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Relationship Between the Drop Rate of Standing Blood Pressure and Major Adverse Cardiovascular Events

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ABSTRACT

Orthostatic hypotension (OH) is defined as a decrease of ≥20 mm Hg systolic blood pressure (SBP) or ≥10 mm Hg diastolic blood pressure (DBP) within 3 min after standing. OH was associated with an increased risk of major adverse cardiovascular events (MACEs) and mortality. As an indicator reflecting the characteristics of orthostatic blood pressure (BP) changes, there is currently no research available on the relationship between the orthostatic BP drop rate and MACEs or mortality. A total of 448 hospitalized patients (mean age 62.07 ± 12.15 years, 35.49% female) completed the follow-up. The median follow-up duration was 5.09 years (0.29–6.13 years). Ninety-two patients (20.54%) developed OH, 12 patients died (2.68%), and 21 patients developed MACEs (4.69%), including 8 cases of non-fatal acute myocardial infarction (MI), 3 cases of non-fatal stroke, and 10 cases died of cardiovascular disease and stroke. Patients were categorized into the $BP_{drop\_rate\_high}$ group (defined as SBP drop rate ≥ 15% and/or DBP drop rate ≥ 5% within 3 min after standing) and the $BP_{drop\_rate\_normal}$ group (defined as SBP drop rate < 15% and DBP drop rate < 5% within 3 min after standing). The Chi-square test and Kaplan-Meier survival analysis indicated that the $BP_{drop\_rate\_high}$ group had a higher risk of MACEs and mortality than the $BP_{drop\_rate\_normal}$ group (all $p < 0.05$). The Receiver Operating Characteristic (ROC) analysis demonstrated SBP drop rate ≥ 15% and/or DBP drop rate ≥ 5% within 3 min after standing has high diagnostic accuracy for OH, with an area under the curve (AUC) of 0.918.Cox regression analysis revealed that the cumulative survival rate of the $BP_{drop\_rate\_normal}$ group was significantly higher than that of the $BP_{drop\_rate\_high}$ group (98.45% vs. 93.69%, HR 0.304, 95% CI 0.095–0.969, $p = 0.044$). This study proposes a novel diagnostic threshold (SBP drop ≥15% and/or DBP drop ≥5% within 3 min after standing) for OH as a strong predictor of MACEs and mortality in hospitalized patients.

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1 | Introduction

Orthostatic hypotension (OH) is common in the elderly, and it is the most common symptom of autonomic nervous dysfunction in the cardiovascular system. It is characterized by dizziness, syncope, and falls [1, 2]. The incidence in middle-aged individuals is approximately 5%–11%, rising to 15%–25% in those aged ≥65 years [3]. A recent meta-analysis showed that the incidence of OH among elderly community residents was 22.2% [4].

OH is defined as a decrease of systolic blood pressure (SBP) by 20 mmHg and/or diastolic blood pressure (DBP) by 10 mmHg within 3 min after standing [5]. However, this diagnostic criterion only reflects the absolute value of blood pressure (BP) changes when the body position changes. The drop rate of orthostatic BP is undeveloped, which provides additional understanding of the changes in postural BP. Prior small-scale studies by Mol et al. established associations between orthostatic BP decline rates and physical impairment, frailty, and fall frequency in elderly patients [6, 7].

At present, there is no study on the relationship between postural BP drop rate and major adverse cardiovascular events (MACEs) and mortality. We assumed that the rate of postural BP decline was closely related to the traditional OH diagnostic criteria and may also independently predict adverse outcomes. The aim of this study was to examine whether an elevated rate of postural BP drop is associated with increased MACEs and mortality risk in hospitalized patients.

2 | Methods

2.1 | Participants

Patients aged ≥18 years hospitalized at the First Affiliated Hospital of Fujian Medical University from January 2016 to December 2017 were included in the study. The First Affiliated Hospital of Fujian Medical University is a general hospital. The Department of Geriatrics mainly treats patients with hypertension, diabetes, coronary heart disease, cerebral infarction, and infectious diseases. All subjects underwent postural BP testing. Exclusion criteria were as follows: (1) Patients with malignant tumors. (2) Patients with tuberculosis. (3) Pregnant or breastfeeding patients. (4) Patients with unstable conditions such as acute myocardial infarction (MI), shock, and acute cerebral infarction. (5) Patients with diseases that affect BP measurement, including atrial fibrillation and other serious arrhythmia, arterial occlusion. (6) Patients with severe dementia or those unable to answer questions correctly. Informed consent was obtained from all subjects.

