Original Article

Population-Based Study on the Prevalence and Correlates of Orthostatic Hypotension/Hypertension and Orthostatic Dizziness

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There are no epidemiological studies of orthostatic hypotension (OH)/hypertension (OHT) and orthostatic dizziness (OD) in adults across all age groups. The aim of this study is to examine the prevalence and correlates of OH, OHT, and OD in community dwellers aged ≥20 years. OH was defined as a decline in systolic/diastolic blood pressure of ≥20/10 mmHg when a person stood up from a supine position. OHT was a postural increase of ≥20 mmHg in systolic blood pressure. OD was dizziness, lightheadedness, or faintness as the person stood up. A total of 1,638 adults were included. Subjects were classified as normotensive, pre-hypertensive, or hypertensive. The prevalences of OH, OHT, and OD were 15.9, 1.1, and 4.8%, respectively. OD was associated with neither OH nor OHT. None of the subjects aged <40 had OHT; hypertension (p=0.030) and female gender (p<0.001) were the independent correlates of OH and OD, respectively, in that age range. For subjects aged ≥40 years, age (p=0.003), pre-hypertension (p=0.024), hypertension (p=0.008), and diabetes mellitus (p=0.036) were independently related to OH. Age (p<0.001) and supine systolic blood pressure (p=0.023) were the correlates of OHT. Female gender (p<0.001) and sedatives/hypnotics (p=0.040) were associated with OD. In conclusion, age, pre-hypertension, hypertension, and diabetes mellitus were important determinants of OH. OD was more prevalent in women and in subjects using sedatives/hypnotics. The risk of OHT increased with age and with supine systolic blood pressure in adults aged ≥40 years. OH and OHT cannot be determined solely from the presence of OD because of their dissociation. (*Hypertens Res* 2008; 31: 897–904)

***Key Words*: population-based study, orthostatic hypotension, orthostatic hypertension, orthostatic dizziness**

Introduction

When a normotensive person stands up from a lying position, blood pressure (BP) is maintained by reflex vasoconstriction and an increase in heart rate and myocardial contractility (*1*). Any abnormality in BP homeostasis may result in orthostatic hypotension (OH) (*2*). Clinically, OH has been considered a potentially dangerous hypotensive response (*2*). OH is believed to be associated with age-related physiologic changes, medications, and pathological changes, such as diabetes mellitus, hypertension, and cardiovascular disease (*2*, *3*). Because advancing age is often accompanied by an accumulation of diseases and medications that may be associated

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with OH, the relative contributions of age, diseases, and medication are hard to separate (*2*, *4*).

Although OH is defined as a reduction in systolic or diastolic BP when the subject stands up from a supine position (*2*, *5*, *6*), some studies have also included symptoms of OH (*7*). Some people with minor falls in systemic BP developed dizziness or faintness on standing, whereas others with greater falls in BP have remained asymptomatic (*8*). Clinically, orthostatic dizziness (OD) is often perceived as being strongly associated with OH, but the evidence is conflicting (*4*, *6*, *7*). The prevalence of OH varied extremely, from 5 to 30%, depending on the selection of study subjects and diagnostic criteria (*2*, *4–6*, *9–16*). Most studies were confined to the elderly, except for two reports in which subjects were at least 40 and 55 years old, respectively (*4*, *16*). The prevalence of OD was found to range from 2 to 19% in the elderly population (*5–7*), but figures for a younger population are not available.

Orthostatic hypertension (OHT), indicated by an increase in BP with orthostatic change, has been associated with a greater risk for cardiovascular disease (*17*). Its definition remains inconclusive, and its clinical significance needs to be elucidated by more studies. Furthermore, the normal BP cutoffs have been revised to less than 120/80 mmHg (*18*), and the effects of pre-hypertension with BP of 120–139/80–89 mmHg on OH, OD, and even OHT are unclear. Because there is a lack of epidemiological studies on OH, OD, and OHT in adults across all age groups, the aim of this study is to examine the prevalences and correlates of OH, OD, and OHT in community dwellers aged ≥20 years from population-based data in Taiwan.

