Pulse wave analysis

Brachial-Ankle Pulse Wave Velocity as a Predictor of Mortality in Elderly Chinese

Chang-Sheng Sheng, Yan Li, Li-Hua Li, Qi-Fang Huang, Wei-Fang Zeng, Yuan-Yuan Kang, Lu Zhang, Ming Liu, Fang-Fei Wei, Ge-Le Li, Jie Song, Shuai Wang, Ji-Guang Wang

Abstract—Pulse wave velocity (PWV) is a measure of arterial stiffness and predicts cardiovascular events and mortality in the general population and various patient populations. In the present study, we investigated the predictive value of brachial-ankle PWV for mortality in an elderly Chinese population. Our study subjects were older (≥60 years) persons living in a suburban town of Shanghai. We measured brachial-ankle PWV using an automated cuff device at baseline and collected vital information till June 30, 2013, during follow-up. The 3876 participants (1713 [44.2%] men; mean [±SD] age, 68.1±7.3 years) included 2292 (59.1%) hypertensive patients. PWV was on average 17.8 (±4.0) m/s and was significantly (P<0.0001) associated with age (r=0.48) and in unadjusted analysis with all-cause (n=316), cardiovascular (n=148), stroke (n=46), and noncardiovascular mortality (n=168) during a median follow-up of 5.9 years. In further adjusted analysis, we studied the risk of mortality according to the decile distributions of PWV. Only the subjects in the top decile (23.3–39.3 m/s) had a significantly (P≤0.003) higher risk of all-cause mortality (hazard ratio relative to the whole study population, 1.56; 95% confidence interval, 1.16–2.08), especially in hypertensive patients (hazard ratio, 1.86; 95% confidence interval, 1.31–2.64; P=0.02 for the interaction between PWV and hypertension). Similar trends were observed for cardiovascular, stroke, and noncardiovascular mortality, although statistical significance was not reached (P≥0.08). In conclusion, brachial-ankle PWV predicts mortality in elderly Chinese on the conditions of markedly increased PWV and hypertension. (Hypertension. 2014;64:1124-1130.) ● Online Data Supplement

Key Words: aged ■ Asian continental ancestry group ■ mortality

Pulse wave velocity (PWV) is a measure of arterial stiffness and can be measured by recording pulse waves on 2 superficial arterial sites and measuring the distance between the 2 arterial sites.1 PWV is usually measured using the applanation technique between carotid and femoral arteries.2 between carotid and brachial arteries,3 or between femoral and tibial or dorsalis arteries.4 Carotid-femoral PWV is considered as a measure of aortic arterial stiffness and mostly studied for cardiovascular prediction.5 Several studies have demonstrated that carotid-femoral PWV predicts cardiovascular events and mortality in the general population6,7 and in various patient cohorts.8,9 Carotid-femoral PWV is, therefore, recommended by several recent hypertension guidelines as a measure of target-organ damage.9,10

Current technology allows automatic detection of pulse waves using cuffs on the limb arterial sites, such as the brachial and posterior tibial arteries. With the time difference between the pulse waves of these arterial sites and an estimated travel path of the pulse waves according to body height, brachial-ankle PWV can then be calculated.11 Previous studies have shown that brachial-ankle PWV is closely correlated with carotid-femoral PWV12 and is also predictive of cardiovascular events and mortality in the general population13-16 and in various patient cohorts.17-25 Nonetheless, brachial-ankle PWV measures stiffness of mixed elastic with muscular arteries,26 instead of the elastic aorta alone, and hence quantitatively differs from carotid-femoral PWV and may have distinct values of cardiovascular prediction. In the present study, we investigated the predictive value of brachial-ankle PWV for mortality in an elderly Chinese population.

Methods

Study Population

Our study was conducted in the framework of the Chronic Disease Detection and Management in the Elderly (≥60 years) Program supported by the municipal government of Shanghai.27,28 In a newly urbanized suburban town, 30 km from the city center, we invited all residents ≥60 years to take part in comprehensive examinations of cardiovascular disease and risk. The Ethics Committee of Ruijin Hospital, Shanghai Jiaotong University School of Medicine, approved the study protocol. All subjects gave written informed consent.

