Rethinking the Association of High Blood Pressure With Mortality in Elderly Adults

The Impact of Frailty

Michelle C. Odden, PhD; Carmen A. Peralta, MD, MAS; Mary N. Haan, DrPH; Kenneth E. Covinsky, MD, MPH

Background: The association of hypertension and mortality is attenuated in elderly adults. Walking speed, as a measure of frailty, may identify which elderly adults are most at risk for the adverse effects of hypertension. We hypothesized that elevated blood pressure (BP) would be associated with a greater risk of mortality in faster-, but not slower-, walking older adults.

Methods: Participants included 2340 persons 65 years and older in the National Health and Nutrition Examination Survey, 1999-2000 and 2001-2002. Mortality data were linked to death certificates in the National Death Index. Walking speed was measured over a 20-ft (6 m) walk and classified as faster (≥0.8 m/s [n=1307]), slower (n=790), or incomplete (n=243). Potential confounders included age, sex, race, survey year, lifestyle and physiologic variables, health conditions, and antihypertensive medication use.

Results: Among the participants, there were 589 deaths through December 31, 2006. The association between BP and mortality varied by walking speed. Among faster walkers, those with elevated systolic BP (≥140 mm Hg) had a greater adjusted risk of mortality compared with those without (hazard ratio [HR], 1.35; 95% CI, 1.03-1.77). Among slower walkers, neither elevated systolic nor diastolic BP (≥90 mm Hg) was associated with mortality. In participants who did not complete the walk test, elevated BP was strongly and independently associated with a lower risk of death: HR, 0.38; 95% CI, 0.23-0.62 (systolic); and HR, 0.10; 95% CI, 0.01-0.81 (diastolic).

Conclusions: Walking speed could be a simple measure to identify elderly adults who are most at risk for adverse outcomes related to high BP.


See Invited Commentary at end of article

Hypertension is a major public health problem in the United States that has prompted extensive efforts to increase awareness and treatment.1 The prevalence of hypertension is increasing, and rates of control remain suboptimal.2 The high prevalence of hypertension has been, at least in part, attributed to the increase in blood pressure (BP) with age and the rapid growth of the elderly population (age ≥65 years).3 Despite the impact of age on BP, the evidence on BP control in elderly adults is limited and treatment recommendations are the same in older and younger adults.4 Joint National Committee (JNC) guidelines suggest that “therapy should not be withheld on the basis of age” and recommended BP goals do not differ by age.5-7 The data on optimal BP goals are especially limited in the oldest old.8 A recent expert consensus document noted that it is “unclear whether target systolic BP should be the same in patients 65 to 79 years of age as in patients ≥80 years of age.”9(p2438) There is substantial evidence from epidemiologic studies demonstrating an attenuated or inverted association between higher BP and mortality at older ages.9,10 Nonetheless, the Hypertension in the Very Elderly Trial (HYVET) demonstrated a beneficial effect of antihypertensive therapy in adults 80 years and older on stroke, cardiovascular events, heart failure, and death, based on a goal BP of lower than 150/80 mm Hg.8 Notably, the participants in this trial were healthier than average and had lower prevalence of comorbid conditions. In clinical practice, decisions regarding BP targets are particularly difficult in poor-functioning older adults, who frequently do not meet the inclusion criteria of randomized controlled trials. Thus, whether current targets are ap-
appropriately for this population remains unclear, and how to identify elderly persons who may benefit from lower BP goals is unknown.

We propose that age may be an inadequate measure of the factors that determine the importance of elevated BP. Other measures that better capture frailty and health status may better identify which elderly persons are most at risk for the adverse consequences of hypertension and which may benefit from higher levels of BP. Walking speed is an excellent integrative measure of health; it incorporates function across multiple organ systems, and it is strongly associated with mortality and other adverse events. In a previous study of older Latino adults, we demonstrated that systolic BP was associated with mortality only in participants with fast self-reported walking speed. The present study extends this research and examines whether the relationship between elevated BP and mortality varies by objectively measured walking speed among a nationally representative sample of elderly adults. This is a timely and important question, as the clinician strives to reconcile the evidence on the impact of hypertension in the growing elderly population.

### MEASURES

The NCHS has linked mortality data from NHANES to death certificate data in the National Death Index (NDI). Mortality data were available from the date of the survey participation through December 31, 2006, based on a probabilistic match between NHANES and NDI death certificate records.

