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Original Study

# Orthostatic Hypotension in the Elderly: A Marker of Clinical Frailty?

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A B S T R A C T

*Background:* Orthostatic hypotension (OH) has high prevalence in frail older adults. However, its effect on mortality, disability, and hospitalization in frail older adults is poorly investigated. Thus, we assessed the relationship between the prevalence of OH and its effect on mortality, disability, and hospitalization in noninstitutionalized older adults stratified by frailty degree.
*Methods:* Prospective, observational study of 510 older participants (≥65 years of age) consecutively admitted to a geriatric evaluation unit to perform a geriatric comprehensive assessment.
*Measurements:* Clinical frailty was assessed using the Italian frailty index (40 items). Systolic blood pressure (mm Hg), diastolic blood pressure (mm Hg), and heart rate (bpm) were evaluated in clinostatic position and after 1, 3, and 5 minutes of orthostatic position. OH was defined with a decrease of 20 mm Hg in systolic blood pressure and/or a decrease of 10 mm Hg in diastolic blood pressure.
*Results:* OH prevalence was 22%, and it increased from 9.0% to 66.0% according to frailty degree ($P$ for trend $<.001$). When stratified by frailty degree, mortality, disability, and hospitalization increased from 1.0% to 24.5%, from 39.0% to 77.0% and from 14.0% to 32.0% in the absence, and from 0.0% to 35.5%, from 42.0% to 95.5% and from 19.0% to 65.5% in the presence of OH, respectively ($P < .01$ vs absence of OH). Multivariate analysis showed that the Italian frailty index is more predictive of mortality, disability, and hospitalization in the presence than in the absence of OH.
*Conclusions:* OH is a common condition in frail older adults, and it is strongly associated with mortality, disability, and hospitalization in the highest frailty degree. Thus, OH may represent a new marker of clinical frailty.



Orthostatic hypotension (OH) has high prevalence in the older population, but it is often assessed and treated inadequately.[1] According to the diagnostic criteria established by the Consensus Committee of the American Autonomic Society and American Academy of Neurology in 1996, OH is defined as a decrease in systolic blood pressure (SBP) of 20 mm Hg or a decrease in diastolic blood pressure (DBP) of 10 mm Hg within 3 minutes of standing.[2] In 2004, a US sample of hospitalized patients showed that 36 admissions on 100,000 were due to OH with a significant age-related increase.[3] These results can be explained by physiological changes occurring with aging (ie, altered baroreflex function)[4] and the strong relationship between OH and the age-related chronic degenerative diseases.[5] This condition often leads to orthostatic syncope,[6] and it becomes particularly relevant in institutionalized frail older patients in whom the prevalence of OH is higher than community dwelling persons (10%-68% vs 6%-33,7%).[7]

Frailty is a complex geriatric condition deriving from the progressive decline of molecular and cellular functions underlying physiological reserves and characterized by a low stress tolerance.[8] This condition is often considered as a state of "vulnerability" or "preclinical frailty," which precedes the condition of disease and

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disability.[9] On the contrary, clinical frailty is characterized by comorbidity, polypharmacy and related adverse reactions, sensorial deficits, low social support, and a high risk of disability, hospitalization, and mortality.[10]

Although the presence of OH is often found in several age-related chronic diseases that adversely influence the prognosis,[5] the association between frailty and OH in older adults is poorly investigated. Thus, the aim of the present study is to investigate the relationship between the prevalence of OH and its effect on mortality, disability, and hospitalization in noninstitutionalized elderly persons stratified by frailty degree.

## Methods

### *Study Population*

The study enrolled 510 older adults (≥65 years of age) consecutively admitted to a Geriatric Evaluation Unit to perform a comprehensive geriatric assessment (CGA). The study received full ethical approval from the Research Ethics Committee in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments. All participants signed an informed consent form, and the institutional review boards approved the study.

### *CGA*

Elderly participants underwent a comprehensive geriatric evaluation that included anthropometric measurements, such as age, sex, body mass index (BMI), and waist circumference.[11] Physiological, pathologic, and pharmacologic anamnesis, cognitive function evaluation with Mini-Mental State Examination ,[12] depressive symptoms with Geriatric Depression Scale,[13] comorbidity with a Cumulative Illness Rating Scale (CIRS) and number of drugs, disability with basic (BADL)[14] and instrumental (IADL)[15] activities of daily living, physical performance with 4-m gait speed,[16] physical activity with Physical Activity Scale for the Elderly,[17] nutritional state with Mini-Nutritional Assessment,[18] social support evaluation with the Social Support Scale (scored from 17 [participants with the lowest support] to 0 [participants with the highest support]),[19] and Tinetti Mobility Test.[20] Muscle strength was assessed by grip strength, measured using a handheld dynamometer (Mecmesin Advanced Force Gauge 500N; GDM, Corsico Milano, Italy). BMI-adjusted values were used as a cut-off point to classify low muscle strength [BMI ≤24, 24.1–28, <28 was 29, ≤30 and ≤32 kg for men and BMI ≤23, 23.1–26, 26.1–29, and <29 was 17, ≤17.3, ≤18, and ≤21 kg for women by bioelectrical impedance analysis (BIA), respectively]. Muscle mass was measured by BIA using a Quantum/S Bioelectrical Body Composition Analyzer (Akern Srl, Florence, Italy). Whole-body BIA measurements were taken between the right wrist and ankle with the participant in a supine position. Muscle mass was calculated using the following BIA equation of Janssen et al.[21] Using the cut-off points indicated in the European Working Group on Sarcopenia in Older People consensus, participants with a low grip strength presenting low muscle mass (skeletal muscle index less than 8.87 and 6.42 kg/m$^2$ in men and women, respectively) were classified as having sarcopenia.[22]