Methods

Population

The subjects were recruited for a population-based study for chronic diseases conducted in Tainan, which is the oldest city in southern Taiwan and has a population of 700,000. A 3-stage sampling scheme was used to generate a stratified systemic cluster sample of households throughout the city. There were 2,416 eligible subjects under systematic sampling from 7 administrative districts. A total of 1,638 subjects aged 20 years old or more, representing a response rate of 67.8%, were included. Details of the study's sampling methods have been described elsewhere (*19*). Written consent was obtained from all participants, and the research committee of National Cheng Kung University Hospital, Taiwan, approved this study.

Clinical Examination and Blood Pressure Measurement

The participants were instructed not to consume alcohol, coffee, tea, or cigarettes on the day of the examination. Demographic characteristics, dietary habits, cigarette smoking, alcohol drinking, physical activity, medical history, and use of medications were assessed. All the subjects received a complete physical examination and measurement of seated BP, body weight, and height. The laboratory tests included blood biochemistry, urine examination, and ECG after an overnight fast of at least 10 h. Subjects without a history of diabetes mellitus received a 75 g oral glucose tolerance test after measurement of BP in the seated, supine, and standing positions. A blood sample was obtained 2 h after the subject drank a glucose solution.

BP and heart rate were measured with a DINAMAP vital sign monitor (Model 1846SX; Critikon, Irvine, USA). Measurements were obtained in a fasting state. An appropriately sized cuff was wrapped around the right upper arm in a quiet room between 08:00 and 10:00 AM. Two readings of seated BP and heart rate were separated by at least 5-min intervals after the subject had rested for at least 15 min. Then, the subject lay down and rested in a supine position for at least 15 min. After supine BP and heart rate were each measured twice, the subject was asked to stand from the supine position with the entire forearm relaxed and supported at heart level (fourth intercostal space) on an adjustable table. BP and heart rate were measured twice again, after 1 and 3 min of standing. The subjects were asked about any feelings of dizziness, lightheadedness, or faintness as the person stood up and a positive or negative response was recorded to determine OD.

Definition of Clinical Measurements

OH was defined as a decline in systolic BP of at least 20 mmHg and/or a decline in diastolic BP of at least 10 mmHg after either 1 or 3 min of standing after the subject stood from a supine (*20*). The definition of OHT was a postural increase of at least 20 mmHg in systolic BP, which was calculated from the average of two BP readings of standing minus the average of two supine BP readings (*17*). OD was defined as dizziness, lightheadedness, or faintness as the person stood up with any change in systolic or diastolic BP (*7*). According to the JNC 7 report, the average of two seated readings of BP was classified as normotension (BP < 120/80 mmHg without a history of hypertension), pre-hypertension (BP of 120–139/80–89 mmHg without a history of hypertension), or hypertension (BP ≥ 140/90 mmHg or a history of hypertension) (*18*). Diabetes mellitus was diagnosed as fasting glucose ≥7.0 mmol/L, 2-h postload glucose ≥11.1 mmol/L, or a history of diabetes mellitus (*21*). Cerebrovascular disease was identified a previously documented stroke, the presence of hemiparesis, asymmetric hyperreflexia, or a positive Babinski reflex on physical examination. ECG with left bundle branch block or ischemic patterns included Q-QS abnormalities, ST segment depression, T wave changes, and left bundle branch block according to the Minnesota code (1.1–3; 4.1–3; 5.1–3; and 7.1) (*22*). Total physical activity, including work, walking, and leisure time, was assessed in metabolic equivalent hours

Table 1. Age-Specific Prevalence of Orthostatic Hypotension (OH), Orthostatic Hypertension (OHT), and Orthostatic Dizziness (OD)

Age, years	Number of subjects	OH, *n* (%)	OHT, *n* (%)	OD, *n* (%)
20–29	342	26 (7.6)	0 (0.0)	15 (4.4)
30–39	358	35 (9.8)	0 (0.0)	12 (3.4)
40–49	397	67 (16.9)	2 (0.5)	21 (5.3)
50–59	243	49 (20.2)	5 (2.1)	12 (4.9)
60–69	194	50 (25.8)	5 (2.6)	12 (6.2)
≥70	104	33 (31.7)	6 (5.8)	6 (5.8)
Total	1,638	260 (15.9)*	18 (1.1)*	78 (4.8)

A test for trends among different age groups, *$p<0.001$.

per week for the past year (*23*).

