Hypertension-Related Morbidity and Mortality in the Southeastern United States

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ABSTRACT: Stroke mortality is higher in the Southeast compared with other regions of the United States. The prevalence of hypertension is also higher (black men = 35%, black women = 37.7%, white men = 26.5%, white women = 21.5%), and the proportion of patients whose hypertension is being controlled is poor, especially in white and black men.

The prevalence of hypertension-related complications other than stroke is also higher in the Southeast. The five states with the highest death rates for congestive heart failure are all in the southern region. Of the 15 states with the highest rates of end-stage renal disease, 10 are in the Southeast.

Obesity is very prevalent (24% to 28%) in the Southeast. Although Michigan tops the ranking for all states, 6 of the top 15 states are in the Southeast, as are 7 of the 10 states with the highest reported prevalence regarding no leisure-time physical activity. Similar to other areas of the United States, dietary sodium and saturated fat intake are high in the Southeast; dietary potassium intake appears to be relatively low.

Other factors that may be associated with the high prevalence, poor control, and excess morbidity and mortality of hypertension-related complications in the Southeast include misperceptions of the seriousness of the problem, the severity of the hypertension, lack of adequate follow-up, reduced access to health care, the cost of treatment, and possibly, low birth weights.

The Consortium of Southeastern Hypertension Control (COSEHC) is a nonprofit organization created in 1992 in response to a compelling need to improve the disproportionate hypertension-related morbidity and mortality throughout this region. The purpose of this position paper is to summarize the data that document the problem, the consequences, and possible causative factors. KEY INDEXING TERMS: Hypertension; Cardiovascular disease; Stroke; Regional; Southeast.

CARDIOVASCULAR DISEASE REMAINS THE LEADING CAUSE OF DEATH IN THE UNITED STATES AND OTHER INDUSTRIALIZED SOCIETIES. AT THE BEGINNING OF THIS CENTURY, THE HOPE THAT MEDICAL SCIENCES WOULD HAVE CONQUERED THIS HUMAN ALIMENT VANISHED, ALTHOUGH ENORMOUS PROGRESS HAS BEEN ACHIEVED IN UNDERSTANDING DISEASE MECHANISMS, INTRODUCING EFFECTIVE MEDICAL AND SURGICAL THERAPIES, AND RAISING PUBLIC AWARENESS OF UNHEALTHY BEHAVIORS AND RISK FACTORS FOR DISEASES OF THE HEART AND BLOOD VESSELS. THERE IS NO DENYING THAT PROGRESS HAS BEEN IMPRESSIVE, AND THE RATES FOR CARDIOVASCULAR MORTALITY HAVE FALLEN FOR MORE THAN 30 YEARS. NEW EVIDENCE SUGGESTS THAT BETWEEN 1990 AND 1994, DEATH RATES ATTRIBUTED TO DISEASES OF THE HEART AND THE CEREBRAL CIRCULATION ARE NO LONGER DECLINING SIGNIFICANTLY. LIKewise, IT NOW APPEARS THAT THE FALL IN CARDIOVASCULAR DISEASE MORTALITY RATES IS NOT A CONSISTENTLY HOMOGENOUS PHENOMENA ACROSS THE ENTIRE NATION. REGIONALLY, THE SOUTHEASTERN UNITED STATES HAS HIGHER NUMBERS OF DEATHS ATTRIB-

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For the Consortium of Southeastern Hypertension Control (COSEHC).

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Hypertension-Related Morbidity and Mortality

**Table 1.** Prevalence* of Hypertension in the Southern United States, NHANES III†

<table>
<thead>
<tr>
<th></th>
<th>South</th>
<th>Other Regions†</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black men</td>
<td>35</td>
<td>33</td>
</tr>
<tr>
<td>White men</td>
<td>26.5%</td>
<td>24.3%</td>
</tr>
<tr>
<td>Black women</td>
<td>34.7%</td>
<td>27.8%</td>
</tr>
<tr>
<td>White women</td>
<td>21.5%</td>
<td>21.0%</td>
</tr>
</tbody>
</table>

* Age-adjusted.
† Northeast, Central, and West.

utable to myocardial infarction, stroke, and renal failure. This situation, first recognized by Roccella and Lenfant, weighs gravely on the economic development of a region that contains more than 26% of the US population.

The Consortium of Southeastern Hypertension Control is a nonprofit organization created in 1992 in response to a compelling need to improve the disproportionate hypertension-related morbidity and mortality throughout the region. The original founders were Drs. Carlos Ferrario and Michael Moore, and the consortium now represents 13 states (Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, South Carolina, Tennessee, Virginia, and West Virginia) and the District of Columbia. Although some variation exists among these populations, the demographic profiles are relatively similar enough to allow reasonable generalization of study results from smaller geographic areas to the overall southeastern region.

These states contain 26% of the US population. They have the highest prevalence of hypertension and the greatest incidence of hypertensive complications compared with other regions. The purpose of this position paper is to summarize the data that document the problem, the consequences, and possible causative factors.