### *Frailty Assessment*

Clinical frailty was assessed using the Italian Frailty Index, a tool of 40 items, validated on an Italian sample of 1077 community-dwelling older adults evaluated at a geriatric evaluation unit.[23] Briefly, this tool has been adapted from the Canadian Frailty Index[24] and explores the 4 domains of frailty: physical, cognitive, nutritional, and socioeconomic. The Italian Frailty Index differs from the Canadian Frailty Index for the nutritional domain, assessed with the Mini-Nutritional Assessment, and the socioeconomic domain, assessed with the Social Support Scale. Frailty was stratified in 3 different degrees: light (0.1–16), moderate (16.1–27.0), and severe (>27.0).

### *OH Assessment*

Participants had been seated for at least 30 minutes and were a minimum of 1 hour pre- or post- lunch when the measurement was obtained. SBP (mm Hg), diastolic blood pressure (DBP, mm Hg) and heart rate (HR, bpm) were evaluated using an aneroid sphygmomanometer in clinostatic position and after 1, 3, and 5 minutes of orthostatic position. OH was defined with a decrease of 20 mm Hg in SBP and/or a decrease of 10 mm Hg in DBP.[25] When it was not possible to measure standing blood pressure, the individuals were excluded from the study (2.5%).

### *Outcomes*

Mortality, disability (defined as ≥1 BADL lost from the baseline), and hospitalization were considered at 6, 12, 18, and 24 months of follow-up.

### *Statistical Analysis*

Data were collected and analysed by SPSS software v 13.0 (SPSS Inc, Chicago, IL). Baseline characteristics of the sample were expressed as mean ± standard deviation. Participants were stratified by degree of frailty (light, moderate, and severe) and according to presence or absence of OH. ANOVA test with Bonferroni's post-hoc correction was performed to compare continuous variables across groups. Differences between continuous variables, divided according to presence or absence of OH, were analysed using *t* test. Differences among dichotomous data were analysed using $\chi^2$ test. Multivariate Cox regression analysis and survival curves, adjusted for age and sex, were used to evaluate the predictive value of the Italian Frailty Index in the presence and absence of OH on mortality, disability, and hospitalization. A *P* value of less than.05 was considered statistically significant.

**Table 1**
Characteristics of the Study Population Stratified by the Presence or Absence of OH

| | All | OH | | *P* |
|---|---|---|---|---|
| | N = 510 | No (n = 398, 78.0%) | Yes (n = 112, 22.0%) | |
| Age (years) | 78.8 ± 6.8 | 78.9 ± 6.7 | 78.5 ± 7.2 | .67 |
| Female sex, no (%) | 219 (54.2) | 183 (46.0) | 38 (34.0) | .09 |
| BMI | 27.6 ± 5.1 | 27.4 ± 5.2 | 28.3 ± 4.7 | .27 |
| MMSE score | 20.3 ± 6.7 | 20.5 ± 6.6 | 19.8 ± 7.2 | .51 |
| GDS score | 8.1 ± 3.9 | 7.6 ± 3.9 | 10.1 ± 3.0 | <.01 |
| BADL lost | 2.3 ± 1.9 | 2.1 ± 1.8 | 3.9 ± 1.9 | <.01 |
| IADL lost | 4.6 ± 2.7 | 4.4 ± 2.7 | 5.3 ± 2.6 | .04 |
| Tinetti score | 16.6 ± 7.6 | 17.4 ± 7.5 | 13.8 ± 7.4 | .03 |
| MNA score | 21.1 ± 4.3 | 21.6 ± 4.3 | 19.5 ± 3.9 | <.01 |
| CIRS-C score | 4.1 ± 2.3 | 3.9 ± 2.3 | 4.9 ± 2.1 | <.01 |
| CIRS-G score | 1.9 ± 0.5 | 1.9 ± 0.5 | 2.0 ± 0.4 | .20 |
| Drugs (n) | 6.1 ± 3.4 | 5.9 ± 3.4 | 6.8 ± 3.2 | .11 |
| Social support score | 8.7 ± 2.9 | 8.8 ± 3.0 | 8.5 ± 2.6 | .59 |
| PASE score | 32.3 ± 47.3 | 34.5 ± 47.9 | 24.2 ± 44.5 | .24 |
| 4-m gait speed (m/sec) | 0.85 ± 0.32 | 0.71 ± 0.24 | 1.31 ± 0.27 | .04 |
| Sarcopenia, no (%) | 88 (22.0) | 56 (14.0) | 32 (29.0) | <.01 |
| Mortality (%) | 56 (14.0) | 40 (10.0) | 16 (14.5) | <.05 |
| Disability (%) | 269 (67.5) | 181 (45.5) | 88 (78.5) | <.05 |
| Hospitalization (%) | 151 (38.0) | 96 (24.0) | 55 (49.5) | <.01 |

CIRS-C, CIRS-Quantity; CIRS-G, CIRS-Severity; GDS, Geriatric Depression Scale; MMSE, Mini-Mental State Examination; MNA, Mini-Nutritional Assessment; PASE, Physical Activity Scale for the Elderly.