A total of 4140 subjects (participation rate 90%) were enrolled in the period from 2006 to 2011 and followed up for vital status and cause of death till June 30, 2013. We excluded 101 subjects from the present analysis, because brachial-ankle PWV was not measured (n=63) or because of missing other information (n=38). We further excluded 163 subjects with an ankle-brachial index <0.90 (n=107) or...
atrial fibrillation (n=56) because of insufficient accuracy in the measurement of brachial-ankle PWV on these disease conditions. Thus, the number of participants included in the present analysis was 3876.

**Measurement of Brachial-Angkle PWV**

Brachial-ankle PWV was measured by the use of the Vascular Profiler-1000 device (Omron, Kyoto, Japan) as previously described. Briefly, trained technicians and physicians placed the pressure cuffs on both arms and both ankles and performed the measurement after the subject had rested for ≈10 minutes in the supine position. The Omron device simultaneously measures pulse waves of the brachial and posterior tibial arteries using an oscillometric cuff technique. The device estimates the travel path from body height and automatically computes brachial-ankle PWV as the ratio of the travel path divided by the time difference between the pulse waves that are transmitted to the brachial and ankle arteries. The maximum of the right and left-side brachial-ankle PWV values was used for analysis. The same device simultaneously measures blood pressure on both arms and ankles and calculates ankle-brachial index as the ratio of the minimum of ankle systolic pressures divided by the maximum of arm systolic pressures.

**Field Work**

One experienced physician measured each participant’s blood pressure 3x consecutively using a validated Omron 7051 oscillometric blood pressure monitor (Omron) on the nondominant arm after the subjects had rested for ≈5 minutes in the sitting position. These 3 blood pressure readings were used for the definition of hypertension and for the computation of short-term blood pressure variability indexes, namely SD and coefficient of variation. The same observer also administered a standardized questionnaire to collect information on medical history, lifestyle, and use of medications. Hypertension was defined as a sitting blood pressure of ≤140 mmHg systolic or 90 mmHg diastolic, or as the use of antihypertensive drugs. Pulse pressure was calculated as the difference between systolic and diastolic pressure, and mean arterial pressure as diastolic blood pressure plus one third pulse pressure. A trained technician performed anthropometric measurements, including body height and body weight. Body mass index was calculated as the body weight in kilograms divided by the body height in meters squared.

Venous blood samples were drawn after overnight fasting for the measurement of plasma glucose and serum total cholesterol. Diabetes mellitus was defined as a plasma glucose concentration of ≥7.0 mmol/L fasting or ≥11.1 mmol/L at any time or as the use of antidiabetic agents.

**Follow-Up**

Information on vital status and the cause of death was obtained from the official death certificate, with further confirmation by the local Community Health Center and family members of the deceased people. The *International Classification of Diseases, 9th Revision* was used to classify the cause of death. Cardiovascular mortality included deaths attributable to stroke, myocardial infarction, and other cardiovascular diseases. Deaths other than cardiovascular reasons were considered as noncardiovascular mortality.

**Statistics**

For database management and statistical analysis, we used SAS software (version 9.2; SAS Institute, Cary, NC). Means and proportions were compared with the Student t test and Fisher exact test, respectively. Multiple Cox regression analysis was performed to compute hazard ratios (HRs) with their 95% confidence intervals (CIs). Because of close correlation between brachial-ankle PWV and age, in adjusted analysis we classified brachial-ankle PWV into deciles and defined dummy variables to compute HR (95% CI) for each decile relative to the whole population.