**Prevalence and Control of Hypertension in the Southeastern United States**

**Prevalence.** Hypertension is the most common outpatient diagnosis, and it accounted for more than 25 million visits to physicians’ offices in 1994. According to the most recent National Health and Nutrition Examination Survey (NHANES) III (1988–1991), 24% of the US adult population (43,186,000 persons) have hypertension. The age-adjusted national prevalence is higher in non-Hispanic blacks (32.4%) than in non-Hispanic whites (23.3%) or Mexican-Americans (22.6%).

The prevalence of hypertension is higher in the southeastern United States. Table 1 compares the rates in the South with the rest of the nation by gender and race. The rates are predominantly higher for black men and women, but they also are higher for white men and, to a lesser degree, white women who reside in the southern region. The totals are relatively large, but no statistical estimates are given (the South versus other regions) because NHANES III was designed to make national rather than regional estimates. Among people with hypertension, the level of blood pressure is higher in the Southeast compared with other regions of the country.

Data concerning the impact of residential mobility of the level of blood pressure are limited, and it is not known whether blood pressure usually changes after moving into or out of the southeastern region. Preliminary data from South Carolina suggest that blacks born in South Carolina (or the Southeast) have a higher age-adjusted stroke mortality than blacks who reside in South Carolina who were born outside the Southeast. This suggests that indigenous, rather than acquired, factors are involved.

Southern-born black men and women residing in New York City have substantially higher cardiovascular disease mortality than do Northeast-born black men and women residing in New York City.

In the last two decades, improved detection and treatment of hypertension have led to the virtual disappearance of the two most extreme manifestations of the disease: accelerated and malignant hypertension. These two forms of the disease occur with alarming frequency in southeastern states. In inner-city Atlanta, Battey et al documented 104 such patients admitted to a hospital during a 6-month period. The average blood pressure was 233/154 mm Hg (range 180 mm Hg to 300 mm Hg systolic and 140 mm Hg to 220 mm Hg diastolic). Of the 88% who were aware of their high blood pressure, only 13% reported any active drug treatment. In Nashville, Davis and associates described 123 patients (62% white) with accelerated or malignant hypertension.

**Control.** Hypertension was acknowledged to be a major community health problem in the 1960s when it was discovered that only 50% of those affected were aware of the problem. Only half of the aware patients were being treated and only half of those were controlled. This led to the adage, “half aware, half of those treated, and half of those controlled.”

Awareness and treatment rates have improved markedly and steadily after the development of the National High Blood Pressure Education Program. There also have been multiple other improvements in the management of hypertension. However, only 29% of all hypertensive patients currently are controlled at the recommended level (below 140 mm Hg systolic and below 90 mm Hg diastolic).

Although it has improved from 10% in 1976–1980,
the current 29% control rate for all hypertensive patients remains unacceptable. The US Department of Health and Human Services has established a national goal to achieve high blood pressure control in at least 50% of hypertensive people by the year 2000.20

Table 3 compares the most recent awareness, treatment, and control rates in the South, grouped by gender and ethnicity, with the rest of the nation.6 Awareness rates are good in the South, and several factors may account for this, including the higher prevalence. Compared with other regions of the country, hypertension treatment rates are similar in women but lower in men residing in the South. Overall hypertension control rates are poor in the South (18.5% to 32.3%), especially in men.

Consequences of Uncontrolled Hypertension in the Southeastern United States

Stroke. Stroke mortality is higher in the southeastern United States.21–25 This has led to the designation of a “stroke belt” (Figure 1), defined as those states with a stroke mortality greater than 10% above the national mean. Table 4 provides a summary of the national rank and the absolute mortality rate for states in the region compared with the national median. South Carolina has the highest stroke mortality rate in the nation and is followed closely by the other southeastern states.

Regional clusters of disease are not unique to hypertension or hypertension-related complications. Kurtzke et al26 reported that multiple sclerosis exhibited a strong north-south gradient (ie, north of the 37th parallel), especially in northwestern states (Figure 2). In these regions, a higher frequency of multiple sclerosis was seen in whites and those of high socioeconomic status. Migration had minimal impact on the incidence of the disease.

End-Stage Renal Disease (ESRD). In past 10 years an

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**Table 2. Awareness, Treatment, and Control Rates for Hypertension in the United States**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Aware</td>
<td>51%</td>
<td>73%</td>
</tr>
<tr>
<td>Treated</td>
<td>31%</td>
<td>55%</td>
</tr>
<tr>
<td>Controlled (&lt;140/90)</td>
<td>10%</td>
<td>29%</td>
</tr>
</tbody>
</table>

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**Table 3. Awareness, Treatment, and Control Rates for Hypertension in the Southern United States, NHANES IIIa**