2.2 | Ethical Approval and Informed Consent

The study received approval from the Ethics Committee of the First Affiliated Hospital of Fujian Medical University (Fujian, China).

2.3 | Protocol

Obtained information regarding age, sex, height, weight, medical history, smoking habits, and alcohol consumption from medical records. We referred to the reference guide of diagnostic criteria for hypertension and diabetes [8, 9], and body mass index (BMI) was calculated as body mass (kg divided by height squared (m^2). Smoking was defined as either past smoking or current smoking of ≥ 1 cigarette per day. Elderly status was defined as age ≥ 60 years.

Orthostatic BP measurements were standardized between 9:00–11:00 a.m. and 2:00–5:00 p.m., with at least 2 h postprandial to minimize confounding by circadian variation or meal-induced hypotension.

Patients were required to lie down quietly for at least 5 min. The BP of the right brachial artery was measured at least twice. The average of two measurements was determined as the lying BP. After measuring the BP in the supine position, the patient stood up as soon as possible, and measured the BP in the upright position for 1 and 3 min as the upright position BP. The value and heart rate of each BP measurement were recorded.

The drop rate of standing SBP or DBP was calculated using the formula:

$$\text{Drop Rate} = (\text{standing SBP or DBP} - \text{lying SBP or DBP})/\text{lying SBP or DBP} \times 100\%.$$

Specifically

- 1 min SBP drop rate = (1 min standing SBP–lying SBP)/lying SBP × 100%;
- 1 min standing DBP drop rate = (1 min standing DBP–lying DBP)/lying DBP × 100%;
- 3 min standing SBP drop rate = (3 min standing SBP–lying SBP)/lying SBP × 100%;
- 3 min standing DBP drop rate = (3 min standing DBP–lying DBP)/lying DBP × 100%.

Lying BP was classified into three categories:

- Normal lying BP: Lying SBP < 140 mm Hg and DBP < 90 mm Hg
- Stage 1 lying hypertension: Lying SBP 140–159 mm Hg and/or DBP 90–99 mm Hg
- Stage 2 lying hypertension: Lying SBP ≥ 160 mm Hg and/or DBP ≥ 100 mm Hg

2.4 | Patient Grouping

OH was defined as a decrease of ≥20 mm Hg in SBP and/or DBP of ≥10 mm Hg within 3 min after standing. According to the diagnostic criteria, patients were divided into two groups: the OH group and the non-OH group. Additionally, patients were further categorized into the $BP_{drop\_rate\_high}$ group (standing SBP dropped ≥15% and/or DBP dropped ≥5% within 3 min after standing up) and the $BP_{drop\_rate\_normal}$ group (standing SBP dropped <15% and DBP dropped < 5% within 3 min after standing).

2.5 | Follow-Up

Follow-up methods included reviewing medical records and conducting telephone interviews to determine the occurrence of MACEs and death. MACEs included fatal and non-fatal MI, stroke, and cardiovascular death. The time when the endpoint event first occurred was used as the cut-off time for follow-up.

2.6 | Statistical Methods

Statistical analyses were performed using SPSS 13.0 (IBM Corp., Armonk, NY) and R version 4.3.1 (R Foundation for Statistical Computing, Vienna, Austria). Measurement data were presented as mean ± standard deviation (SD), and differences between the two groups were assessed using the independent sample t-test. Enumeration data were expressed as percentages.

Kaplan-Meier curve and Cox regression analysis were used to explore the correlation between orthostatic BP drop rate, MACEs, and mortality. Receiver Operating Characteristic (ROC) curve analysis and Spearman correlation analysis were employed to assess the relationship between the drop rate of standing BP and OH. Logistic regression was performed to identify risk factors for OH and orthostatic BP drop rate. Statistical significance was set at $p < 0.05$.

3 | Results

Of the 476 initially enrolled patients, 28 were lost to follow-up (these patients could not be contacted by telephone). A total of 448 patients (mean age 62.07 ± 12.15 years, 35.49% female) completed the follow-up. The median follow-up duration was 5.09 years (0.29–6.13 years).