**Results**

**Baseline Characteristics of the Study Participants**

At baseline, 3876 participants (1713 [44.2%] men) had a mean (±SD) age of 68.1±7.3 years and included 2292 (59.1%) hypertensive patients, of whom 1498 (65.4%) were treated with antihypertensive drugs and 577 (25.2%) were controlled to the target blood pressure (≤140/90 mm Hg). Table 1 shows the baseline characteristics by sex. Men and women differed significantly (P≤0.04) in all baseline characteristics except for mean arterial pressure (99.9 mm Hg; P=0.12), short-term blood pressure variability expressed as SD (5.1 mm Hg; P=0.33), and coefficient of variation (3.6%; P=0.35), proportion of the users of antihypertensive drugs (38.6%; P=0.06), and prevalence of hypertension (59.1%; P=0.95).

**Continuous Analyses**

During a median follow-up of 5.9 years (interquartile range, 3.2–6.9 years), the cumulative number of person-years was 20243, and all-cause, cardiovascular, stroke, and noncardiovascular deaths occurred in 316, 148, 46, and 168 subjects, respectively. In unadjusted continuous analyses, brachial-ankle PWV was significantly (P<0.0001) associated with all-cause, cardiovascular, stroke, and noncardiovascular mortality. The corresponding HRs (95% CIs) for 1 m/s increase in brachial-ankle PWV were 1.11 (1.08–1.13), 1.13 (1.10–1.17), 1.12 (1.06–1.19), and 1.08 (1.05–1.12), respectively. These HRs (95% CIs) were quantitatively similar to that for 1-year
increase in age, which were 1.12 (1.11–1.14), 1.18 (1.15–1.21), 1.17 (1.12–1.22), and 1.08 (1.06–1.10), respectively (Table 2). However, if the HRs were computed for 1 SD increase in PWV (4.0 m/s) and age (7.3 years), respectively, the size of HRs for PWV was substantially smaller than for age (Table S1 in the online-only Data Supplement). If PWV and age were mutually adjusted, age but not PWV remained statistically associated with mortality (Table S2).

**Analyses According to the Decile Distributions of Brachial-Ankle PWV**

In further adjusted analyses, we classified the study subjects according to the decile distributions of brachial-ankle PWV and investigated hazards of mortality in each decile relative to the whole study population. After adjustment for age, sex, body mass index, current smoking, alcohol intake, use of antihypertensive drugs, mean arterial pressure, diabetes mellitus, and serum total cholesterol, multiple Cox regression analyses showed that only the subjects in the top decile of brachial-ankle PWV (≥23.3 m/s) had a significantly higher risk of all-cause mortality (HR, 1.56; 95% CI, 1.16–2.08; \( P = 0.003 \); Table 3; Figure). Similar trends were observed for cardiovascular, stroke, and noncardiovascular mortality, although statistical significance was not reached (\( P = 0.08 \); Table 3).

Further analyses that incorporated pulse pressure and blood pressure variability indexes in the model did not materially change the results on brachial-ankle PWV and did not show significant association of these blood pressure components with mortality (\( P \geq 0.12 \)). Pulse pressure (67.4 versus 55.4 mmHg; \( P = 0.001 \)), but not the SD (5.5 versus 5.1 mmHg; \( P = 0.17 \)) or coefficient of variation of systolic blood pressure (3.6% versus 3.8%; \( P = 0.36 \)), was higher in the top decile of brachial-ankle PWV than the rest of study participants.

**Sensitivity Analyses**

We performed sensitivity analyses according to various baseline characteristics of the study population (Table 4) and found that the relationship between brachial-ankle PWV and all-cause mortality was dependent on the presence (Figure) and absence of hypertension, regardless of the control status of hypertension (\( P = 0.02 \) for the interaction between brachial-ankle PWV and hypertension in relation to all-cause mortality; Table 4). The subjects in the top decile of brachial-ankle PWV had a significantly higher risk of all-cause mortality in the presence of controlled (HR, 1.89; 95% CI, 1.08–4.32; \( P = 0.03 \)) or uncontrolled hypertension (HR, 1.85; 95% CI, 1.30–3.23; \( P = 0.01 \)) but not in the absence of hypertension (\( P = 0.73 \); Table 4). Similar results were observed for cardiovascular mortality, although the interaction between brachial-ankle PWV and hypertension was not statistically significant (\( P = 0.18 \); Table S3).

