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Original Study

Blood Pressure, Gait Speed, and Mortality in Very Old Individuals: A Population-Based Cohort Study

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A B S T R A C T

Objectives: Clinical trials and observational studies have produced contradictory results regarding the association of blood pressure (BP) and mortality in people aged 80 years or older. Gait speed at usual pace has been shown to moderate this association in a population of noninstitutionalized people aged 65 years or older. The aims of this study were to investigate the association of BP with all-cause mortality in a representative sample of people aged 85 years or older and to assess whether gait speed moderates this association.
Design, Setting, and Participants: A total of 806 participants in the population-based prospective Umeå 85+/GERDA study aged 85, 90, and 95 years or older.
Measurements: Gait speed at usual pace was measured over 2.4 m. The main outcome was hazard ratios (HRs) for all-cause mortality according to systolic and diastolic BP categories in the total sample and in faster-walking ($\geq$0.5 m/s, n = 312) and slower-walking ($<$0.5 m/s, n = 433) subcohorts; the latter also included habitually nonwalking participants. Comprehensive adjustments were made for sociodemographic and clinical characteristics associated with death.
Results: Mean age and baseline systolic and diastolic BP were 89.6 ± 4.6 years, 146.8 ± 23.9 mm Hg, and 74.8 ± 11.1 mm Hg, respectively. Most (n = 561 [69%]) participants were women, 315 (39%) were care facility residents, and 566 (70%) were prescribed BP-lowering drugs. Within 5 years, 490 (61%) participants died. In the total sample and slower-walking subcohort, systolic BP appeared to be inversely associated with mortality, although not independent of adjustments. Among faster-walking participants, mortality risk after adjustment was more than 2 times higher in those with systolic BP of 140 to 149 mm Hg (HR = 2.25, 95% confidence interval [CI] = 1.03–4.94) and 165 mm Hg or higher (HR = 2.13, 95% CI = 1.01–4.49), compared with systolic BP of 126 to 139 mm Hg. Mortality risk was also independently higher in faster-walking participants with diastolic BP higher than 80 mm Hg, compared with diastolic BP of 75 to 80 mm Hg (HR = 1.76, 95% CI = 1.07–2.90).
Conclusion: The gait speed threshold of 0.5 m/s may be clinically useful for the distinction of very old people with and without increased all-cause mortality risk due to elevated systolic and diastolic BP.

The population of very old people (aged $\geq$85 years) is growing rapidly, along with an increasing prevalence of hypertension.[1,2] The association between blood pressure (BP) and mortality is not entirely understood in this population, including those with multimorbidity and those living in residential care facilities. Results of population-based studies[3–10] have suggested that hypertension is not a risk factor for death in very old individuals. Antihypertensive treatment has been shown to have positive effects on cardiovascular morbidity in a systematic review[11] and a large meta-analysis[12] of randomized controlled trials, but neither study found any effect on overall mortality in people aged 80 years or older. However, the Hypertension in the

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Very Elderly Trial (HYVET),[13] the largest double-blind, placebo-controlled trial to examine this issue, found that antihypertensive therapy markedly reduced total mortality in people aged 80 years or older. Because the level of comorbidity in the HYVET sample was low in comparison with that of the general population of very old individuals, the applicability of this study's findings to the latter remains unclear.

Gait speed, measured over a short distance, is an integrative measure of health and functional abilities that has been shown to predict adverse outcomes and mortality risk.[14–17] Using gait speed to divide a population of noninstitutionalized adults aged 65 years or older into subcohorts, Odden et al[18] found that hypertension was associated with all-cause mortality only in participants whose usual pace was 0.8 m/s or faster. In slower-walking participants, including those who were physically unable to complete the walk, BP was not associated with mortality. Gait speed thus appears to distinguish groups of older people with and without increased mortality risk related to hypertension. However, the mean age of participants in the study by Odden et al[18] was 74 years, and its results remain to be confirmed in the very old population. The cutoff value of 0.8 m/s for gait speed has been well supported in the scientific literature for younger old populations, but a lower threshold may be more suitable for very old, and generally slower-walking, people.[15]

This study was conducted to investigate the association between BP and mortality in a representative sample of very old people and to assess whether gait speed at usual pace could moderate this association.