Statistical Analysis

Data analyses were performed using the Statistical Package for the Social Sciences version 10.0 (SPSS, Chicago, USA) for Windows. Age-stratified analyses were performed in subjects aged <40 years and ≥40 years. In univariate analysis, comparisons of categorical variables between groups were analyzed using the χ^2 test or Fisher's exact test for cells less than 5. A test for trends was used to compare the prevalence of OH, OD, and OHT among different age groups. Comparisons of continuous variables between the two groups were carried out using Student's *t*- or the Mann-Whitney test. ANOVA and the Bonferroni post hoc test were used to compare continuous variables among subjects with different statuses of orthostatic BP change, classified as orthostatic normotension (ON), OH, and OHT. The Kruskal-Wallis test was used to compare plasma triglyceride and physical activity levels among groups.

Multivariate binary or multinomial logistic regression was used to assess the contributions of different clinical variables to orthostatic BP change and OD. The outcome variables were orthostatic BP change and OD. The predictor variables included age, gender, body mass index, pre-hypertension, hypertension, diabetes mellitus, physical activity level, current smoking, alcohol, antihypertensive agents, and sedative/hypnotic use. Multinomial logistic regression was also used to examine the effect of supine BP as a continuous variable on the status of orthostatic BP change. *p* values of 0.05 or less were considered significant.

Results

Table 1 shows that the age-specific prevalences of OH, OHT, and OD were 15.9%, 1.1%, and 4.8%, respectively. The prevalence of OH increased with age (test for trend, $p<0.001$), but there was no significant difference in the prevalence of OD among the different age groups ($p=0.483$). OHT was absent in subjects aged <40 years, although the prevalence of OHT increased with age (test for trend, $p<0.001$).

For the association between OH and OD in subjects aged <40 years, the prevalence of OD was not apparently different between those with OH and those without it (4.1 *vs*. 3.8%, $p=0.713$). For subjects aged ≥40 years, there was no significant difference in the prevalence of OD between those with different BP changes (ON:OH:OHT, 5.3:6.0:5.6%, $p=0.916$).

Table 2 presents the clinical characteristics of subjects classified by orthostatic BP change and OD, respectively. Age-stratified analyses were performed in two age groups: <40 years and ≥40 years. For subjects aged <40 years, those with OH had higher diastolic BP ($p=0.014$) but had lower systolic ($p=0.002$) and diastolic BP ($p<0.001$) during standing than did subjects without OH. Subjects aged <40 years with OD were younger ($p=0.028$) and more likely to be female ($p<0.001$) but were lower in body mass index ($p=0.01$), physical activity level ($p=0.029$), supine systolic ($p<0.001$) and diastolic BP ($p=0.008$), and standing systolic ($p<0.001$) and diastolic BP ($p=0.007$) compared to subjects aged <40 years without OD. For subjects aged ≥40 years with different orthostatic BP changes, there were significant differences in age ($p<0.001$), supine and standing systolic ($p<0.001$) and diastolic BP ($p<0.001$), and the prevalence of diabetes mellitus ($p=0.015$) and antihypertensive use ($p=0.035$) among subjects with ON, OH, and OHT. The OH group was older ($p<0.001$) and had higher supine systolic ($p<0.001$) and diastolic BP ($p<0.001$), but had lower standing systolic ($p=0.021$) and diastolic BP ($p<0.001$) than the ON group. Compared to the ON group, the OHT group was older ($p<0.001$) and had higher standing systolic BP ($p<0.001$). Univariate analysis in subjects aged ≥40 years with and without OD shows that subjects with OD were more likely to be female ($p<0.001$) and have sedative/hypnotic use ($p=0.040$); however, they also had lower supine ($p=0.024$) and standing diastolic BP ($p=0.043$) than did subjects without OD.

Figure 1 shows the prevalences of OH, OHT, and OD in subjects with normotension, pre-hypertension, and hypertension. For subjects aged <40 years, there was a significant difference in the prevalence of OH ($p=0.002$) among those with normotension, pre-hypertension, and hypertension. However, the prevalence of OD was not apparently different among

Table 2. Clinical Characteristics in Subjects Classified by Orthostatic Blood Pressure (BP) Change and Orthostatic Dizziness in Different Age Groups