<table>
<thead>
<tr>
<th></th>
<th>South (%)</th>
<th>Other Regions (%)</th>
</tr>
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<tr>
<td>Aware</td>
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<td></td>
</tr>
<tr>
<td>WM</td>
<td>61.8</td>
<td>62.9</td>
</tr>
<tr>
<td>BM</td>
<td>68.6</td>
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<tr>
<td>WF</td>
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<tr>
<td>BF</td>
<td>81.2</td>
<td>74.7</td>
</tr>
<tr>
<td>Treated</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WM</td>
<td>43.8</td>
<td>45.0</td>
</tr>
<tr>
<td>BM</td>
<td>44.3</td>
<td>49.5</td>
</tr>
<tr>
<td>WF</td>
<td>60.1</td>
<td>59.8</td>
</tr>
<tr>
<td>BF</td>
<td>65.3</td>
<td>65.0</td>
</tr>
<tr>
<td>Controlled†</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WM</td>
<td>18.5</td>
<td>19.3</td>
</tr>
<tr>
<td>BM</td>
<td>19.3</td>
<td>22.3</td>
</tr>
<tr>
<td>WF</td>
<td>30.1</td>
<td>26.7</td>
</tr>
<tr>
<td>BF</td>
<td>32.3</td>
<td>24.1</td>
</tr>
</tbody>
</table>

* Northeast, Central, and West.
† BP < 140/90.
BF = black female; BM = black male; WF = white female; WM = white male.

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**Table 4. Stroke Mortality in the Southeast by State, 1986b†**

<table>
<thead>
<tr>
<th>State</th>
<th>Rank (of 53)</th>
<th>Mortality/100,000†</th>
</tr>
</thead>
<tbody>
<tr>
<td>South Carolina*</td>
<td>1</td>
<td>88.9</td>
</tr>
<tr>
<td>Georgia*</td>
<td>2</td>
<td>83.7</td>
</tr>
<tr>
<td>North Carolina*</td>
<td>3</td>
<td>77.9</td>
</tr>
<tr>
<td>Alabama*</td>
<td>4</td>
<td>75.2</td>
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<tr>
<td>Tennessee*</td>
<td>5</td>
<td>75.0</td>
</tr>
<tr>
<td>Mississippi*</td>
<td>6</td>
<td>74.3</td>
</tr>
<tr>
<td>Virginia*</td>
<td>7</td>
<td>72.6</td>
</tr>
<tr>
<td>Arkansas*</td>
<td>8</td>
<td>71.6</td>
</tr>
<tr>
<td>Kentucky*</td>
<td>11</td>
<td>70.3</td>
</tr>
<tr>
<td>Louisiana*</td>
<td>12</td>
<td>70.3</td>
</tr>
<tr>
<td>West Virginia</td>
<td>14</td>
<td>65.4</td>
</tr>
<tr>
<td>District of Columbia</td>
<td>19</td>
<td>62.7</td>
</tr>
<tr>
<td>Maryland</td>
<td>25</td>
<td>60.5</td>
</tr>
<tr>
<td>Florida</td>
<td>41</td>
<td>51.7</td>
</tr>
<tr>
<td>National median</td>
<td>–</td>
<td>51.8</td>
</tr>
</tbody>
</table>

* 1986 “Stroke Belt” (>10% above national age-adjusted mean mortality).
† Age-adjusted.
average annual 9.1% increase occurred in the incidence of hypertension-related long-term dialysis or renal transplantation in the United States. The southeastern area has some of the highest rates in the nation. End-stage renal disease Network 6 (Georgia, North Carolina, and South Carolina) has the largest number of patients (15,899) in the nation. The 1995 United States Renal Data System report indicates that Network 6 (959 per million) and Network 8 (Alabama, Mississippi, and Tennessee, 931 per million) rank first and second (among the 18 regional Networks) in the point prevalence of treated ESRD, adjusted for age, race, and sex. Table 5 provides a summary of the national rank and the annual treatment rates of ESRD for individual states in the region compared with the national median (written communication, Eggers P. HCFA, June 1996). Of the top 15 states, 10 are in the southeastern region.

Hypertension and diabetes are the two leading causes of ESRD. The most recent (1995) sex- and age-adjusted incidence of hypertension-related ESRD is 6.1 times higher in blacks (237/million) compared with whites (39/million). During 1992, 28.9% of all new ESRD patients were black, although blacks comprise only 12.4% of the US population. Of blacks in the United States, 54% reside in the southeast, which undoubtedly influences the high prevalence of ESRD in the region.

Racial differences in the incidence of ESRD are confounded by socioeconomic status (SES). In Jefferson County, Alabama, a clear relation was reported between the number of patients with treated ESRD and the number of households with per capita incomes below $7,500 within individual zip codes. Young and coworkers adjusted for race, sex, and age and reported an independent inverse association between socioeconomic status and the incidence of treated ESRD. Nevertheless, the high incidence in blacks was only partially explained by lower socioeconomic status. Further consideration must be given to the tendency of nephrologists to code a black (versus white) ESRD patient as having hypertension-related kidney disease.

