Bone Mineral Density, Blood Pressure, and Stroke in Elderly Women

To the Editor:
We read with great interest the recent article by Mussolino and colleagues1 dealing with the relationship between bone mineral density (BMD) and stroke in a large national study. The results of their presented study demonstrated that no significant associations of BMD and stroke incidence or mortality were found not only for white men and women but also for blacks. The finding might be inconsistent with previous reports showing that there were significant associations between low BMD and stroke death and incidence in elderly women.2–3

As Mussolino et al discussed, essential hypertension may be linked to the increased mobilization of calcium from bone. Several studies have reported changes in BMD in hypertensive subjects. It was shown that the rate of bone loss at the femoral neck was increased with blood pressure in elderly white women.4 In a previous study, we showed, using the dual-energy x-ray absorptiometric method, that BMD in lumbar spine was significantly decreased in elderly hypertensive women compared with elderly normotensive women.5 In addition, BMD was inversely correlated with systolic blood pressure, suggesting that high blood pressure might be associated with the decrease in BMD in elderly women.

There has been much evidence that hypertension is related to abnormalities of the calcium metabolism such as increased calcium losses from kidney and secondary activation of parathyroid glands.6,7 We also demonstrated that 24-hour urinary calcium excretion was significantly greater in female hypertensive subjects than in female normotensive subjects. Furthermore, the greater the calcium excretion was, the lower the BMD was in women.5 The result might suggest that increased urinary calcium could lead to a decrease in BMD in female hypertensives. In this context, it can be speculated that, in women with essential hypertension and lowered BMD, the disturbances in the calcium metabolism are more pronounced.

The precise mechanisms responsible for the decreased BMD in female hypertensives are still unclear. Recent developments have advanced our knowledge of the potential role of estrogen in the regulation of BMD and various cardiovascular functions in elderly women.8–10 It is possible that estrogen deficiency after menopause might accelerate abnormalities in the calcium metabolism at both the cellular and systemic levels, which would explain, in part, osteoporosis and hypertension in elderly women. Because hypertension is the major risk factor for cerebrovascular diseases, it would be important to assess more precisely whether more bone loss with higher blood pressure may be associated with increased stroke incidence or mortality in elderly women.

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Response
In our recent report, we did not find an association between phalangeal bone mineral density (BMD) and subsequent development of stroke.2 As we noted, phalangeal BMD may not be as good a cardiovascular disease risk indicator as proximal femoral or lumbar spine BMD. Unfortunately, BMD at proximal sites was not measured. Dr Tsuda makes some interesting comments on our recent article in Stroke regarding the possible relationship between hypertension and BMD. However, no causal mechanism has firmly been established in any of the previous reports of BMD and hypertension, stroke incidence, or death.

Dr Tsuda found some evidence that hypertension may be related to abnormalities of calcium metabolism in a cross-sectional study of 31 hypertensive and 14 normotensive Japanese women.2 We attempted to replicate these findings in a sample including 895 hypertensive white American women using cross-sectional data from the First National Health and Nutrition Examination Survey (NHANES I).1,4 Prevalent hypertension cases met the following criteria: a blood pressure (first reading) ≥140 mm Hg systolic and/or 90 mm Hg diastolic or a history of currently taking medication for high blood pressure. Age at examination, smoking status, alcohol consumption, education, and physical activity level were obtained by interview, and body mass index was calculated from measured height and weight. History of diabetes was based on self-reported doctor’s diagnosis. Multivariate logistic regression analyses were performed.

The number of prevalent cases of hypertension by sex and race is shown in the Table. In multivariate logistic regression analysis, the prevalence of hypertension was not associated with a 1-SD decrease in BMD (the Table). In white men 45 to 74 years of age, no association of hypertension prevalence and BMD could be demonstrated (P = 0.50). Nor were associations seen for white women (P = 0.41). No relationship was found among black men and women (P = 0.11). The age-adjusted partial correlation coefficients for BMD with systolic blood pressure were as follows: white men, r = 0.02, P = 0.40; white women, r = 0.01, P = 0.80; and blacks, r = 0.02, P = 0.75.

Odds Ratios* for Hypertension Prevalence According to Bone Mineral Density Measurement in Persons Aged 45–74 Years at Examination: NHANES I

<table>
<thead>
<tr>
<th>Model</th>
<th>OR</th>
<th>95% CI</th>
<th>OR</th>
<th>95% CI</th>
</tr>
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<tbody>
<tr>
<td>Age-Adjusted</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>White men</td>
<td>0.99 (0.89–1.12)</td>
<td>1.04 (0.92–1.18)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>White women</td>
<td>1.00 (0.88–1.13)</td>
<td>1.06 (0.93–1.21)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blacks</td>
<td>1.15 (0.90–1.46)</td>
<td>1.23 (0.95–1.57)</td>
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</tbody>
</table>

*Odds ratios (OR) and 95% confidence intervals (CI) are based on a decrease of 1 SD in bone mineral density.
†Adjusted for age at examination, smoking status, alcohol consumption, history of diabetes, education, body mass index, and recreational physical activity. Sex is included in age- and risk-adjusted models for blacks. Persons with missing values on any of these variables or with history of stroke were excluded.
Because mechanisms responsible for a decreased BMD in individuals with hypertension are unclear and we could not replicate previous findings, additional large-scale studies are needed to establish whether such an association in fact exists. In summary, in a large nationally representative sample, no significant associations of BMD and hypertension prevalence were found for whites or blacks.

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