During the follow-up period, 92 patients (20.54%) developed OH, 12 patients (2.68%) died, including 6 cases of acute MI, 2 cases of heart failure, 2 cases of acute stroke, and 2 cases of tumor. Among the 21 patients (4.69%) with MACEs, including 8 cases of non-fatal acute MI, 3 cases of non-fatal stroke, and 10 cases died from cardiovascular disease or stroke.

Table 1 presents the characteristics of patients. Compared with the non-OH group, the OH group had a higher average age, carotid-femoral pulse wave conduction velocity (cfPWV), lying SBP, rate of elderly patients, rate of hypertension, rate of diabetes, and usage of β receptor blockers, diuretics, and antiplatelet agents. However, the standing SBP and DBP, total cholesterol (TC), and low-density lipoprotein cholesterol (LDL-C) were lower in the OH group.

Table 2 shows the relationship between the drop rate of standing BP and mortality using the Kaplan-Meier method. Standing SBP dropped ≥15% or DBP dropped ≥5% within 3 min after standing up was significantly associated with mortality (all $p < 0.05$).

Table S1 shows the mortality rate difference in the OH group and the non-OH group, the $BP_{drop\_rate\_high}$ group, and the $BP_{drop\_rate\_normal}$ group using the Chi-square test. The mortality rate was significantly higher in the $BP_{drop\_rate\_high}$ group and OH group compared to the $BP_{drop\_rate\_normal}$ group and non-OH group (all $p < 0.05$).

Table S2 shows the relationship between the drop rate in the standing SBP of ≥15% and/or DBP of ≥5% within 3 min after standing up and mortality, MACEs, using the Kaplan-Meier survival curve method. Compared to the $BP_{drop\_rate\_normal}$ group and non-OH group, $BP_{drop\_rate\_high}$ group and OH group demonstrated a higher risk of mortality and MACEs (all $p < 0.05$).

Table S3 showsa 15% drop in SBP and/or a 5% drop in DBP within 3 minutes after standing has high diagnostic accuracy for OH, with an AUC of 0.918 (95% CI: 0.889–0.942) as determined by ROC analysis. Additionally, Spearman correlation analysis revealed a strong correlation coefficient of 0.783 ($p < 0.05$) between the two variables.

Table 3 shows the risk factors for postural BP decline using the logistic regression method. The main factors affecting OH were arteriosclerosis (cfPWV ≥ 9 m/s), elevated lying BP, and the use of diuretic drugs. The main factors affecting the drop rate in the SBP of ≥15% and/or DBP of ≥5% within 3 min after standing were elderly, arteriosclerosis, elevated lying BP, and the use of α receptor blocker drugs. Dependent variables in Cox regression analysis included: elderly (age ≥60 years), sex, obese (BMI ≥28 Kg/m^2), arteriosclerosis, hypertension, diabetes, smoke, use of drugs (antihypertensive drugs, statin, antiplatelet drugs), dyslipidemia (TC ≥ 5.20 mmol/L, LDL-C ≥ 3.4 mmol/L, Triglyceride [TG] ≥ 1.70 mmol/L, one of the three) and lying BP level.

Cox regression analysis showed that after 60 months of follow-up, the cumulative survival rate of the $BP_{drop\_rate\_normal}$ group is significantly higher than that of the $BP_{drop\_rate\_high}$ group (98.45% vs. 93.69%, HR 0.304, 95% CI 0.095–0.969, $p = 0.044$), indicating a 69.6% reduction in mortality risk in the $BP_{drop\_rate\_normal\ group}$ compared to the $BP_{drop\_rate\_high\ group}$. Similarly, compared with the OH group, the cumulative survival rate of the non-OH group significantly increased (98.53% vs. 92.39%, HR 0.226, 95% CI 0.071–0.720, $p = 0.012$). Refer to Figure 1 for details.