Myocardial Infarction. Heart disease is the leading cause of death in the United States. The National Center for Health Statistics recently has reported that the number of US deaths from cardiovas-

Table 5. End-Stage Renal Disease in the Southeast by State, 1989–1994

<table>
<thead>
<tr>
<th>Rank (of 53)</th>
<th>Annual Incidence*</th>
</tr>
</thead>
<tbody>
<tr>
<td>District of Columbia</td>
<td>1</td>
</tr>
<tr>
<td>South Carolina</td>
<td>2</td>
</tr>
<tr>
<td>Louisiana</td>
<td>3</td>
</tr>
<tr>
<td>Florida</td>
<td>5</td>
</tr>
<tr>
<td>Georgia</td>
<td>6</td>
</tr>
<tr>
<td>Alabama</td>
<td>7</td>
</tr>
<tr>
<td>Mississippi</td>
<td>8</td>
</tr>
<tr>
<td>North Carolina</td>
<td>11</td>
</tr>
<tr>
<td>Maryland</td>
<td>12</td>
</tr>
<tr>
<td>Tennessee</td>
<td>14</td>
</tr>
<tr>
<td>Virginia</td>
<td>18</td>
</tr>
<tr>
<td>Arkansas</td>
<td>20</td>
</tr>
<tr>
<td>West Virginia</td>
<td>26</td>
</tr>
<tr>
<td>Kentucky</td>
<td>31</td>
</tr>
<tr>
<td>National average</td>
<td>–</td>
</tr>
</tbody>
</table>

*Unadjusted incidence per million. Source: Paul Eggers, HCFA, 6-26-96.
cicular disease (including stroke and myocardial infarction) increased during the 12 months ending December 1995 (942,510 deaths) compared with the 12 months ending December 1994 (939,180 deaths). Hypertension is one of the top three modifiable risk factors (along with cholesterol and smoking) for ischemic heart disease. The reported smoking rates for the majority of the southeastern states are above the national median; Kentucky and Tennessee rank first and second (Table 6).47

Congestive Heart Failure. Hypertension is the number one risk factor for the development of heart failure. As the US population ages, the prevalence and hospitalization rates for heart failure increase annually (Figures 3 and 4). Heart failure is the most common hospital discharge diagnosis among patients aged 65 years or older. The 1-year mortality rate is approximately 10%, and the 10-year mortality rate approaches 50%. The five states with the highest age-adjusted death rates for congestive heart failure for 1990 are in the southern region (Table 7). Despite many advances, no improvement was seen in the age-adjusted survival rates for heart failure between 1948 and 1988.

All-Cause Mortality. In a 15-year follow-up study of 11,936 hypertensive veterans, all-cause mortality was 23% higher in the southeastern stroke belt than in other regions of the country. Access to medical care was equal for black and white veterans, and no racial difference in mortality was observed. In the Charleston Heart Study, 30-year all-cause mortality was associated significantly with hypertension.

Possible Causes for the High Prevalence and Poor Control of Hypertension in the Southeastern United States

Obesity. Obesity is a strong and independent risk factor for hypertension. The association between

Table 7. Congestive Heart Failure Mortality in the Southeast by State, 1990

<table>
<thead>
<tr>
<th>State</th>
<th>Rank of 53</th>
<th>Mortality/100,000*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alabama</td>
<td>1</td>
<td>31.5</td>
</tr>
<tr>
<td>Mississippi</td>
<td>2</td>
<td>27.4</td>
</tr>
<tr>
<td>Kentucky</td>
<td>3</td>
<td>23.7</td>
</tr>
<tr>
<td>Arkansas</td>
<td>4</td>
<td>23.4</td>
</tr>
<tr>
<td>Louisiana</td>
<td>5</td>
<td>21.3</td>
</tr>
<tr>
<td>West Virginia</td>
<td>7</td>
<td>20.1</td>
</tr>
<tr>
<td>Virginia</td>
<td>11</td>
<td>18.8</td>
</tr>
<tr>
<td>Georgia</td>
<td>12</td>
<td>18.4</td>
</tr>
<tr>
<td>District of Columbia</td>
<td>15</td>
<td>17.6</td>
</tr>
<tr>
<td>South Carolina</td>
<td>18</td>
<td>17.3</td>
</tr>
<tr>
<td>Maryland</td>
<td>24</td>
<td>14.5</td>
</tr>
<tr>
<td>North Carolina</td>
<td>34</td>
<td>11.9</td>
</tr>
<tr>
<td>Tennessee</td>
<td>37</td>
<td>11.6</td>
</tr>
<tr>
<td>Florida</td>
<td>49</td>
<td>3.7</td>
</tr>
<tr>
<td>National average</td>
<td>–</td>
<td>13.3</td>
</tr>
</tbody>
</table>

*Age-adjusted.
Hypertension-Related Morbidity and Mortality

Obesity and hypertension has been well documented for almost all racial and socioeconomic groups studied. Population studies have shown that body mass index (BMI) correlates with blood pressure in normotensive and hypertensive patients. The correlation between BMI and blood pressure appears to be a continuous function, spanning BMI ranges from below normal to extremely high. Weight gain also appears to contribute to much of the rise in blood pressure that occurs with aging, and obesity may be one of the best predictors for the risk of developing hypertension later in life.

