypertension vary significantly by race, sex, and age with African Americans and older individuals having the higher rates (Figs 2 and 3).[25] These disease patterns in risks and trends of hypertension are consistent with the patterns of insulin resistance and obesity, suggesting parallel epidemics.[25]

Hypertension in the Future

Population projections for the future forecast a greater impact of high blood pressure and a greater dynamic hypertension epidemic. The number of Americans over age 65 is projected to increase from 30 million in 2000 to more than 45 million people in 2020 (Fig 4),[27] and more than 65% of these individuals would be considered to have high blood pressure with the definition of 140/90 mm Hg and/or medically treated.[26]

Further complicating the population demographics, the proportion of older individuals will increase at a greater rate than young adults entering the job market (Fig 5).[26]

The impact of high blood pressure on medical care will be even greater when the Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC 7) category of prehypertension is considered, which will increase the number of individuals considered to have high blood pressure.[27]

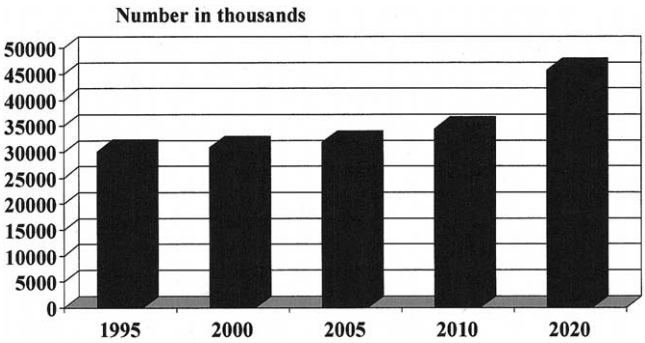

Figure 4 The amount of the US population who were 65 years of age and older from 1995 to present and the projected amount of who will be 65 years of age and older through 2020. Data from Day.[26]

The epidemiology of systemic hypertension has identified the patterns of disease consistent with endemic, epidemic, and pandemic events. The epidemiologic findings predict an increased impact of high blood pressure and hypertension-related outcomes on the population. However, these observations also could prompt actions as seen from other epidemics. As Rose[28] recommended decades ago, the clinical and population-based prevention strategies should be implemented in response to the epidemic. These strategies include population efforts to increase hypertension awareness and prevention interventions such as weight management and diet modification, and clinical efforts such as the implementation of treatment guidelines.

References

1. Cumston CG: An Introduction to the History of Medicine. New York, Alfred A. Knopf, 1926
2. Timmreck TC: An Introduction to Epidemiology. Sudbury, MA, Jones and Bartlett, 2002
3. Snow J: On the Mode of Communication of Cholera (2nd ed). New York, Commonwealth Fund, 1953
4. Murray CJL, Lopez AD: Global mortality, disability, and the contribution of risk factors: Global burden of disease study. Lancet 349:1436-1442, 1997
5. McGinnis JM, Foege WH: Actual causes of death in the United States. JAMA 270:2207-2212, 1993
6. Ezzati M, Lopez AD, Rodgers A, et al: Selected major risk factors and global and regional burden of disease. Lancet 360:1347-1360, 2002
7. Arias E, Anderson RN, Hsiang-Ching K, et al: Deaths: Final data for 2001. National Vital Statistics Report 52:1-116. Hyattsville, MD, National Center for Health Statistics, 2003
8. Roccella EJ, Lenfant C: Regional and racial differences among stroke victims in the United States. Clin Cardiol 12:IV18-IV22, 1989 (suppl IV)
9. Lackland DT, Moore MA: Hypertension-related mortality and morbidity in the Southeast. South Med J 90:191-198, 1997
10. Perry HM, Roccella EJ: Conference report on stroke mortality in the southeastern United States. Hypertension 31:1206-1215, 1998
11. Lackland DT, Egan BM, Jones PJ: Impact of nativity and race on "stroke belt" mortality. Hypertension 34:57-62, 1999
12. Lackland DT, Bachman DL, Carter TD, et al: The geographic variation in stroke incidence in two areas of the Southeastern Stroke Belt. The Anderson and Pee Dee Stroke Study. Stroke 29:2061-2068, 1998
13. Kannel WB, Dawber JR, McGee DL: Perspectives in systolic hypertension in the Framingham Study. Circulation 61:1179-1182, 1982

14. Kannel WB: Framingham Study insights into hypertensive risk of cardiovascular diseases. Hypertens Res 18:181-196, 1995
15. Himmelmann A, Hedner T, Hansson L, et al: Isolated systolic hypertension: An important cardiovascular risk factor. Blood Press 7:197-207, 1998
16. Kannel WB: Hypertension as a risk factor for cardiac events—epidemiologic results of long-term studies. J Cardiovasc Pharmacol 21:S27-S37, 1993 (suppl 2)
17. Brazy PC: Epidemiology and prevention of renal disease. Curr Opin Nephrol Hypertens 2:211-215, 1993
18. Phillips SJ, Whisnant JP: Hypertension and the brain. The National High Blood Pressure Education Program. Arch Intern Med 152:938-947, 1992
19. Wolf PA, D'Agostina RB, Belanger DJ, et al: Probability of stroke: A risk profile from the Framingham Study. Stroke 22:312-318, 1991
20. Lackland DT, Keil JE, Gazes PC, et al: Outcomes of black and white hypertensive individuals after 30 years of follow-up. Clin Exp Hypertens 17:1091-1105, 1995
21. Shea S, Missa D, Ehrlich MH, et al: Predisposing factors for severe uncontrolled hypertension in an inner city minority population. N Engl J Med 327:776-781, 1992
22. Webster J, Petrie JC, Jeffers TA, et al: Accelerated hypertension—patterns of mortality and clinical factors affecting outcome in treated patients. QJM 86:485-491, 1993
23. Burt VL, Cutler JA, Higgins M, et al: Trends in the prevalence, awareness, treatment, and control of hypertension in the adult US population. Data from the health examination surveys, 1960 to 1991. Hypertension 26:60-69, 1995
24. Hajjar I, Kothen TA: Trends in prevalence, awareness, treatment, and control of hypertension in the United States, 1988-2000. JAMA 290: 199-206, 2003
25. Davy KP, Hall JE: Obesity and hypertension: two epidemics or one? Am J Physiol 286:R803-R813, 2004
26. Day JC: Population Projection of the United States by Age, Sex, Race, and Hispanic Origin, 1995 to 2050. Washington, DC, US Bureau of the Census Current Population Reports, US Government Printing Office, 1996, pp 25-1130
27. Chobanian AV, Bakris GL, Black HR, et al: The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure: the JNC 7 report. JAMA 289:2560-2571, 2003
28. Rose G: The strategy for prevention: Lessons from cardiovascular disease. BMJ 282:1847-1851, 1981