At the mobile examination center, 3 or 4 BP measurements were taken in sequence on seated participants using a mercury sphygmomanometer. If only 1 BP reading was obtained, that reading was recorded. If there was more than 1 BP reading, the first reading was excluded and the BP was recorded as the average of all subsequent readings. Persons were considered to have elevated BP at levels of 140 mm Hg or higher (systolic) and 90 mm Hg or higher (diastolic), based on current guidelines. Prior research has demonstrated that slow gait speed has the strongest prognostic ability of the traditional components used to assess frailty. A 20-ft (6-m)–long test area was set up in a corridor of the mobile examination center. Adhesive tape strips on the floor indicated the start and stop points, and the walk was timed using a handheld stopwatch. The participant was asked to walk at their usual pace. Start and stop times were defined as when the participant’s first foot touched the floor across the start line and finish line. We classified slower walkers as walking less than 0.8 m/s, based on the prior literature recommending this cut point, and because it best discriminated between survival times of the fast and slow walkers. A total of 243 participants did not complete the timed walk. The comments on the incomplete walking tests are as follows: safety exclusion (n = 21), participant refusal (n = 22), no time or came late/early (n = 69), physical limitation (n = 77), ill or emergency (n = 13), other reasons (n = 36), and 5 were missing an explanation.

Age, sex, race, education, smoking, and alcohol use were determined through questionnaire. Height and weight were measured by standard protocol at the mobile examination center, and fasting total and high-density lipoprotein (HDL) cholesterol, triglyceride, and cystatin C levels were measured in se-

### STUDY POPULATION

The National Health and Nutrition Examination Survey (NHANES) is a nationally representative survey of the civilian, noninstitutionalized US population, conducted by the National Center for Health Statistics (NCHS) of the Center for Disease Control and Prevention. Standardized questionnaires were administered in the home, followed by a detailed physical examination at the mobile examination center. This study includes data from participants 65 years and older in 2 waves of the survey (1999-2000 and 2001-2002); 2438 of 2855 (85.4%) completed both the interview and examination (Table 1).

### METHODS

#### Table 1. Characteristics of NHANES Participants 65 Years and Older (1999-2002), Stratified by Walking Speed

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Faster 0.8 m/s (n = 1307)</th>
<th>Slower &lt;0.8 m/s (n = 790)</th>
<th>Did Not Complete (n = 243)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, mean (SD), y</td>
<td>72 (6)</td>
<td>77 (6)</td>
<td>77 (6)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Female, %</td>
<td>52</td>
<td>67</td>
<td>61</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Black race, %</td>
<td>5</td>
<td>10</td>
<td>14</td>
<td>.001</td>
</tr>
<tr>
<td>&lt;High school education, %</td>
<td>24</td>
<td>48</td>
<td>45</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Current/prior smoking, %</td>
<td>56</td>
<td>57</td>
<td>47</td>
<td>.02</td>
</tr>
<tr>
<td>BMI, mean (SD)</td>
<td>27 (5)</td>
<td>28 (6)</td>
<td>29 (6)</td>
<td>.01</td>
</tr>
<tr>
<td>Total cholesterol, mean (SD), mg/dL</td>
<td>212 (39)</td>
<td>212 (45)</td>
<td>206 (40)</td>
<td>.25</td>
</tr>
<tr>
<td>HDL-C, mean (SD), mg/dL</td>
<td>54 (16)</td>
<td>54 (18)</td>
<td>53 (17)</td>
<td>.56</td>
</tr>
<tr>
<td>Estimated GFR, mean (SD), mL/min/1.73 m²</td>
<td>77 (19)</td>
<td>64 (20)</td>
<td>64 (24)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>History of diabetes, %</td>
<td>10</td>
<td>23</td>
<td>23</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>History of CHD, %</td>
<td>11</td>
<td>13</td>
<td>12</td>
<td>.72</td>
</tr>
<tr>
<td>History of stroke, %</td>
<td>5</td>
<td>12</td>
<td>23</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>History of CHF, %</td>
<td>4</td>
<td>13</td>
<td>15</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Antihypertensive medication Use, %</td>
<td>39</td>
<td>54</td>
<td>46</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Systolic BP, mean (SD), mm Hg</td>
<td>139 (21)</td>
<td>143 (23)</td>
<td>147 (30)</td>
<td>.003</td>
</tr>
<tr>
<td>Diastolic BP, mean (SD), mm Hg</td>
<td>70 (13)</td>
<td>66 (15)</td>
<td>68 (14)</td>
<td>.001</td>
</tr>
</tbody>
</table>