Although Michigan tops the ranking for all states, the southeastern region, affecting 24% to 28% of all adults, has the highest prevalence of obesity in the United States. Table 8 indicates that 6 of the top 15 states are in the southeastern region. The highest national prevalence of obesity (43.8%) occurs in black women. Mississippi has the third highest prevalence of obesity in the United States. In Jackson, Mississippi, Jones reported a remarkably high average BMI in elderly hypertensive black women (n = 57, BMI = 34.8) and white women (n = 35, BMI = 32.0).

The dynamic pattern of an increasing national prevalence and demographic variability in obesity is applicable for the southeastern population. Data from a 1987 population-based study in South Carolina determined an age-adjusted obesity prevalence of 29.1% in adults. Race-sex specific rates were 24.0% (white women), 28.1% (black men), 28.3% (white men), and 47.5% (black women). Similar to other regions of the country, body size was associated strongly with the levels of blood pressure in southeastern populations.

**Physical Inactivity.** The prevalence of hypertension is increased in those with a low level of physical fitness. Physical activity protects against the development of cardiovascular disease and favorably modifies cardiovascular disease risk factors, such as hypertension, obesity, and blood lipid levels. Long-term aerobic exercise regimens reduce blood pressure by an average of 7 mm Hg/6 mm Hg in hypertensive people. The mechanism of the reduction in blood pressure relates in part to a decrease in systemic vascular resistance associated with a decline in sympathetic activity. A decrease in plasma volume and cardiac index also may contribute.

Physical inactivity is associated directly with an increase in mortality from cardiovascular disease. Approximately 24% of US adults (more for women) report sedentary lifestyles with no leisure-time physical activity. The Healthy People 2000 goal is to decrease this proportion to 15% (a 38% decrease) by the year 2000.

Physical inactivity is highly prevalent in the Southeast, affecting 25% to 43% of all adults in the region. Table 9 indicates that 7 of the 10 states with the highest reported prevalence of no leisure-time physical activity are in the southeastern region.

**Dietary Factors.** Salt. Excessive dietary salt intake has long been suspected as a cause of the high prevalence of hypertension in the Southeast, especially in blacks. Dietary sodium intake is estimated most accurately by the 24-hour urinary excretion of sodium in a steady state. Table 10 provides data from three large studies of adults residing in the Southeast. The estimated average sodium intake was 142 mEq/day to 179 mEq/day (3,220 mg/
takes in blacks and whites residing in the Southeast. However, one study focused on the stroke-prone area of Savannah, Georgia and found higher dietary sodium intake in black men (193 mEq/day) versus white men (153 mEq/day), and in black women (158 mEq/day) versus white women (123 mEq/day).96

A high dietary salt intake clearly contributes to the risk of hypertension.101,102 The level of dietary sodium intake is important in hypertensive populations because high sodium intake antagonizes the blood pressure lowering effect of most antihypertensive drug classes.103 Approximately 50% or more of hypertensive patients are salt-sensitive.101,104,105 Salt sensitivity is more prevalent in blacks versus whites,106 older versus younger people,107 and diabetic versus nondiabetic patients.108 Obese, young people lose their salt-sensitivity after weight loss.79 In the Southeast, where obesity prevalence is exceedingly high, particularly in black women,83 high sodium intake might have even greater therapeutic and public health implications than elsewhere in the United States. Among salt-sensitive people, dietary salt loading can change intrarenal hemodynamics (ie, increase glomerular pressure and renal resistance) and increase urinary albumin excretion.109,110 These data suggest a potential mechanism of renal injury that could be especially important in the Southeast, particularly in blacks who manifest a high prevalence of obesity, hypertension, and ESRD.

The INTERSALT study noted a stronger association between high dietary salt intake and stroke mortality than the association between salt intake and level of blood pressure, which suggested that salt had a direct effect on the vascular wall.111,112

### Potassium

The studies of southeastern dietary salt intake and hypertension in the Southeast have focused on adults.113,114 The INTERSALT study found a stronger association between high dietary sodium intake and stroke mortality than the association between salt intake and level of blood pressure, which suggested that salt had a direct effect on the vascular wall.111,112

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**Table 9. Prevalence of No Leisure-Time Physical Activity* in the Southeast by State, 1991**

<table>
<thead>
<tr>
<th>State</th>
<th>Rank (of 53)</th>
<th>Percent of Adults</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mississippi</td>
<td>1</td>
<td>42.6</td>
</tr>
<tr>
<td>West Virginia</td>
<td>2</td>
<td>42.3</td>
</tr>
<tr>
<td>Kentucky</td>
<td>3</td>
<td>42.0</td>
</tr>
<tr>
<td>Georgia</td>
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<td>39.9</td>
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<td>District of Columbia</td>
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<td>39.4</td>
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<td>38.7</td>
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<td>27.8</td>
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<tr>
<td>Virginia</td>
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<td>25.2</td>
</tr>
<tr>
<td>National median</td>
<td></td>
<td>29.0</td>
</tr>
</tbody>
</table>

*No exercise, recreation, or physical activities (other than regular job duties) during the previous month.