	Age <40 years				Age ≥40 years				
	Orthostaitc BP change		Orthostatic dizziness		Orthostaitc BP change			Orthostatic dizziness	
	ON (n=639)	OH (n=61)	No (n=673)	Yes (n=27)	ON (n=721)	OH (n=199)	OHT (n=18)	No (n=887)	Yes (n=51)
Age, years	29.5±5.9	28.3±5.9	29.6±5.9	28.3±5.7*	53.3±10.4	57.3±11.1‡	64.8±13.4‡	54.2±10.8	55.3±10.6
Female gender, %	52.8	56.3	52.2	77.8‡	51.7	50.8	53.8	50.2	80.4‡
Body mass index, kg/m^2	22.5±3.5	23.0±3.4	22.8±3.5	21.6±3.0*	24.5±3.3	24.7±3.5	25.5± 5.4	24.6±3.4	24.5±3.7
Physical activity, met-h/week#	66.3±106.9	52.5±48.9	68.4±109.6	47.4±50.1*	55.9±66.7	44.5±46.8	31.2±27.4	54.4±66.0	46.3±39.8
Supine SBP, mmHg	109.8±12.6	112.2±11.4	110.6±14.4	105.5±9.3‡	122.9±21.4	135.5±24.4‡	126.1±20.1	125.7±22.5	125.0±23.1
Supine DBP, mmHg	67.1±8.2	69.6±8.1*	67.6±9.2	65.3±7.4†	74.2±10.9	78.5±10.6‡	72.9±8.7	75.4±10.9	73.2±10.9*
Standing SBP, mmHg	103.7±14.5	98.5±12.0†	104.1±14.9	98.4±10.3‡	118.1±23.3	113.5±24.1*	149.9±22.2‡	118.2±23.7	116.4±25.4
Standing DBP, mmHg	66.1±10.1	59.1±8.5‡	65.7±10.5	63.0±8.5†	73.4±11.8	69.4±12.0‡	74.8±11.6	72.9±11.9	70.8±12.0*
Cholesterol, mmol/L	4.7±1.0	4.8±0.9	4.7±1.0	4.6±0.9	5.3±1.1	5.2±1.1	5.0±1.2	5.2±1.1	5.2±1.0
Triglyceride, mmol/L#	1.2±1.1	1.3±0.7	1.3±1.2	1.1±0.6	1.6±1.7	1.6±1.0	1.5±1.1	1.3±0.4	1.4±0.8
HDL-cholesterol, mmol/L	1.3±0.3	1.3±0.4	1.3±0.3	1.4±0.4	1.3±0.4	1.3±0.4	1.3±0.5	1.3±0.4	1.4±0.4
Cerebrovascular disease, %	0.5	1.6	0.4	3.7	3.6	4.0	0	3.6	3.9
LBBB/ischemic ECG pattern, %	7.7	8.2	3.6	7.4	16.2	18.6	27.8	16.9	17.6
Diabetes mellitus, %	1.9	1.6	1.6	3.7	14.1	19.8	27.8§	15.6	13.7
Antihypertensive use, %	0.3	1.6	0.4	0.0	12.1	19.1	16.7§	13.6	13.7
Sedative/hyponotics use, %	0.3	0	0.3	0	1.8	1.5	0	1.5	5.9*
Antidepressant use, %	0.3	0	0.3	0	0.7	0.5	0	0.6	2.0
Current smoking, %	20.4	20.0	20.5	14.8	21.5	22.1	11.1	21.7	15.7
Current alcohol use, %	12.1	11.3	12.2	7.4	13.6	14.6	5.6	13.9	9.8

ON, orthostatic normotension; OH, orthostatic hypotension; OHT, orthostatic hypertension; SBP/DBP, average of two supine (standing) systolic/diastolic BPs; HDL, high-density lipoprotein; LBBB, left bundle branch block. *p<0.05, †p<0.01, ‡p<0.001 when compared to subjects with ON or absence of orthostatic dizziness; §p<0.05, χ^2 test for the relationship between clinical variables and orthostatic BP change. #Mann-Whitney test or Kruskal-Wallis test.

these three groups in subjects aged <40 years (p=0.257). For subjects aged ≥40 years, a significant difference in the prevalence of OH (p<0.001) existed among subjects with normotension, pre-hypertension, and hypertension, but the prevalences of OHT and OD were not significantly different among these three groups (OD, p=0.326; OHT, p=0.719).