**Discussion**

The key finding of our study was that brachial-ankle PWV predicted mortality in elderly Chinese, with an unadjusted HR for 1 m/s increase similar to that for 1-year increase in age. After adjustment for age and other confounding factors in analyses according to the decile distributions of brachial-ankle PWV, only the subjects in the top decile had significantly higher mortality, especially in the presence of hypertension. Taken together, our findings suggest that the incremental predictive value of brachial-ankle PWV for mortality in elderly Chinese is rather modest and mainly on the conditions of extremely increased PWV and hypertension.

Whether measuring carotid-femoral PWV would improve the prediction of mortality in elderly Chinese remains to be elucidated. Despite that carotid-femoral and brachial-ankle PWVs are closely related, these 2 measure stiffness of different arteries that are under differential regulatory and counterregulatory mechanisms. Carotid-femoral PWV measures stiffness of large elastic arteries, which is mainly attributable

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**Table 2. Unadjusted Continuous Analyses on the Risk of Mortality in Relation to Brachial-Ankle PWV and Age**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>No. of Deaths</th>
<th>Rate per 1000 Person-Years</th>
<th>Brachial-Ankle PWV (+1 m/s)</th>
<th>Age (+1 y)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>HR (95% CI) P Value</td>
<td>HR (95% CI) P Value</td>
</tr>
<tr>
<td>All-cause mortality</td>
<td>316</td>
<td>15.6</td>
<td>1.11 (1.08–1.13) &lt;0.0001</td>
<td>1.12 (1.11–1.14) &lt;0.0001</td>
</tr>
<tr>
<td>Cardiovascular</td>
<td>148</td>
<td>7.3</td>
<td>1.13 (1.10–1.17) &lt;0.0001</td>
<td>1.18 (1.15–1.21) &lt;0.0001</td>
</tr>
<tr>
<td>Stroke mortality</td>
<td>46</td>
<td>2.3</td>
<td>1.12 (1.06–1.19) &lt;0.0001</td>
<td>1.17 (1.12–1.22) &lt;0.0001</td>
</tr>
<tr>
<td>Noncardiovascular</td>
<td>168</td>
<td>8.3</td>
<td>1.08 (1.05–1.12) &lt;0.0001</td>
<td>1.08 (1.06–1.10) &lt;0.0001</td>
</tr>
</tbody>
</table>

Hazard ratios (HRs) and their 95% confidence intervals (CIs) were computed for 1 m/s increase in brachial-ankle pulse wave velocity (PWV) and 1 y increase in age.

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**Table 3. Adjusted Analyses on the Risk of Mortality in Subjects in the Top Decile of Brachial-Ankle PWV Relative to the Whole Study Population**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>No. of Deaths</th>
<th>Rate per 1000 Person-Years</th>
<th>Top Decile of Brachial-Ankle PWV vs Whole Study Population</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>HR (95% CI) P Value</td>
</tr>
<tr>
<td>All-cause mortality</td>
<td>75</td>
<td>39.9</td>
<td>1.56 (1.16–2.08) 0.003</td>
</tr>
<tr>
<td>Cardiovascular</td>
<td>43</td>
<td>22.9</td>
<td>1.46 (0.90–2.05) 0.15</td>
</tr>
<tr>
<td>Stroke mortality</td>
<td>13</td>
<td>6.9</td>
<td>1.49 (0.69–3.20) 0.31</td>
</tr>
<tr>
<td>Noncardiovascular</td>
<td>32</td>
<td>17.0</td>
<td>1.60 (1.18–2.75) 0.006</td>
</tr>
</tbody>
</table>

The analyses were adjusted for age, sex, body mass index, current smoking and alcohol intake, use of antihypertensive drugs, mean arterial pressure, diabetes mellitus, and serum total cholesterol. CI indicates confidence interval; HR, hazard ratio; and PWV, pulse wave velocity.
...to hemodynamic overload and atherosclerotic and arteriosclerotic lesions. Brachial-ankle PWV, however, also measures stiffness of muscular arteries in addition to elastic arteries, which can be influenced by autonomic regulation of vascular tone, endothelial function, and other functional mechanisms. Muscular arteries, at variance from elastic arteries, are more sensitive to short-term changes in central sympathetic drive. Thus, brachial-ankle PWV, at variance from carotid-femoral PWV that is more influenced by structural changes in elastic arteries, may be heavily influenced by acute variations in the vascular tone and blood pressure levels, for example, as a consequence of the alerting reaction to the clinic visit and the associated short-term changes in central sympathetic drive. This might contribute to explain why in our study brachial-ankle PWV predicted mortality only on the conditions of markedly increased PWV and hypertension.