4 | Discussion

When changing from supine position to upright position, SBP usually decreased by about 5–10 mmHg, while DBP increases by about 2–5 mmHg, and the average arterial pressure hardly changed. However, impaired autonomic nerve compensation mechanisms can lead to OH [10]. The definition of OH remains controversial, particularly in patients with hypertension or specific populations. Meanwhile, the presence of hypotension symptoms seems to depend mostly on the BP reduction of magnitude rather than absolute BP value in the standing position [11]. However, there was no research comparing the orthostatic BP drop rate with traditional OH diagnostic criteria or the relationship between the orthostatic BP drop rate and MACEs, so we conducted this study. The traditional diagnostic criteria for OH were based on the absolute value of orthostatic BP drop, we proposed that the orthostatic BP drop rate as another diagnostic threshold for OH.

TABLE 1 | General characteristics of patients ($n = 448$).

	Total $n = 448$	OH group $n = 92$	non-OH group $n = 356$	T or χ^2 value	p
Age, y	62.07 ± 12.15	67.29 ± 12.53	60.72 ± 11.70	−4.73	<0.001*
Elderly people *n*, %	249 (55.58)	67 (72.83)	182 (51.12)	13.95	<0.001*
Man *n*, %	289 (64.51)	55 (65.73)	234 (59.78)	1.13	0.288
BMI (kg/m^2)	25.15 ± 3.30	24.61 ± 3.34	25.29 ± 3.27	1.75	0.081
cfPWV (m/s)	9.74 ± 2.25	10.91 ± 2.73	9.44 ± 2.00	−5.82	<0.001*
Arteriosclerosis *n*, %	183 (40.85)	59 (64.13)	124 (34.83)	25.97	<0.001*
Smoking *n*, %	155 (34.60)	25 (27.17)	130 (36.52)	2.82	0.093
Drinking *n*,%	82 (18.30)	11 (11.96)	71 (19.94)	3.12	0.077
Hypertension *n*, %	332 (74.11)	76 (82.61)	256 (71.91)	4.36	0.037*
Diabetes *n*, %	146 (32.59)	41 (44.57)	105 (29.49)	7.56	0.006*
Abnormal blood lipids *n*, %	179 (39.96)	39 (42.39)	140 (39.33)	0.29	0.593
Creatinine (μmol/L)	71.17 ± 26.09	72.67 ± 19.50	70.78 ± 27.54	−0.62	0.536
Uric acid (UA) (μmol/L)	378.13 ± 96.67	370.75 ± 94.00	380.04 ± 97.39	0.82	0.412
TC (mmol/L)	4.63 ± 1.12	4.30 ± 0.93	4.71 ± 1.14	3.18	0.002*
TG (mmol/L)	1.58 ± 1.20	1.39 ± 0.63	1.63 ± 1.30	1.71	0.088
HDL-C (mmol/L)	1.17 ± 0.34	1.11 ± 0.24	1.19 ± 0.36	2.05	0.041*
LDL-C (mmol/L)	2.93 ± 0.96	2.72 ± 0.86	2.98 ± 0.98	2.32	0.021*
ACEI/ARB *n*, %	161 (35.94)	35 (38.04)	126 (35.39)	0.22	0.637
CCB *n*, %	159 (35.49)	38 (41.30)	121 (33.99)	1.71	0.191
β receptor blocker *n*, %	82 (18.30)	24 (26.09)	58 (16.29)	4.69	0.030*
α receptor blocker *n*, %	3 (0.67)	1 (1.09)	2 (0.56)	0.303	0.582
Diuretic *n*, %	28 (6.25)	11 (11.96)	17 (4.78)	6.43	0.011*
Statin *n*, %	236 (52.68)	51 (55.43)	185 (51.97)	0.35	0.553
Antiplatelet drugs *n*, %	167 (37.28)	51 (55.43)	116 (32.58)	16.33	0.001*
Supine SBP mmHg	134.91 ± 18.47	144.64 ± 19.93	132.39 ± 17.22	−5.88	<0.001*
Supine DBP mmHg	75.97 ± 10.42	77.28 ± 11.71	75.63 ± 10.05	−1.36	0.174
Supine HR (beats/min)	71.65 ± 12.00	72.68 ± 13.32	71.38 ± 11.64	−0.93	0.352
Standing 1 min SBP (mmHg)	129.18 ± 19.33	120.36 ± 19.98	131.46 ± 18.52	5.04	<0.001*
Standing 1 min DBP (mmHg)	78.71 ± 12.41	70.77 ± 12.05	80.76 ± 11.67	7.27	<0.001*
Standing 1 min HR (beats/min)	71.00 ± 11.91	72.08 ± 13.06	70.72 ± 11.60	−0.97	0.332
Standing 3 min SBP (mmHg)	131.76 ± 19.27	125.67 ± 20.86	133.33 ± 18.55	3.44	0.001*
Standing 3 min DBP (mmHg)	79.79 ± 12.22	73.98 ± 12.54	81.29 ± 11.69	5.27	<0.001*
Standing 3 min HR (beats/min)	71.34 ± 11.82	72.45 ± 12.75	71.05 ± 11.57	−1.01	0.314