Methods

Setting and Design

This study was based on data from the Umeå 85+/GErontological Regional DAtabase (GERDA) population-based cohort study by Umeå University, Sweden. Half of inhabitants aged 85 years (selected from a randomized starting point) and all of those aged 90 and 95 years or older in 8 municipalities of northern Sweden and western Finland were selected from national tax and population registers for participation in the Umeå 85+/GERDA study. The objective of the study was to increase knowledge of the living conditions of very old people, increase quality of life, and provide data to support planning of future eldercare. Data collection commenced in 2000, 2002, 2005, and 2007; in 2005 it was conducted in collaboration with Åbo Akademi University and the University of Vaasa, Finland. The study design has been described in detail elsewhere.[19] Eligible participants were invited by mail to participate in the study and subsequently contacted by telephone to obtain informed consent. For participants with cognitive impairment, a close relative also provided oral consent, when appropriate. Trained assessors visited all participants at their homes or institutions to conduct standardized interviews and tests. Relatives and/or health care professionals were interviewed when needed and the medical records of all consenting participants were reviewed. The Umeå 85+/GERDA study has been approved by the Regional Ethical Review Board in Umeå (§99-326, §05-063M) and the Ethics Committee of Vaasa Central Hospital (registration number 05-87).

Participants

Of 1310 eligible Umeå 85+/GERDA study participants, 115 died before contact and 347 declined home visits (Figure 1). All participants whose BP was measured (n = 806; 67.4% participation rate) were included in the present study. The 389 nonparticipants who declined home visits or for whom no BP measurement was obtained did not differ significantly from participants in age ($P = .636$) or sex ($P = .136$). For persons who participated in more than one round of data collection, the earliest dataset was used. Gait speed was assessed in 609 participants, who were included in gait speed analyses and subcohorts. Of 197 participants who were unable to complete the gait speed test, 136 participants were included in a gait-speed subcohort because they were considered to have habitual physical impairment of gait function (habitually nonwalking), which may reflect mortality risk in this population.[15] Sixty-one of those who were unable to complete the gait speed test were excluded from gait speed analyses and subcohorts because of recent fracture preventing gait speed assessment, failure to understand instructions, severe visual or hearing impairment, environmental limitation, or other reasons not related to a habitual physical impairment of gait function. In total, 745 participants were included in gait speed subcohorts.

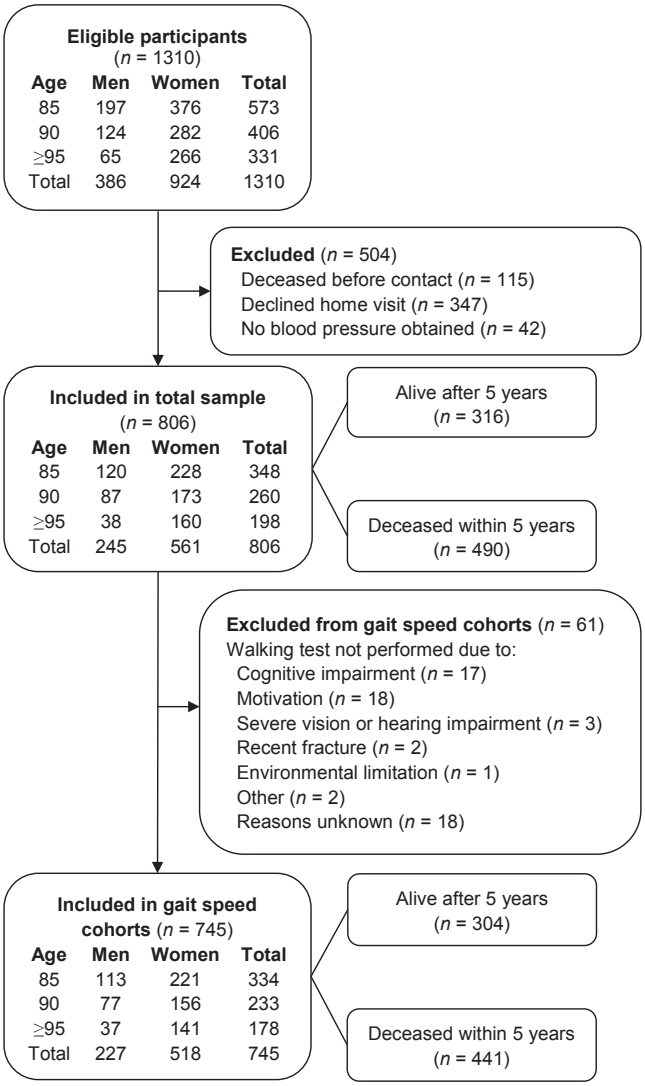

Fig. 1. Flow chart of study participation.

Measures

Dates of death were collected from death certificates, electronic medical records, and population registers for the 5 years after the date of study inclusion. Information on participants' age, sex, living conditions, education, and smoking status was collected during interviews. BP was measured using a calibrated manual sphygmomanometer and stethoscope with participants supine after 5 minutes of