It is also possible that the predictive value of brachial-ankle PWV decreases with advancing age. Several recent prospective studies in the general or hypertensive Japanese population demonstrated significant predictive value of brachial-ankle PWV for cardiovascular events, independent of age. Indeed, the age- and sex-adjusted HR for all fatal and nonfatal cardiovascular events associated with $\approx 2$ m/s increase in brachial-ankle PWV was 1.25 (95% CI, 1.11–1.42) in the 4164 subjects enrolled in the Takashima study (≥20 years) and 1.32 (95% CI, 1.15–1.53) in the 2916 subjects enrolled in the Hisayama study (≥40 years). Nonetheless, 2 earlier studies of smaller sample size (n=298 and 530, respectively) did show significant predictive value of brachial-ankle PWV in elderly Japanese for total and cardiovascular mortality.

Our finding in hypertensive patients is in line with the results of a meta-analysis of prospective studies that studied aortic PWV and may have straightforward explanations. In population-specific meta-analyses, the pooled relative risk ratio for fatal and nonfatal cardiovascular events was computed for high (various definitions) versus low PWV and was significantly ($P=0.009$) greater in studies in hypertensive patients (2.46; 95% CI, 1.93–3.13) than in the general population (1.68; 95% CI, 1.45–1.96). Nonetheless, these diseases are independent clinical entities and may still have independent and synergistic cardiovascular predictive values.

Why the risk of mortality associated with increased brachial-ankle PWV in hypertensive patients does not differ between controlled and uncontrolled hypertension remains under investigation. The possibility of chance finding cannot be entirely excluded because of the small number of controlled hypertensive patients. Another plausible explanation is that control of hypertension is insufficient in terms of blood pressure level and coverage of the whole day. More stringent...
blood pressure target might be needed to prevent stroke, which is the major complication of hypertension in Chinese and is directly associated with blood pressure. Only 15.5% of our treated elderly hypertensive patients were controlled to a level <130/80 mm Hg. Long-acting antihypertensive drugs might be needed to control blood pressure >24 hours of a day. However, most of our treated elderly hypertensive patients used short-acting antihypertensive drugs in an inappropriate manner, for example, once daily.28

Our study demonstrated that brachial-ankle PWV predicted not only cardiovascular but also noncardiovascular mortality. This finding remains incompletely understood. A speculative explanation is that stiffer arteries may also cause damages in organs other than the heart, brain, and kidneys, and, therefore, predispose diseases in noncardiovascular organs and then deaths attributable to noncardiovascular diseases. If this explanation were true, arterial stiffening can also be a cause of pathological aging and diseases in elderly persons.

Our study should be interpreted within the context of its strengths and limitations. Our study had a relatively large number of subjects and fatal events and, therefore, had adequate power to do analysis according to the decile distributions of brachial-ankle PWV. However, we only performed measurement of brachial-ankle but not carotid-femoral PWV in the early phase of our cohort study. The latter is the current standard measure of arterial stiffness and is recommended by most hypertension and arterial guidelines.9,10,33 In addition, we only performed analysis on mortality, but not fatal combined with nonfatal cardiovascular events, because data collection on nonfatal events was incomplete at the time of this analysis.