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**Table 10. Dietary Sodium and Potassium Intake in the Southeastern Region**

<table>
<thead>
<tr>
<th>Location</th>
<th>n</th>
<th>Race-Gender</th>
<th>24-hour Urinary Na Excretion (mEq, mean ± SD)</th>
<th>24-hour Urinary K Excretion (mEq, mean ± SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evans Co, GA96</td>
<td>148</td>
<td>BM</td>
<td>130 ± 60</td>
<td>24 ± 2.0</td>
</tr>
<tr>
<td></td>
<td>342</td>
<td>WM</td>
<td>162 ± 76</td>
<td>40 ± 1.8</td>
</tr>
<tr>
<td></td>
<td>208</td>
<td>BF</td>
<td>131 ± 73</td>
<td>27 ± 16</td>
</tr>
<tr>
<td></td>
<td>328</td>
<td>WF</td>
<td>135 ± 58</td>
<td>36 ± 16</td>
</tr>
<tr>
<td>Total</td>
<td>1,026</td>
<td>All</td>
<td>142 ± 72</td>
<td>34 ± 9</td>
</tr>
<tr>
<td>Southeast</td>
<td>407</td>
<td>BM</td>
<td>176 ± 117</td>
<td>45 ± 40</td>
</tr>
<tr>
<td>VA Hospitals87</td>
<td>216</td>
<td>WM</td>
<td>194 ± 108</td>
<td>73 ± 41</td>
</tr>
<tr>
<td>Total</td>
<td>623</td>
<td>All</td>
<td>179 ± 114</td>
<td>55 ± 40</td>
</tr>
<tr>
<td>Savannah, GA96</td>
<td>88</td>
<td>BM</td>
<td>193</td>
<td>36</td>
</tr>
<tr>
<td></td>
<td>142</td>
<td>WM</td>
<td>153</td>
<td>35</td>
</tr>
<tr>
<td></td>
<td>162</td>
<td>BF</td>
<td>158</td>
<td>37</td>
</tr>
<tr>
<td></td>
<td>195</td>
<td>WF</td>
<td>123</td>
<td>36</td>
</tr>
<tr>
<td>Total</td>
<td>587</td>
<td>All</td>
<td>150</td>
<td>36</td>
</tr>
</tbody>
</table>

*Birmingham, AL; Miami, FL; Jackson MS; Memphis, TN; Washington, DC.
BF = black female; BM = black male; WF = white female; WM = white male.
sodium intake (Table 10) document a relatively low dietary intake of potassium, approximately 34 mEq/day to 55 mEq/day (1,328 mg/day to 2,150 mg/day).95–97,113 The average dietary potassium intake in other regions of the country is approximately 60 mEq/day to 80 mEq/day (2,346 mg/day to 3,128 mg/day).98

A low dietary potassium intake might contribute to the risk of hypertension and stroke.114,115 Krisna et al.116 reported a 7 mm Hg/6 mm Hg rise in blood pressure in 12 normotensive people who received low dietary potassium intake (16 mmol/day) for 10 days. In experimental animals, Tobian117–119 has shown that hypokalemia can activate peripheral vasoconstriction, and potassium supplements in stroke-prone or salt-sensitive rats were associated with a reduction in blood pressure and a strikingly lower death rate from stroke. In a community-based epidemiologic study by Khaw and Barrett-Conner,120 a 10 mmol increase in daily potassium intake was associated with a 40% decrease in the risk of stroke mortality. Potassium supplementation trials in hypertensive people have had variable results,121 but one metaanalysis of 16 randomized controlled trials found an average blood pressure reduction of 5.1 mm Hg/3.0 mm Hg.122

Saturated Fat. A high dietary intake of saturated fat is prevalent in lower socioeconomic groups in the Southeast.63,128,124 No conclusive evidence exists of a specific blood pressure lowering effect of either a reduction in total fat intake or a substitution of saturated fats by polyunsaturated or monounsaturated fatty acids.125,126 There is considerable circumstantial evidence that a reduction in fat intake can lead to weight loss and a related reduction in blood pressure.

Misperceptions of the Seriousness of the Problem. A common problem is patient or provider compliance with treatment programs.127–134 It is estimated that only 60% of hypertensive patients take their medication as prescribed.135 A national survey of patients who stopped their medication reported that 46% thought they were cured, 25% perceived that their physician had advised them to stop, 11% experienced adverse effects with the medication, and 6% could not afford the therapy.136 Factors generally identified as obstacles to medication adherence include poor physician-patient communication, younger age, male gender, adverse drug effects, lower socioeconomic status, and cost.137–141 Lack of knowledge about hypertension has also been associated with lower medication adherence.142

Complexity of the treatment and dosing frequency also contribute to nonadherence.143,144 Eisen et al.145 compared compliance rates in 105 patients prescribed antihypertensive drug doses every day, two times a day, or three times a day. Compliance rates were 84%, 75% and 59%, respectively, and compliance was significantly lower in the three times a day regimen. Cramer et al.146 studied dosage frequencies of once a day, twice a day, three times a day, or four times a day using a microprocessor (hidden in the bottle cap) and reported compliance rates of 87%, 81%, 77%, and 39%, respectively.