Abbreviations: BMI, body mass index; cfPWV, cervical-femoral pulse wave conduction velocity; DBP, diastolic blood pressure; HDL-c, high-density lipoprotein cholesterol; HR, heart rate; LDL-c, low-density lipoprotein cholesterol; SBP, systolic blood pressure; TC, total cholesterol; TG, triglycerides.
*p <0.05.

The hypertension guidelines emphasized the importance of standing BP measurement, especially in elderly hypertensive patients. We need to consider not only postural BP values, but also OH-related symptoms [12–14]. However, the relationship between OH, symptomatic OH, and clinical prognosis was still controversial. A study of 210 patients with Parkinson's disease emphasized that the average arterial pressure within 3 min after standing had high diagnostic value for symptomatic OH. The sensitivity and specificity of predicting symptomatic OH with a mean arterial pressure <75 mmHg during standing were high. In contrast, predicting symptomatic OH had lower sensitivity and specificity [15]. Another study involving 205 patients found a decrease of ≥60 mmHg in standing SBP during the upright tilt test, indicating a weak correlation between the decrease in standing SBP and symptomatic OH. The relationship between these variables is not considered closely related [16]. A short-term

TABLE 2 | Relationship between drop rate of standing BP and mortality using Kaplan-Meier survival curve method.

	χ^2 value	*p*
Standing 1 min SBP		
Decrease 5%	2.809	0.094
Decrease 10%	0.935	0.329
Decrease 15%	5.586	0.018
Decrease 20%	15.973	<0.001
Standing 1 min DBP		
Decrease 5%	6.573	0.010
Decrease 10%	9.712	0.002
Decrease 15%	17.244	<0.001
Standing 3 min SBP		
Decrease 5%	0.658	0.417
Decrease 10%	2.169	0.141
Decrease 15%	4.563	0.033
Decrease 20%	5.306	0.021
Standing 3 min DBP		
Decrease 5%	4.285	0.038
Decrease 10%	1.827	0.176
Decrease 15%	1.773	0.183

Observation: A significant association between SBP drop rate ≥ 15% or DBP ≥ 5% drop rate within 3 min after standing up and mortality.

study involving 9451 patients with acute hypertension showed that the risk of acute heart failure and acute coronary syndrome was lower in the OH group [17]. There is still controversy about the clinical significance of OH in patients, so we explored the relationship between orthostatic BP drop rate and MACEs, and provided new evidence for the exploration of the relationship between orthostatic BP drop rate and clinical outcomes.

OH is a common cause of hospitalization, particularly in the elderly [18]. Currently, it is widely accepted that patients with OH are at increased risk of falls and death, and make hospitalization difficult [19]. A retrospective cohort study investigated cardiovascular outcomes in initial and sustained OH in the hospitalized patients aged ≥50 years. This study found that no matter whether initial or sustained OH increased the cardiovascular risk, while only sustained OH increased the risk of mortality [20]. There were few studies that focused on the relationship between OH and MACEs in inpatients. Our study provided a reference for exploring the prognosis and risk factors in the hospitalized OH patients.

The ROC analysis demonstrated the SBP drop rate ≥15% and/or DBP drop rate ≥5% within 3 min after standing has high diagnostic accuracy for OH, with an AUC of 0.918. If postural BP drop rate reaches this diagnostic threshold, we need to pay attention to the presence of OH and measure postural BP repeatedly if necessary [21].