Table 3 shows multiple logistic regression analysis of the contributions of different clinical variables to orthostatic BP change and OD. In subjects aged <40 years, only hypertension (p=0.030) was independently associated with OH. The independent correlate of OD was female gender (p<0.001). In subjects aged ≥40 years, age (p=0.003), pre-hypertension

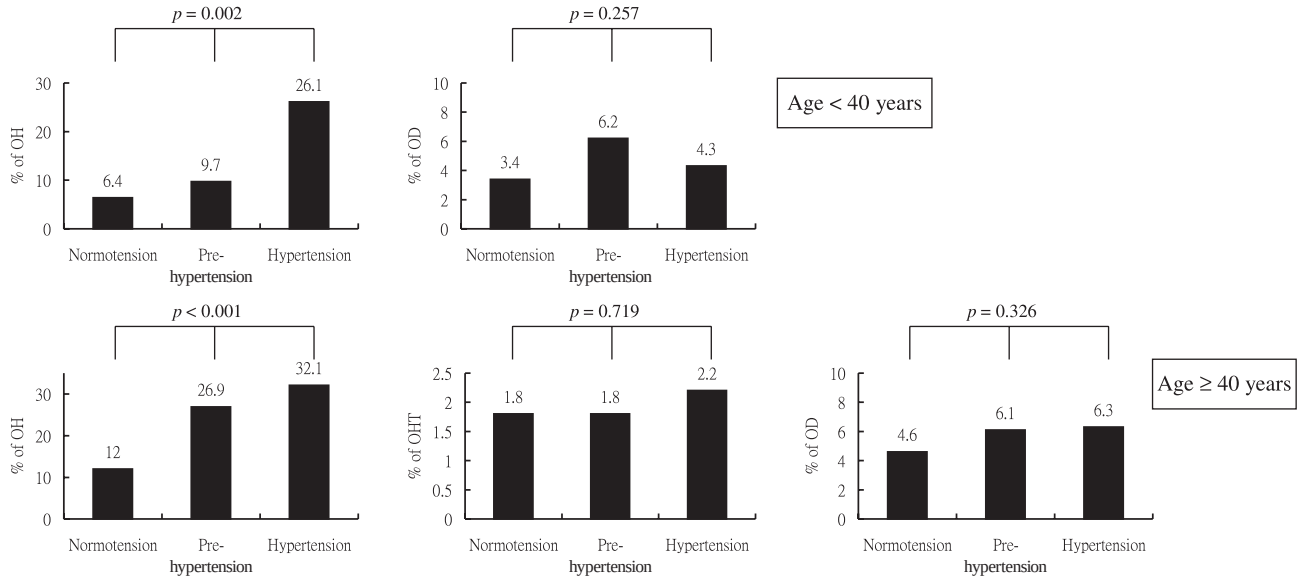

Fig. 1. *Prevalences of orthostatic hypotension (OH), orthostatic hypertension (OHT), and orthostatic dizziness (OD) in subjects with normotension, pre-hypertension, and hypertension. Upper panel, age < 40 years; lower panel, age ≥40 years.*

Table 3. Multiple Logistic Regression Analysis in the Contribution to Orthostatic Blood Pressure (BP) Change and Orthostatic Dizziness (OD) from Clinical Variables in Different Age Groups

Variables	Age <40 years (n=700)				Age ≥40 years (n=938)					
	Orthostaitc BP change		OD		Orthostaitc BP change				OD	
	OH				OH		OHT			
	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)
Age, years	0.96	(0.91–1.00)	0.97	(0.93–1.01)	1.08	(1.03–1.14)†	1.10	(1.05–1.15)‡	1.02	(1.00–1.04)
Female *vs*. male	1.39	(0.68–2.84)	5.05	(2.83–9.03)‡	1.39	(0.85–2.28)	0.81	(0.26–2.55)	4.73	(2.53–8.83)‡
Pre-hypertension *vs*. normotension	1.74	(0.81–3.73)	0.68	(0.26–1.77)	2.86	(1.46–5.63)*	1.67	(0.49–5.68)	0.72	(0.41–1.27)
Hypertension *vs*. normotension	2.20	(1.10–4.42)*	0.62	(0.17–4.21)	4.38	(2.14–10.08)†	2.86	(0.59–13.88)	1.05	(0.55–2.03)
Diabetes mellitus	1.51	(0.52–3.68)	1.01	(0.41–5.18)	1.85	(1.10–3.52)*	1.25	(0.33–3.90)	0.70	(0.36–1.38)
Sedative/hypnotic use	0.00	0.00	1.46	(0.19–5.69)	1.11	(0.40–5.82)	1.29	(0.15–6.28)	2.25	(1.12–4.56)*

OH, orthostatic hypotension; OHT, orthostatic hypertension; OR, odds ratio; CI, confidence interval. Dependent variables: orthostatic BP change (including OH *vs*. orthostatic normotension and OHT *vs*. orthostatic normotension) and OD, respectively. OHT was absent in subjects aged <40 years. Independent variables: age, gender, body mass index, pre-hypertension, hypertension, diabetes mellitus, physical activity level, current smoking, alcohol, antihypertensive, and sedative/hypnotic use. *p<0.05, †p<0.01, ‡p<0.001.