Poor adherence to prescribed antihypertensive medication is a major cause of inadequate blood pressure control. In the Hypertension Detection and Follow-up Program, the blood pressure goal was achieved by 79% versus 71% of those whose antihypertensive pill counts were ≥ 80% versus < 80%; it was only 63% in those who forgot to bring their medication bottles to the visit.147

Severity of Hypertension and Difficulty in Management. Severe hypertension is more common among hypertensive patients residing in the southeastern region, and hypertensive emergencies are not infrequent.12,13 Antihypertensive therapy often necessitates the use of multiple drugs, and many patients seemingly are resistant to therapy. Medication adherence problems usually are considered to account for the lack of control in up to half of these patients. In a review of 91 patients referred for resistant hy-
pertension, Yakovlevitch and Black\textsuperscript{148} reported that the most common cause (n = 39) was a suboptimal medical regimen, primarily caused by inadequate diuretic therapy. Less common reasons were medication intolerance (n = 13), secondary causes of hypertension (n = 10), noncompliance (n = 9), psychiatric problems (n = 7), including anxiety, panic attacks or misinterpretation of adverse effects, office artifacts (office blood pressure and measurements [n = 2]), illicit drug abuse (n = 2), or drug interactions (n = 1).

Lack of Follow-up. In a population-based household survey of 4,668 adults in Georgia, continuity of care was identified as a major correlate of blood pressure control.\textsuperscript{149} Nonattendance was defined as the failure to visit a physician for hypertensive care within a 6-month interval and was reported by 29% of 907 patients aware of their hypertension. Poor blood pressure control was more than twice as likely in patients who had not visited physicians recently (67%) than in those who did (30%).

Earlier studies from private practices suggested that as many as 51% of hypertensive patients are lost to follow-up within a year.\textsuperscript{150} In a later survey of nine practicing physicians in Edgewood County, North Carolina (each followed more than 100 hypertensive patients), 21% of 641 randomly selected hypertensive patients did not have an office visit in the preceding 12 months.\textsuperscript{151} Dropping out of follow-up is more frequent in younger (versus older) hypertensive patients, and in men (versus women). In a recent study of appointment keeping in a family practice clinic, Smith and Yawn\textsuperscript{152} reported that 1,902 of 7,283 (26.1%) scheduled appointments were missed without cancellation.

Access to Health Care. Lack of access to medical care may be a cause of uncontrolled high blood pressure.\textsuperscript{153-161} Data from South Carolina identified higher risks of hypertension-related outcomes (eg, stroke) in rural areas with significantly less access to primary-care physicians.\textsuperscript{162} To what extent can higher morbidity and mortality rates in the South be related to decreased access to medical care? There are several ways to estimate the regional use of medical care. Trends in the extent of hospital usage in the four geographic census areas of the United States can be obtained from annual hospital discharge rates and the average length of hospital stay. During the most recent two decades, the Midwest had the highest annual hospital discharge rate (160 per 1,000 in a population in 1966 to 150 in 1986). The rates in the South, the Northeast, and the West followed in that order; the rate in the South averaged approximately 15% below that in the Midwest and 15% above that in the West.\textsuperscript{163}

During the same two decades, the South also had an intermediate average length of hospital stay below the average for the Northeast and the Midwest both, but above the average for the West. The pattern was similar for all ages. In the South, the stay averaged a little longer than 7 days in 1966 and 6 days in 1986. For patients aged 45 to 64, above 64, and for the entire two-decade interval, the hospital stay in the South averaged 75% to 90% of the stay in the Northeast and 105% to 120% of the stay in the West.\textsuperscript{163} Finally, the number of office visits per patient per year averaged 2.7 in the South and Northeast, 3.1 in the Midwest, and 3 in the West.\textsuperscript{164} Patients in both the South and the Northeast saw the physician less frequently than those in the Midwest and West; again the rates in the South were no lower than in the Northeast.

Despite the apparently similar access to care, 10 of the 11 states in the stroke belt are in the Southeast (Table 4). This high stroke mortality is long-standing and 9 of the 11 stroke belt states had some of the highest stroke mortality rates from 1940 through 1990.

During 1975 to 1995, the study of 100,000 veterans revealed a 23% higher all-cause mortality rate in the stroke belt than elsewhere in the United States, even after adjustment for age, race, blood pressure, smoking, and BMI.\textsuperscript{159} Again the effect did not seem to be only one of access to care.

Fatal stroke, the cardiovascular catastrophe most closely related to hypertension, is and has long been more frequent in the South than elsewhere in the United States. The excess of fatal stroke was present consistently in the South long before any effective antihypertensive treatment was available. Access to medical care is not the only cause and probably is not the major cause of increased morbidity and mortality in the South, although it could be a factor for certain subpopulations or diseases.