The prevalence of OH increases exponentially with age, especially among those aged 75 years and older [22]. Patients with OH will increase the risk of falling and death, and bring great challenges to hospitalization management [23]. Atherosclerosis contributes significantly to the pathophysiology of OH, affecting the sensitivity of pressure receptors and BP regulation during posture changes [24–26]. This study identified arteriosclerosis as an independent risk factor for OH and the standing BP drop rate. Consistent with previous research results, the older patients with OH, the higher the prevalence of hypertension and diabetes [27]. This study found that patients with Oh used more antiplatelet drugs, while the levels of TC and LDL-C were lower, which may be related to the higher cardiovascular risk and lipid-lowering treatment in these patients. The usage ratio of β receptor blockers and diuretics was higher in the OH group, highlighting potential impacts of antihypertensive therapy [28]. However, some studies found that current antihypertensive drugs do not increase OH [29]. A recent meta-analysis involving 29 235 hypertensive patients receiving intensified treatment showed that intensified antihypertensive therapy was beneficial regardless of baseline OH or standing hypotension (standing SBP<110 mmHg and/or DBP<60 mmHg) [30].

TABLE 3 | Analysis of the influencing factors of Orthostatic BP Change using the logistic method.

	β	SE	Wald χ^2	OR value	95% CI	*p* value
OH						
Arteriosclerosis	0.864	0.261	10.995	2.372	1.424–3.953	0.001
Diuretic	0.845	0.435	3.774	2.329	0.993–5.464	0.052
Classification of lying blood pressure	0.559	0.150	13.834	1.750	1.303–2.349	<0.001
SBP drop rate ≥15% and/or DBP ≥5% drop rate within 3 min after standing						
Elderly	0.587	0.275	4.550	1.799	1.049–3.086	0.033
Arteriosclerosis	0.827	0.265	9.701	2.286	1.359–3.846	0.002
α receptor blocker	2.656	1.316	4.071	14.238	1.079–187.902	0.044
Classification of lying blood pressure	0.374	0.141	7.084	1.454	1.104–1.914	0.008

Observation: The Main factors affecting OH are arteriosclerosis, elevated lying BP, and the use of diuretic drugs. Main factors affecting the SBP drop rate ≥15% and/or DBP ≥ 5% drop rate within 3 min after standing are elderly, arteriosclerosis, elevated lying BP, and the use of α receptor blocker drugs.