Abbreviations: BMI, body mass index (calculated as weight in kilograms divided by height in meters squared); BP, blood pressure; CHD, coronary heart disease; CHF, congestive heart failure; GFR, glomerular filtration rate; HDL-C, high-density lipoprotein cholesterol; NHANES, National Health and Nutrition Examination Survey.

*SI conversion factor: To convert cholesterol to millimoles per liter, multiply by 0.0259.*
Table 2. Walking Speed by Age and Sex in NHANES Participants 65 Years and Older (1999-2002)

<table>
<thead>
<tr>
<th>Sex/Age, y</th>
<th>Walking Speed</th>
<th></th>
<th>Did Not Complete</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Faster ≥0.8 m/s (n = 1307)</td>
<td>Slower &lt;0.8 m/s (n = 790)</td>
<td>Complete (n = 243)</td>
</tr>
<tr>
<td>Men</td>
<td>243 (77)</td>
<td>52 (16)</td>
<td>21 (7)</td>
</tr>
<tr>
<td>65-69</td>
<td>204 (66)</td>
<td>77 (25)</td>
<td>28 (9)</td>
</tr>
<tr>
<td>70-74</td>
<td>131 (60)</td>
<td>67 (30)</td>
<td>22 (10)</td>
</tr>
<tr>
<td>75-79</td>
<td>103 (50)</td>
<td>91 (44)</td>
<td>12 (6)</td>
</tr>
<tr>
<td>80-84</td>
<td>30 (35)</td>
<td>62 (53)</td>
<td>26 (22)</td>
</tr>
<tr>
<td>≥85</td>
<td>26 (23)</td>
<td>80 (55)</td>
<td>32 (22)</td>
</tr>
<tr>
<td>Women</td>
<td>206 (65)</td>
<td>80 (25)</td>
<td>31 (10)</td>
</tr>
<tr>
<td>65-69</td>
<td>175 (61)</td>
<td>88 (31)</td>
<td>24 (8)</td>
</tr>
<tr>
<td>70-74</td>
<td>109 (54)</td>
<td>71 (35)</td>
<td>23 (11)</td>
</tr>
<tr>
<td>75-79</td>
<td>72 (33)</td>
<td>122 (56)</td>
<td>24 (11)</td>
</tr>
<tr>
<td>80-84</td>
<td>34 (23)</td>
<td>80 (55)</td>
<td>32 (22)</td>
</tr>
<tr>
<td>≥85</td>
<td>30 (35)</td>
<td>62 (53)</td>
<td>26 (22)</td>
</tr>
</tbody>
</table>

Abbreviation: NHANES, National Health and Nutrition Examination Survey.

*Data are given as number (percentage) of participants.

rum samples also taken during the examination. Estimated glomera
dular filtration rate was calculated based on the Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI) group formula (76.7 × cystatin C−1.19). Self-rated health and whether the participant had anyone to ask for emotional support were assessed by questionnaire. Average daily physical activity, his
tory of diabetes, coronary heart disease, stroke, heart failure, and antihypertensive medication use were also assessed by questionnaire.

STATISTICAL ANALYSIS

NHANES uses a complex, multistage, probability sampling de
design; we appropriately accounted for this in all analyses by speci
fying the sampling design parameters. All analyses were con
ducted using Stata svy commands (StataCorp).

We first compared the baseline characteristics of the par
ticipants with faster and slower walking speed and in those who
did not complete the walking test. We calculated the weighted
mean and proportions across the continuous and categorical
characteristics, respectively, and tested for differences based on
the Wald test. We next summarized the mortality rates by level of
BP and walking speed and calculated the rate difference in
persons with and without elevated BP (≥140 mm Hg [systolic] and ≥90 mm Hg [diastolic]).