(p=0.024), hypertension (p=0.008), and diabetes mellitus (p=0.036) were independently related to OH. In contrast, age (p<0.001) was the independently associated factor in OHT. The independent correlates of OD were female gender (p<0.001) and sedative/hypnotic use (p=0.040) in subjects aged ≥40 years, after adjusting for other factors.

We also evaluated the effect of supine BP on orthostatic BP change, including OH and OHT, by multiple logistic regression analysis (data not shown). For subjects aged ≥40 years, supine systolic BP was independently related to OH (p=0.003, odds ratio [OR]: 1.03, 95% confidence interval [CI]: 1.01–1.04) and OHT (p=0.023, OR: 1.04, 95% CI: 1.01–1.08). In addition, diastolic BP was also the independent correlate of OH (p=0.042, OR: 1.04, 95% CI: 1.00–1.06), but not of OHT (p=0.404). For subjects aged <40 years, supine diastolic BP (p=0.020, OR: 1.03, 95% CI: 1.01–1.06), but not systolic BP (p=0.087), was independently associated with OH.

Discussion

Our results showed the prevalence and correlates of OH and OD in community dwellers aged 20–84 years. Although studies on the prevalence of OH in community dwellers aged <40

years was lacking, a lower prevalence of OH was anticipated in younger adults. The prevalence of OH in our subjects aged <40 years was 8.7% with the criterion of a decline in BP of 20/10 mmHg from supine to standing BP. In Korean adults aged 40–69 years, the prevalence of OH at 0 min after standing was 12.3% (*16*). In contrast 19.9% of our subjects aged 40–69 had OH after either 1 or 3 min of standing. In other studies, the prevalences of OH at 1 min after standing were 16.2% and 30.0% in subjects aged ≥65 and ≥70 years, respectively (*4*, *11*). The Korean study found a prevalence of 23.1% in adults aged 65–69 years (*16*). Our results showed that the prevalences of OH were 26.5% and 31.7% in subjects aged ≥65 and ≥70 years, respectively. The variation in the prevalence of OH may be due to ethnicity, subject selection, and measurement bias (*3*).

Studies have shown that hypertension is a risk factor for OH (*4*, *8*, *16*, *24*), and our study demonstrated similar results. Our results also revealed that pre-hypertension with BP of 120–139/80–89 mmHg was independently associated with OH in subjects ≥40 years. The mechanism is related to impaired baroreflex sensitivity due to a decrease in vascular compliance and consequent diminution of baroreceptor stretch and relaxation during BP change (*24*). As BP increased, baroreflex sensitivity declined; this may be responsible, in part, for OH (*3*). Tilvis *et al*. demonstrated that supine systolic BP was associated with OH (*5*). Recently, basal systolic BP has been suggested as an important determinant of prone hypotension (*25*). We found that the higher the supine BP, the higher the prevalence of OH in subjects ≥40 years. This provides epidemiological evidence that subjects ≥40 years suffer a higher risk of OH and that the risk of OH increases with supine BP. However, the effect of supine systolic BP on OH was not apparent in subjects <40 years.

The explanation for the insignificant association between antihypertensive medication use and OH in a cross-sectional study was an adjustment of the treatment regimen due to a side effect or related symptom, resulting in the underestimation of their relationship (*15*). Furthermore, the incidence of OH decreased significantly followed by decreasing or normalizing BP after use of antihypertensive agents (*26*). This may also be one of the explanations for the insignificant association between OH and antihypertensive medication use.