**Perspectives**

Our study demonstrated that brachial-ankle PWV was positively associated with the risk of mortality only on the condition of markedly increased brachial-ankle PWV and mainly in the presence of hypertension. In spite of its modest predictive value, brachial-ankle PWV might still be useful in the management of hypertension. At present, there is no specific treatment with proven effect on arterial stiffening. Antihypertensive therapy may be an option of treatment against arterial stiffening, while reducing the risks associated with hypertension. Recent hypertension guidelines recommended less tight blood pressure control in elderly persons.34 However, in the presence of increased arterial stiffness, more intensive antihypertensive treatment might provide more cardiovascular protection. This hypothesis should be tested in randomized controlled trials that compare more with less intensive blood pressure lowering in elderly patients with hypertension and arterial stiffness, for instance, 130/80 versus 140 to 150/90 mm Hg.

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Disclosures

J.-G. Wang reports receiving grants and lecture and consulting fees from Omron Healthcare (Kyoto, Japan). The other authors report no conflicts.

References


What Is New?
- In a relatively large number of elderly Chinese subjects, we investigated the predictive value of brachial-ankle pulse wave velocity for mortality while accounting for age and hypertension.

What Is Relevant?
- In elderly hypertensive patients, brachial-ankle pulse wave velocity might be useful for the management of hypertension, especially when it was markedly increased.

Summary
In the elderly, brachial-ankle pulse wave velocity significantly predicts mortality only on the condition of markedly increased pulse wave velocity and mainly in the presence of hypertension.
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Online Supplements

Table S1. Unadjusted Continuous Analyses on the Risk of Mortality Associated with 1-SD Increase in Brachial-Ankle Pulse Wave Velocity and Age

<table>
<thead>
<tr>
<th>Outcome</th>
<th>No. of deaths</th>
<th>Rate per 1000 person-years</th>
<th>Brachial-ankle pulse wave velocity (+4.0 m/s)</th>
<th>Age (+7.3 years)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Hazard ratio (95% CI)</td>
<td>Hazard ratio (95% CI)</td>
</tr>
<tr>
<td>All-cause mortality</td>
<td>316</td>
<td>15.6</td>
<td>1.50 (1.37-1.64)</td>
<td>2.34 (2.10-2.61)</td>
</tr>
<tr>
<td>Cardiovascular mortality</td>
<td>148</td>
<td>7.3</td>
<td>1.64 (1.45-1.85)</td>
<td>3.38 (2.85-4.01)</td>
</tr>
<tr>
<td>Stroke mortality</td>
<td>46</td>
<td>2.3</td>
<td>1.59 (1.27-1.99)</td>
<td>3.13 (2.32-4.22)</td>
</tr>
<tr>
<td>Noncardiovascular mortality</td>
<td>168</td>
<td>8.3</td>
<td>1.38 (1.21-1.56)</td>
<td>1.75 (1.52-2.03)</td>
</tr>
</tbody>
</table>

Hazard ratios and their 95% confidence intervals (CIs) were computed for 1-SD increase in brachial-ankle pulse wave velocity and age.
<table>
<thead>
<tr>
<th>Outcome</th>
<th>Brachial-ankle pulse wave velocity (+4.0 m/s)</th>
<th>Age (+7.3 years)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hazard ratio (95% CI)</td>
<td>P</td>
</tr>
<tr>
<td>All-cause mortality</td>
<td>1.05 (0.94-1.16)</td>
<td>0.71</td>
</tr>
<tr>
<td>Cardiovascular mortality</td>
<td>1.01 (0.87-1.16)</td>
<td>0.94</td>
</tr>
<tr>
<td>Stroke mortality</td>
<td>0.99 (0.75-1.29)</td>
<td>0.92</td>
</tr>
<tr>
<td>Noncardiovascular mortality</td>
<td>1.08 (0.93-1.26)</td>
<td>0.30</td>
</tr>
</tbody>
</table>

Hazard ratios and their confidence intervals (CIs) were computed 1-SD increase in brachial-ankle pulse wave velocity and age. The Cox models were mutually adjusted for brachial-ankle pulse wave velocity and age in a single model.
Table S3. Adjusted Sensitivity Analyses on the Risk of Cardiovascular Mortality in the Top Decile of Brachial-Ankle PWV Relative to the Whole Study Population