We examined the adjusted association of elevated systolic
and diastolic BP with mortality in Cox proportional hazards
models. We used the Schoenfeld residuals and Kaplan-Meier
survival curves to test if the proportional hazards assumption
was met. Age, sex, black race, and survey year were included
as potential confounders in all models. Other candidate con
founders included education (less than high school, high school,
more than high school); smoking status (never, former/ current); self-rated health (excellent/very good/good/fair/poor); emotional support; physical activity (low, medium, high); body mass index (BMI); total and HDL cholesterol, triglycer
ide, and cystatin C levels; and history of diabetes, coronary heart disease, stroke, and heart failure. A covariate was included in
the adjusted model if it was associated with mortality and BP at a significance level of P < .20. Of measures examined, edu
cation, smoking status, cholesterol level, heart failure, cor
onary heart disease, and stroke met these criteria. We included
multiplicative interaction terms between elevated systolic and
diastolic BP and walking speed and used a Wald test for inter-
action. Subsequently, models were stratified on walking speed.
We repeated these analyses with systolic and diastolic BP clas
sified as a linear variable.

We conducted several sensitivity analyses. First, we re
stricted deaths to those with underlying cause of death due to
cardiovascular disease (International Statistical Classification of Diseases, 10th Revision, code 100-78). Because falling BP lev
cels can be an indicator of the end of life, we conducted an analy
sis excluding deaths in the first year of follow-up. As an addi
tional sensitivity analysis, we also explored the inclusion of
antihypertensive medication use in the multivariable models
and also stratified based on medication status. We also strati
fied by age above and below 75 years. Finally, because not com
pleting the 20-ft (6-m) walk test may be an indicator of frailty,
we grouped the slower walkers and those participants who did
not complete the walk test (because of reasons other than lo
gistical) together as a combined, lower-functioning group.

RESULTS

A total of 2340 participants in NHANES waves 1999-
2000 and 2001-2002 were 65 and older and had mea
ured systolic BP; 2282 had measured diastolic BP. The
NHANES participants represent a total of 32 million non
institutionalized US adults. Of these participants, 56%
had a walking speed of 0.8 m/s or faster, 34% had a walk
ning speed slower than 0.8 m/s, and 10% did not com
plete the walk for various reasons (described in the “Meth
ods” section). Faster walkers were younger, less often
female and black, and more likely to have a high school
education compared with slower walkers (Table 1). They
were more likely to smoke, had a lower BMI, and had
better kidney function. In addition, persons with faster
walking speed had less comorbidities compared with those
with slower walking speed; they had a lower prevalence
of diabetes, stroke, and heart failure. Persons with faster
walking speed were less likely to be using antihyper
tensive medications and had lower systolic BP and higher
diastolic BP compared with slower walking partici
pants. Persons who did not complete the timed walk had
the highest systolic BP levels. Overall, elevated systolic
BP (>140 mm Hg) was prevalent in approximately 50%
of all participants (1164 of 2340), whereas elevated dia
stolic BP (>90 mm Hg) was only prevalent in 6% (133
of 2282) of participants. The proportion of men and
women who did not complete the walk test was highest
in those 85 years and older (Table 2). In all age groups,
women were slightly less likely to have a usual walking
speed of 0.8 m/s or faster compared with men (Table 2).
By December 31, 2006, there were 589 deaths (re
presenting 7 million US adults); the mortality rate in the
study population was 41.7 per 1000 person-years. Faster
walking participants with elevated systolic BP (≥140
mm Hg) had a higher mortality rate compared with those
with a systolic BP lower than 140 mm Hg, whereas slower
walkers with elevated systolic BP did not appear to have
increased mortality (Table 3 and Figure 1A). In con
trast, among those participants who did not complete the
walk test, participants with elevated systolic BP had a lower
mortality rate (Table 3 and Figure 1A).

The adjusted association between elevated systolic BP
and mortality varied across walking speed (P value for in
teraction, <.001). Higher systolic BP was associated
with a 35% elevated risk of mortality in the fast walkers, even after adjustment for potential confounders (P = .03) (Table 3 and eTable 1 [http://www.archinternmed.com].) In contrast, there was no association between elevated systolic BP and mortality in the slower walkers (P = .37). There was an inverted relationship between elevated systolic BP and mortality in those participants who did not complete the walk test; higher systolic BP was associated with a lower risk of death, even after accounting for potential confounders (P < .001).