Cost of Treatment. In 1993, the estimated cost for treating hypertension in the United States was approximately $15 billion.\textsuperscript{165} One recent analysis estimated a mean cost (drug acquisition, supplemental drugs, laboratory, clinic visits, and adverse effects) that ranged from $895 to $1,425 for the treatment of similar groups of hypertensive patients for 1 year with drugs from each of the available classes.\textsuperscript{166} Unfortunately, the economic burden of managing hypertension emerges as an important factor in cardiovascular mortality.\textsuperscript{167-172} The severity of hypertension is greater among those of low socioeconomic status, which disproportionately includes blacks.\textsuperscript{173} Patients with stage 3 or stage 4 hypertension are at much greater risk for cardiovascular complications in the short-term than are patients with mild hypertension, and they are more likely to benefit from effective antihypertensive therapy.\textsuperscript{174} This creates the tragic paradox that the patients who are most likely to derive benefit from more intensive management for hypertension are the ones least able to afford it. To indicate the magnitude of this problem,
Shulman et al. reported that among blacks with moderate/severe hypertension, 50% were unable to afford medication at some point during the course of treatment, in contrast to 10% of white hypertensive patients. Collectively, these observations suggest that the cost of medical therapy may be a significant barrier to effective hypertension management in those of lower socioeconomic status, which includes a disproportionate number of black patients with more severe disease.

Additional support for the premise that cost of health care is a greater barrier to prevention of cardiovascular complications in hypertensive black patients than in white patients is provided by the Hypertension Detection and Follow-up Program. Among blacks in this program, stroke mortality was 53% lower in those randomized to stepped care versus referred care, and total mortality declined by 21%. Among whites, stroke mortality was 32% lower in the stepped care than in the referred care group, and the decline in total mortality was 7.6%. Despite greater reductions of mortality with the stepped care intervention in blacks than in whites, mortality remained higher among blacks than whites in the stepped care group. Improving access to health care, although not the entire solution, is important for preventing hypertension-related cardiovascular diseases, especially among those of low socioeconomic status.

Low Birth Weight. Low birth weights, particularly those less than 2,500 g to 3,000 g, have been associated with a threefold or greater increase in the risk for abdominal obesity, insulin resistance, and a number of cardiovascular risk factors. The latter includes hypertension, diabetes, ESRD, and cardiovascular disease.

Using 1989 data from Charleston County, South Carolina as an index for the potential magnitude of low birth weight as a cardiovascular risk factor in the Southeast, 37% of black babies and 18% of white babies weighed less than 3,000 g at birth. Furthermore, 14% of black babies and 6% of white babies weighed less than 2,500 g, and 11% of black babies and 5.2% of white babies were between 1,500 g and 2,500 g. These rates of low birth weight infants between 1,500 g and 2,500 g in Charleston County are 20% to 25% higher than race-matched rates of low birth weight infants in the entire United States.

Low birth weight risk is compounded by adult obesity. Conversely, between two equally obese adults the one with low birth weight is at greater risk of having the risk factor cluster, which includes insulin resistance, elevated blood pressure, elevated triglycerides, and reduced high-density lipoprotein cholesterol. The concurrence of low birth weight and adult obesity may be a particular concern among black women. Unfortunately, previous large-scale studies concerning birth weight as a cardiovascular risk factor have not included black subjects. Further research is necessary to better define the magnitude of low birth weight as a cardiovascular risk factor in the Southeast.

Conclusion

Little doubt exists that hypertension and its sequelae pose an important health problem of epidemic proportion throughout the United States. Many aspects of this disease are amplified within the southeastern region of the country. Considerations of this regional issue have led to the formation of COSEHC. The mission statement of COSEHC is given below. In pursuit of this mission, the explicit goal is to improve the degree of control of hypertension in the southeastern US. The adoption of such a goal requires a metrics-based understanding of the problem: What is the standard for blood pressure control? What proportion of hypertensive individuals has attained this target today, and how should future milestones toward complete control be defined and tracked? This work is in progress.

The COSEHC Mission is to reduce morbidity and mortality from hypertension-related conditions (heart attack and disease, stroke, and kidney failure) in the southeastern US. The COSEHC Goal is to improve the degree of control of hypertension in the southeastern US.

The Consortium of Southeastern Hypertension Control defined its key strategic approach as the improvement of knowledge about hypertension and of hypertension-related problems in the Southeast. This was driven by the root causes of the problems and the degree to which these causes could be influenced. This strategic approach recognizes that much has been done already to address issues in this region and COSEHC seeks to facilitate the broader dissemination of existing best-practices. It also acknowledges that there are many gaps in the translation of data into practical knowledge at many levels in the chain of influence in healthcare. By articulating a broad strategy that seeks to improve knowledge, a number of target audiences will be distinctly identified. For each audience implementation of the strategy will be different. The defined target audiences are as follows: healthcare providers (physicians and nonphysician providers, such as nurses, nurse practitioners, physician assistants, pharmacists, among others); the public and patients; managed care organizations and other provider groups; and healthcare payers (employers, employer coalitions, and government).

Acknowledgments

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