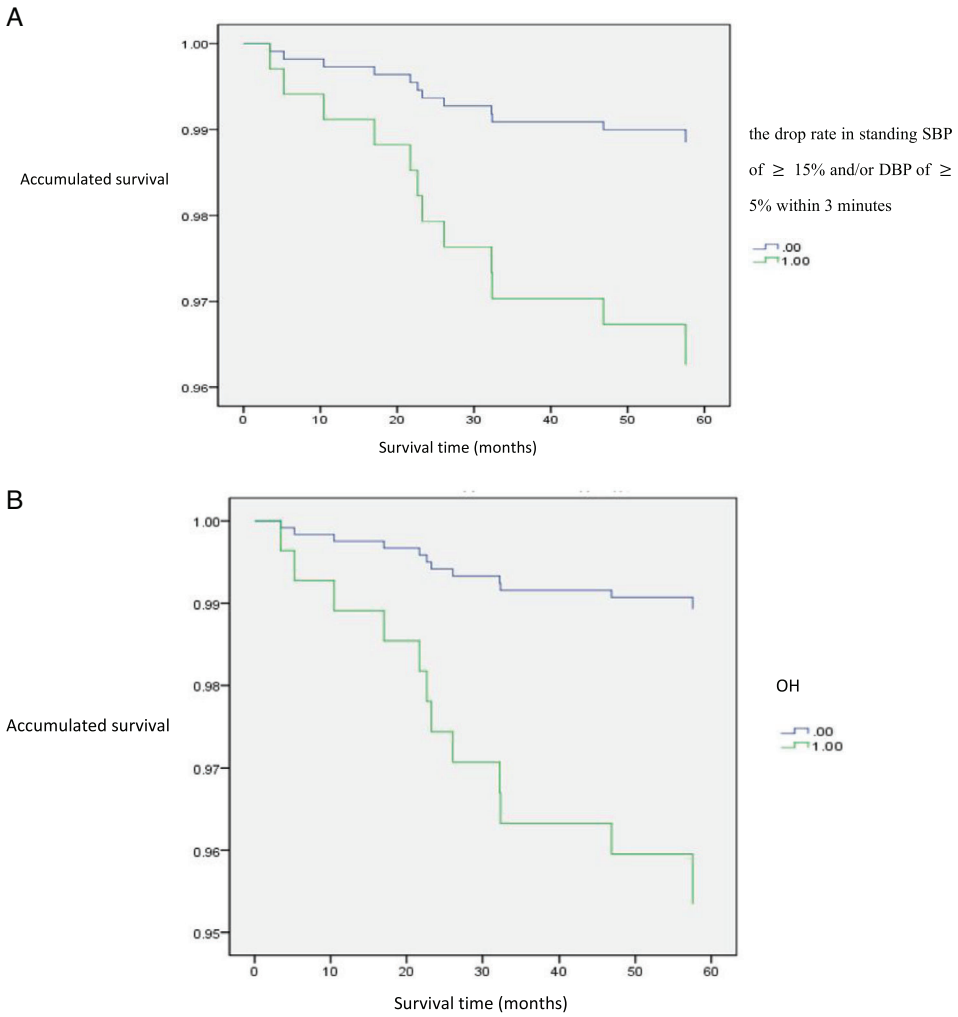

FIGURE 1 | Cox regression analysis of the relationship between orthostatic blood pressure change and mortality. (A) Cox regression analysis of the relationship between the drop rate in standing SBP of 15% and/or DBP of 5% within 3 min after standing up and mortality. (B) Cox regression analysis of the relationship between OH and mortality.

Similar to previous studies, this study also found elderly age and the use of α receptor blockers as independent risk factors for postural BP decline [31]. Many studies have found that diabetic patients are more prone to OH, and this study also found a higher incidence of diabetes mellitus in the OH group, but diabetes mellitus was not found to be an independent risk factor for OH, which may be related the limitations of the included population and glucose-lowering treatment.In this study, we found that elevated lying BP level was an independent risk factor for OH and higher orthostatic BP drop rate.

This study found that a 15% decrease in SBP and/or a 5% decrease in DBP within 3 min after standing was associated with an increased risk of MACEs and mortality. Cox regression analysis revealed that the cumulative survival rate of the $BP_{drop\_rate\_normal}$ group is significantly higher than that of the $BP_{drop\_rate\_high}$ group. Therefore, we found that the orthostatic BP drop rate was an important index for predicting the risk of MACEs and mortality in hospitalized patients.

This study had some limitations, such as its relatively small sample size and reliance on telephone-based follow-up. The conclusions need to be further validated in a large-scale, prospective study involving a more diverse population.

5 | Conclusions

This study proposes a novel diagnostic threshold (SBP drop ≥15% and/or DBP drop ≥5% within 3 min after standing) for OH as a strong predictor of MACEs and mortality in hospitalized patients. The drop rate of orthostatic BP provides a biomarker for identifying OH patients, enabling targeted interventions to mitigate MACEs and mortality.

Author Contributions

Wenqin Cai: Writing–review & editing, writing–original draft, visualization, validation, software, resources, project administration, methodology, investigation, funding acquisition, formal analysis, data curation, and conceptualization. **Yuexian Yao**: Writing—review & editing, writing—original draft, visualization, validation, software, resources, project administration, methodology, investigation, funding acquisition, formal

analysis, data curation, and conceptualization. **Suli Zheng**: Visualization, validation, resources, project administration, methodology, investigation, funding acquisition, and data curation. **Wanting Chen**: Software, methodology, investigation, formal analysis, and data curation. **Lingxin Bao**: Software, methodology, investigation, formal analysis, and data curation. **Jinzi Su**: Visualization, validation, resources, and investigation. **Li Luo**: Visualization, validation, resources, and investigation. **Liangdi Xie**: Writing—review & editing, writing—original draft, visualization, validation, software, resources, project administration, methodology, investigation, funding acquisition, formal analysis, data curation, and conceptualization

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Ethics Statement

Branch for Medical Technology Clinical Application. The study received approval from the Ethics Committee of the First Affiliated Hospital of Fujian Medical University, Document No:lEC-FOM-013-1.0 Date: 6.23.2016.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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Supporting Information

Additional supporting information can be found online in the Supporting Information section.