Faster walkers with elevated diastolic BP did not have a higher mortality rate compared with those without elevated diastolic BP (Table 3 and Figure 1B). Slower walkers with elevated diastolic BP had a lower mortality rate, although the hazard ratio was not statistically significant (Table 3 and eTable 2). In participants who did not complete the walk test, those with elevated diastolic BP had a lower mortality rate compared with those with lower diastolic BP levels, and the adjusted association was strongly in the protective direction (P = .03).

Similar patterns of association were present when we classified BP as a linear variable, although the association of higher systolic BP and mortality in the faster walkers no longer reached statistical significance after adjustment for potential confounders (Table 4). In participants who did not complete the walk test, elevated systolic and diastolic BP were associated with a lower adjusted risk of mortality.

The estimates were robust against multiple sensitivity analyses, although there was limited power in several of these analyses (Figure 2). Finally, as an alternative classification of frail participants, we grouped the slower walkers and those who did not complete the walk for nonlogistical reasons; there was no association between higher systolic (HR, 1.00; 95% CI, 0.78-1.28) or diastolic (HR, 0.57; 95% CI, 0.23-1.40) BP and mortality in this lower-functioning group.
In this nationally representative sample of elderly adults, we found that the association of BP with mortality varied by walking speed. Higher systolic BP was associated with an increased risk of mortality only among elderly adults who had a medium to fast walking pace. In contrast, among slower-walking older adults, there was not an association between elevated systolic or diastolic BP and mortality. Strikingly, we found elevated systolic and diastolic BP was strongly and independently associated with a lower mortality risk in participants who did not complete the walk test. Our findings suggest that walking speed may be a useful measure to identify older adults who are most at risk for the adverse effects of high BP.

Our findings are consistent with prior studies that have found that the association of BP and mortality diminishes with age because the prevalence of frailty increases with age. The present findings are also consistent with a recent study from our group. We previously examined the relationship between BP, self-reported walking speed, and mortality in a cohort of older Latino adults. In participants who reported fast walking speed, there was an association of higher systolic BP with mortality, whereas there was no association in slower walkers. Latino adults may be at an increased risk for functional im-
painment owing to the high prevalence of obesity and diabetes in this population. The present study extends our findings to a nationally representative study population and uses an objective measure of walking speed.

The association of elevated systolic BP and mortality in the faster walking elderly adults is also congruent with findings from randomized controlled trials that have demonstrated a benefit of treatment of antihypertensive therapy in study participants. Participants in trials are often healthier compared with the general population owing to study inclusion criteria that may limit the types and severity of comorbid conditions. In the Systolic Hypertension in the Elderly Program (SHEP), investigators reported a beneficial effect of antihypertensive therapy on stroke, major cardiovascular events, and all-cause mortality. A large randomized controlled trial, the Hypertension in the Very Elderly Trial (HYVET), also demonstrated that persons 80 years and older who were receiving antihypertensive therapy had a reduced risk of all-cause mortality after 2 years of treatment.

There has been substantial evidence published regarding the pathophysiologic consequences of hypertension in older adults. Less literature has focused on the potential harm of lower BP, and the majority has focused on orthostatic hypotension as a risk factor for falls. In older frail adults, elevated BP may be necessary to maintain perfusion of the vital organs, especially the heart, which is perfused during diastole. This may explain the apparently protective association we observed between higher diastolic BP and lower mortality in participants who did not complete the walk test. Low diastolic BP may also contribute to high pulse pressure, which is a strong risk factor for coronary events in elderly adults. Older frail adults may be at higher risk from aggressive therapeutic interventions, and our findings warrant further investigation of the effects of BP control in this population.

This finding of an inverted association between BP and mortality in those who did not complete the walk test was striking, although the wide range of reasons for not completing the walk precludes us from making any definitive conclusions regarding the mechanism for this inverted association in this population. There was a wide variety of comments regarding this missing data in the NHANES data, which included both logistical and safety reasons. Because only 243 participants had missing data, we did not have the statistical power to determine if the relation between BP and mortality differed within subgroups of these participants. On the basis of their baseline characteristics and mortality rate, the participants with missing walk test data appeared to have worse health status compared with those with complete data. Given the substantial difference in associations in those with and without walk test data, we suggest that future studies in older adults use methods to address this potential source of bias.