<table>
<thead>
<tr>
<th>Variable</th>
<th>No. of subjects</th>
<th>No. of Deaths</th>
<th>Pulse Wave Velocity</th>
<th>Hazard Ratio (95% CI)</th>
<th>P</th>
<th>P_{int}</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>1713</td>
<td>68</td>
<td>1.69 (0.94-3.06)</td>
<td>0.08</td>
<td>0.40</td>
<td></td>
</tr>
<tr>
<td>Women</td>
<td>2163</td>
<td>80</td>
<td>1.45 (0.84-2.51)</td>
<td>0.18</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≥80 years</td>
<td>286</td>
<td>54</td>
<td>0.92 (0.59-1.45)</td>
<td>0.72</td>
<td>0.85</td>
<td></td>
</tr>
<tr>
<td>60-80 years</td>
<td>3590</td>
<td>94</td>
<td>1.22 (0.71-2.10)</td>
<td>0.47</td>
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<tr>
<td>Body mass index</td>
<td></td>
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</tr>
<tr>
<td>≥28.0 kg/m²</td>
<td>463</td>
<td>8</td>
<td>0.92 (0.52-1.065)</td>
<td>0.32</td>
<td>0.90</td>
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<tr>
<td>&lt;28.0 kg/m²</td>
<td>3413</td>
<td>140</td>
<td>1.55 (1.03-2.34)</td>
<td>0.04</td>
<td></td>
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<tr>
<td>Current smoking</td>
<td></td>
<td></td>
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<tr>
<td>Yes</td>
<td>957</td>
<td>28</td>
<td>0.91 (0.52-1.59)</td>
<td>0.73</td>
<td>0.78</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>2919</td>
<td>120</td>
<td>1.58 (1.01-2.45)</td>
<td>0.04</td>
<td></td>
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<tr>
<td>Alcohol intake</td>
<td></td>
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<tr>
<td>Yes</td>
<td>643</td>
<td>21</td>
<td>0.98 (0.27-3.54)</td>
<td>0.98</td>
<td>0.53</td>
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</tr>
<tr>
<td>No</td>
<td>3233</td>
<td>127</td>
<td>1.60 (1.04-2.47)</td>
<td>0.03</td>
<td></td>
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<tr>
<td>Antihypertensive treatment</td>
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</tr>
<tr>
<td>Yes</td>
<td>1498</td>
<td>65</td>
<td>1.34 (0.74-2.43)</td>
<td>0.33</td>
<td>0.61</td>
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</tr>
<tr>
<td>No</td>
<td>2378</td>
<td>83</td>
<td>0.95 (0.53-1.70)</td>
<td>0.86</td>
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<tr>
<td>Diabetes mellitus</td>
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<tr>
<td>Yes</td>
<td>338</td>
<td>11</td>
<td>1.56 (0.71-3.41)</td>
<td>0.26</td>
<td>0.08</td>
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<tr>
<td>No</td>
<td>3538</td>
<td>137</td>
<td>1.17 (0.94-1.44)</td>
<td>0.15</td>
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<td>Hypertension *</td>
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<tr>
<td>Yes/uncontrolled</td>
<td>1715</td>
<td>69</td>
<td>1.63 (0.89-2.12)</td>
<td>0.32</td>
<td>0.18</td>
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<tr>
<td>Yes/controlled</td>
<td>577</td>
<td>26</td>
<td>1.65 (0.66-4.47)</td>
<td>0.28</td>
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<tr>
<td>No</td>
<td>1584</td>
<td>53</td>
<td>1.12 (0.55-2.34)</td>
<td>0.74</td>
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</table>

Hazard ratios and their confidence intervals (CIs) were computed for the top decile of brachial-ankle pulse wave velocity relative to the whole study population, and adjusted for age, gender, body mass index, current smoking and alcohol intake, use of antihypertensive drugs, mean arterial pressure, diabetes mellitus, and serum total cholesterol, as appropriate.

*The P value was the interaction between pulse wave velocity and hypertension (no vs. yes).