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Original Study

Frailty, Disability, and Ambulatory Blood Pressure in Older Adults

Teresa Gijón-Conde MD [a,b], Auxiliadora Graciani MD [a], Esther López-García PhD [a], Esther García-Esquinas MD [a], Martin Laclaustra MD [a,c], Luis M. Ruilope MD [a], Fernando Rodríguez-Artalejo MD [a], José R. Banegas MD [a,*]

[a] *Department of Preventive Medicine and Public Health, School of Medicine, Universidad Autónoma de Madrid/IdiPAZ CIBER in Epidemiology and Public Health (CIBERESP), Madrid, Spain*
[b] *Centro de Salud Universitario Cerro del Aire, Majadahonda, Madrid, Spain*
[c] *Aragon Institute for Health Research (IIS Aragón), Translational Research Unit, Hospital Universitario Miguel Servet, CIBERCV, Universidad de Zaragoza, Zaragoza, Spain*

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A B S T R A C T

Background and objective: Frailty and disability are associated with cardiovascular risk factors, including hypertension, in older people; however, little is known about their association with ambulatory blood pressure (BP). Thus, we assessed the relationship of frailty and disability with ambulatory BP in older adults.
Design, setting, and participants: Cross-sectional study of 1047 community-living individuals aged ≥60 years in Spain.
Measurements: BP was determined with validated devices under standardized conditions during 24 hours. Frailty was defined as having 3 or more of the following criteria: weight loss, low grip strength, low energy, slow gait speed, and low physical activity. Disability was assessed with the Lawton-Brodýs questionnaire on instrumental activities of daily living. Associations with systolic BP (SBP) and dipping (nocturnal SBP decline) were modeled and adjusted for sociodemographic variables, body mass index, lifestyles, antihypertensive drug treatment, comorbidities, 24-hour heart rate, and conventional or ambulatory SBP as appropriate.
Results: Participants' mean age was 71.7 years (50.8% men); 6% were frail and 8.1% had disability. Compared with nonfrail participants, those with frailty had 3.5 mm Hg lower daytime SBP ($P = .001$), 3.3% less SBP dipping ($P = .003$), and 3.6 mmHg higher nighttime SBP ($P = .016$). Compared with participants who are not disabled, those who are disabled had 2.5 mmHg lower daytime SBP ($P = .002$), 2.5% less SBP dipping ($P = .003$), and 2.7 mmHg higher nighttime SBP ($P = .011$).
Conclusions: In community-dwelling older adults, frailty and disability were independently associated with lower diurnal SBP, blunted nocturnal decline of SBP, and higher nocturnal SBP. These findings may help explain the higher mortality associated with low clinic SBP in frail older subjects observed in epidemiologic studies.

Hypertension is highly prevalent among elderly persons and contributes substantially to poor physical function, and cardiovascular and all-cause mortality.[1–4] Ambulatory blood pressure monitoring (ABPM) is a useful tool for the diagnosis and management of hypertension because it predicts clinical outcomes better than conventional blood pressure (BP) measurements.[5–8] In particular, nighttime systolic BP (SBP) is the strongest predictor of cardiovascular disease (CVD).[9–11] Likewise, a blunted nocturnal decline of SBP (dipping) is also a risk factor for CVD mortality.[12,13] Night/day SBP ratio expresses the same information as the dipping size,[8] and independently predicts total mortality.[12] On the other hand, frailty and disability syndromes are

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* Address correspondence to José R. Banegas, MD, Department of Preventive Medicine and Public Health, Universidad Autónoma de Madrid, Arzobispo Morcillo 4, Madrid 28029, Spain.
E-mail address: joseramon.banegas@uam.es (J.R. Banegas).

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associated with aging and chronic diseases, and also increase the risk of falls, hospitalizations, and mortality.[14,15]

A significant association of BP, hypertension, and other CVD risk factors with frailty and disability has been previously described.[3,16–19] However, most studies on the relationship between BP and frailty/disability focused on conventional BP measurements,[3,16–19] and only a few small, cross-sectional studies in older individuals have evaluated this relationship using ABPM.[20–22] In addition, these latter studies were conducted in clinical settings or with voluntary patients, and adjusted for only a few covariates, not including important confounders (eg, physical activity, diet, or comorbidities).