Healthy participant bias is a well-described source of bias and may be of particular importance in older populations where frailty and disability are common. This bias may help explain the apparently discordant findings between epidemiologic studies and randomized controlled trials of BP and antihypertensive medications in older adults. This study also has limitations that should be considered. Both walking speed and BP often vary over time, and because NHANES only had a 1-time measure of each, we were unable to account for changes in these factors over time. We assessed 1 domain of frailty, whereas the underlying process is complex and likely best assessed with a constellation of measures. In addition, many of the variables were self-reported, and there may be some misclassification of these measures. We classified walking speed into 2 levels to maximize statistical power within the strata, although the relationship between BP, walking speed, and mortality could likely be better described across multiple levels of walking speed in a larger study population.

In conclusion, this is the first study, to our knowledge, to examine the relationship between BP, walking speed, and mortality in a representative sample of US adults 65 years and older. We found that systolic BP is associated with an increased risk of mortality in adults with medium to fast walking speed. The association of BP and mortality is less clear in slower-walking adults, and future research should aim to characterize this relationship better in frail older adults and the institutionalized population. Some researchers have recommended that walking speed be incorporated into regular geriatric assessment as a predictive tool to identify those at risk for future adverse events and identify functional impairment in 1 or more of the systems that contribute to the ability to walk. Walking speed appears to be a simple measure to explain the differential association of high BP and mortality in older adults.

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**Gait Speed**

An Important Vital Sign in Old Age

In 1988, Matilla et al reported that, among the very old, elevated systolic and diastolic blood pressure (BP) were associated with longer survival. The differences were not subtle. The 5-year survival of those with systolic BPs greater than 200 mm Hg were almost twice as high as those with levels of 120 to 140 mm Hg. Over the ensuing 25 years, a substantial number of population-based studies have reported the same findings: in those older than 85 years (or older than 80 years in some studies), high BP is an excellent prognostic sign.2,3

Perhaps the most rigorous assessment came from the Framingham Study, which reported that the strong positive association of BP with cardiovascular mortality was reversed between the ages of 75 and 85.4 Importantly, no population-based study has found the opposite, that high BP is a marker for bad outcomes in octogenarians. Conversely, “normal” BP is bad. Perhaps the worst sign is falling BP.5

This set of observations has been one of the best-kept secrets in medicine. In my experience, many physicians find the information offensive and its proselytizers suspect. After all, the recognition and effective treatment of hypertension has been among the greatest medical and public health accomplishments of the last 20 centuries. Anyone with a message that threatens this progress might be dangerous.

Why might high BP be a good sign in those older than 80 years? Diehr and colleagues6 noted that very old populations represent mixtures of those who are aging with those who are dying. They showed a steady decrease in BP in the 3 years before death in the very old. In other words, high BP is only a good sign in very old age because many of those with “normal” BP have it for bad reasons.

Additional evidence for this concept comes from longitudinal studies of somewhat younger populations. Several groups reported that higher levels of systolic or diastolic BP predicted lower mortality in those older than 70 years, but this relationship was eliminated and in some cases reversed if the analyses controlled for the presence of comorbidity, level of physical functioning, and other indicators of overall health status.2 In this regard, normal levels of BP may be seen as a marker for frailty, and hypertension, a marker for robustness.

Another layer of complexity is added when we consider the question of treatment of hypertension in the very old. Of the 4 early randomized trials that included subjects older than 80 years, 3 reported interactions between BP and treatment with a greater degree of mortality benefit from treatment in those with lower BP at baseline. The exception was the Systolic Hypertension in the Elderly Program (SHEP); however, there was no effect modification in the subgroup of patients with systolic BP of 160 mm Hg or greater at baseline. In contrast, the Antihypertensive and Lipid-Lowering Treatment to Prevent Heart Attack Trial (ALLHAT) reported a differential effect of treatment by baseline BP such that lower BP was associated with a greater benefit of treatment in those with higher BP at baseline. Additional evidence to consider is that the role of antihypertensive treatment in this group may be complex. High BP may simply be a marker of overall health status; therefore, the treatment benefits may not extend to those with lower BP. This is a challenging area of study given the lack of randomized trials specifically designed to examine the efficacy of antihypertensive treatment in those older than 80 years.