OH is a clinical manifestation of diabetic autonomic neuropathy (*27*). Diabetes mellitus was an independently associated factor of OH in our study, which is consistent with the literature (*27*, *28*). Regarding the mechanism of OH in diabetes mellitus, a neurogenic cause is usually associated with efferent involvement of the baroregulatory reflex arc with damaged sympathetic vasoconstrictor fibers in the splanchnic bed, muscle, and skin (*28*). In our study, diabetes mellitus, pre-hypertension, and hypertension were the independently associated factors for OH. Thus, diabetic subjects with hypertension, or even pre-hypertension, have a much higher risk of OH.

Two studies (*6*, *9*) on the elderly demonstrated that the prevalence of OH increased with age. One study on subjects aged 40–69 years (*16*) showed a similar finding. Our results revealed that the prevalence of OH significantly increased with age in subjects ≥40 years but not in subjects <40 years, after adjusting for other clinical variables. The following age-related physiologic changes are expected to favor the development of OH: declines in baroreflex sensitivity and in arterial and cardiac compliance, increased venous tortuosity, and decreased renal sodium conservation, plasma volume, renin, angiotensin, and aldosterone levels. Conversely, age-related changes such as increased plasma norepinephrine, diminished β-adrenergic responsiveness, and unaltered α-adrenergic sensitivity offer protection from OH (*3*). Age-related OH has been suggested to be predominantly associated with dysfunction in the afferent pathway of the baroreflex arc (*29*), although the precise mechanism of aged-related OH remains unknown.

One study showed that 8.7% of community-dwelling elderly exhibited OHT (*30*), but data for the non-elderly population is not available. Our data adopted the same criterion as the previous study and revealed that the prevalence of OHT was 1.1% in study subjects aged 20–84 years and 4.6% in elderly subjects. Although the mechanism of OHT is not well understood, it maybe involve excessive orthostatic venous pooling, which leads to decreased cardiac output, augmented sympathetic stimulation, and finally excessive arteriolar constriction (*31*). Further study is needed to determine whether or not the discrepancy in the prevalence of OHT is related to the difference in autonomic function due to ethnic effect.

Although OHT may be associated with cerebrovascular disease, hypertension, and diabetes mellitus (*17*, *30*, *32*), our results showed that age and supine systolic BP were the independent correlates of OHT. The lower prevalence of OHT in our study may result in an insignificant association between OHT and the above chronic diseases due to a lower statistical power (*33*). Although a general decrease in sympathetic outflow and declining vagal modulation of heart rate (*34*) with advancing age may partially explain age-related OHT, the exact mechanism needs to be clarified.

Clinically, OD is often thought to be associated with OH. Most population-based studies of the elderly showed a dissociation between OD and OH (*4*, *6*), but only one report found that OD was related to OH (*8*). Our study, with a general population aged ≥20 years, provided further evidence for a dissociation between OD and OH. Reports have suggested that OH, cerebral ischemia, vestibular dysfunction, vision impairment, and disorders in the proprioceptive system may be involved in the mechanism of OD (*8*, *35–37*). OH may be just one of the causes of OD, and they do not share all the same risk conditions (*5*). Therefore, a diagnosis of OH cannot be made just from the presence of OD in clinical practice, because of their dissociation.

The prevalence of OD varied greatly, from 2 to 19%, in elderly population-based studies (*5–7*) and there are no reports covering a younger population. Our study revealed the preva-

lence of OD was 4.8% in adults aged ≥20 years. Our report and another study (*7*) showed that sedative/hypnotic use was a risk factor for OD. Although our results cannot clarify a cause and effect between OD and sedative/hypnotic use, they support the need to review the possible role of sedatives/hypnotics in subjects with OD. A report on the relationship between OD and gender is not available yet, although a study of community-dwelling elderly found that dizziness was more common in females than in males (*37*). Our study provides epidemiological evidence that female subjects have a higher risk of OD than male subjects, but further investigation is required to discover whether women are more sensitive to perceptions of postural change from a supine to an upright position.

In conclusion, the overall prevalences of OH, OHT, and OD in adults ≥20 years were 15.9, 1.1, and 4.8%, respectively. No subjects <40 years had OHT. Hypertension and female gender were the independent correlates of OH and OD, respectively. For subjects ≥40 years, age, pre-hypertension, hypertension, and diabetes mellitus were important determinants of OH. The risk of OH increased as supine systolic/diastolic BP increased. OD was much more prevalent in women and subjects using sedatives/hypnotics. Age and supine systolic BP were independent correlates of OHT in subjects ≥40 years. OH and OHT cannot be determined solely from the presence of OD, because of their dissociation.

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