A better characterization of the relationship between ABPM and frailty/disability could serve to identify the role of daytime and nighttime BP in these entities and to shed light on the complex and controversial relation between BP and mortality in older adults[16,23]; in particular, it remains poorly understood why in older adults with frailty or poor functional status, observational studies usually find higher mortality associated with lower BP while clinical trials show benefit from BP lowering even in the oldest old.[16,24–31] Thus, this study examines the relationship of frailty and disability with conventional BP and daytime and nighttime ambulatory BP in a large sample of community-dwelling older adults in Spain.[32]

Methods

Study Design and Population

Data were taken from the Seniors-ENRICA cohort, whose methods have been previously reported.[32,33] In brief, this cohort was established in 2008–2010 with 2614 individuals selected through stratified random sampling from the population aged ≥60 years in Spain.[32] At baseline, information on sociodemographic variables, lifestyle, health status, and morbidity was collected by telephone interview; also a home visit was conducted to collect blood samples, and another home visit to perform a physical examination and to record habitual diet and prescribed medication. Participants were followed-up until 2012–2013, when a second wave of data collection was performed with the surviving 2519 participants, of which 2037 provided updated information for the phone interview, the physical examination, diet, and medication. In this second wave, and because of logistic and cost reasons, ABPM was offered to 1698 individuals, and was performed in 1328 participants (response rate, 78.2%). Compared with participants without ABPM, those who underwent it had similar age and sex distribution, education levels, obesity, diabetes, current smoking, and previous history of CVD.

Personnel involved in data collection were trained and certified in the study procedures. Study participants gave written informed consent. The study was approved by the Clinical Research Ethics Committee of the "La Paz" University Hospital in Madrid.

Blood Pressure Measurement

BP was measured using standardized procedures and conditions, with validated automatic devices (Omron M6; Omron Healthcare, Lake Forest, IL) and appropriate-sized cuffs. BP was determined 3 times at 2-minute intervals, after resting 5 minutes in a seated position. In the analyses, BP was calculated as the mean of the last 2 of 3 readings. Thereafter, 24-hour ABPM was performed using a validated automated noninvasive oscillometric device (Microlife WatchBPO3 monitor; Microlife Corp, Widnau, Switzerland),[34] programmed to register BP at 20-minute intervals during the day and at 30-minute during the nighttime for the 24-hour period. Appropriate cuff sizes were used. The patients were instructed to maintain their usual activities but keeping the arm extended and immobile at the time of cuff inflation. Valid ABPM registries had to fulfill several pre-established criteria, including 24-hour duration and at least 70% of systolic BP (SBP) and diastolic BP (DBP) successful recordings during the daytime and nighttime periods.[7,8] Daytime and nighttime periods were defined individually according to the patient's self-reported time of going-to-bed and getting-up.

Frailty Assessment

We used the operational definition of frailty developed by Fried et al.[35] in the Cardiovascular Health Study. Specifically, frailty was defined as having at least 3 of the following 5 criteria: (1) exhaustion, based on a response of "≥3-4 days a week" to any of the following questions from the Center for Epidemiologic Studies Depression Scale: "I felt that anything I did was a big effort" or "I felt that I could not keep on doing things"; (2) low physical activity, defined as walking ≤2.5 h/wk in men and ≤2 h/wk in women; (3) slow walking speed, defined as the lowest quintile in our study sample for the 3-m walking speed test, adjusted for sex and height; (4) weight loss, defined as involuntary loss of ≥4.5 kg in the preceding year; and (5) weakness (low grip strength), defined as the lowest quintile in our study sample of maximum strength on the dominant hand, adjusted for sex and body mass index (BMI); strength was measured twice with a Jamar dynamometer on the dominant hand.

Disability Assessment

Disability was assessed according to instrumental activities of daily living (IADL) with the Lawton–Brody questionnaire.[36] This scale evaluates the individual's ability to use the telephone, go shopping, prepare meals, do housework, do laundry, use different means of transportation, take medication, and manage finances. Owing to cultural issues, meal preparation, housework, and laundry were excluded in men; thus, summary scores ranged from 0 to 5 in men, and from 0 to 8 in women. Disability was defined as <5 points in men and <8 in women.[36]

Other Variables

Study participants reported their sociodemographic characteristics: sex, age, educational level (primary; secondary; university), marital status (single/separated/widowed; married), cohabitation (living alone; living with the family, with flat mate, in an institution, or accompanied in any other situation); smoking status (no; yes), and alcohol consumption (no-drinker; drinker). Salt intake (g/d) was assessed with a validated computerized diet history developed from that used in the European Prospective Investigation into Cancer and Nutrition cohort study in Spain.[37,38] Adherence to the Mediterranean diet was summarized with the Mediterranean diet adherence screener (MEDAS).[39] MEDAS consists of 12 items with targets on food consumption and another 2 items with targets for food intake habits characteristic of the Mediterranean diet in Spain. One point is given for each target achieved. The total MEDAS score ranged from 0 to 14, with a higher score indicating better Mediterranean adherence. For the purpose of analysis, we excluded alcohol consumption from the MEDAS as this variable is considered separately in this study. Information on physical activity was also obtained with the validated European Prospective Investigation into Cancer and Nutrition study instrument, and individuals were classified as inactive or active.[40] Participants also reported their usual sleep quality during the night (very good/good; or bad/very bad).[41] Medication use was collected by a face-to-face interview and verified against drug packaging. Participants also reported if they suffered from any of the following physician-diagnosed diseases: cardiovascular diseases (myocardial infarction, stroke, and heart failure), diabetes mellitus, cancer at any site, asthma or chronic bronchitis, osteomuscular disease (osteoarthritis, arthritis, hip fracture), or depression requiring drug treatment.