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Orthostatic hypotension: prevalence and associated risk factors among the ambulatory elderly in an Asian population

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INTRODUCTION The prevalence of orthostatic hypotension (OH) among the elderly population in Singapore, as defined by a decline in blood pressure upon a change in position, is not well-established. Studies associate OH with clinically significant outcomes such as falls. This study aims to determine the prevalence of OH among elderly patients attending a public primary care clinic (polyclinic) for chronic disease management, and examine the relationships between postulated risk factors and OH.

METHODS Patients aged ≥ 65 years attending a typical polyclinic in Geylang were identified and targeted for recruitment at the study site. A questionnaire on symptoms and postulated risk factors was administered, followed by supine and standing blood pressure measurements. Cross-sectional analysis was performed with independent sample *t*-test for continuous data and chi-square test for categorical data. Prevalence rate ratios with 95% confidence interval were calculated for the latter.

RESULTS A total of 364 multiethnic patients participated in the study. The prevalence of OH was 11.0%. Older age, comorbidities such as cardiac failure and kidney disease, being physically inactive at work, fatigue, self-reported dizziness in the past year, and the use of loop diuretics were found to be significantly associated with OH.

CONCLUSION About one in ten elderly patients at a local polyclinic was affected by OH, which was associated with multiple factors. Some of these factors are modifiable and can be addressed to reduce the incidence of OH.

Keywords: elderly, orthostatic hypotension, prevalence, primary care

INTRODUCTION

The 1996 consensus statement by the Consensus Committee of the American Autonomic Society and the American Academy of Neurology[1,2] defines orthostatic hypotension (OH) as a drop in systolic blood pressure ≥ 20 mmHg or diastolic blood pressure ≥ 10 mmHg within three minutes of standing from a supine or seated position.[3-5] OH is a well-established clinical entity[6-8] that is associated with a wide range of morbidities in the literature, such as cardiovascular disease, cognitive decline and an increased risk of falls.[4,5,9-11] Despite this, its current prevalence among the local elderly population attending primary healthcare settings is not well-established. The first set of data collected locally in 1987 suggested a prevalence of 22% in a hospitalised population.[12] Another sub-analysis in a longitudinal study in 1999 showed a prevalence of 16.6% in a community-dwelling Chinese population aged 55 years and above, but did not include patients with comorbidities such as previous stroke and cardiovascular diseases.[5] Overseas population studies provided wide variations in estimates of OH prevalence ranging from 5% to 34%. The variation is attributable to the different demographic characteristics and settings of study populations.[13]

The magnitude of OH and understanding of its associated risk factors has an impact on the design of screening programmes, clinical practice and health service delivery to the geriatric population in the local community. Thus, the primary objective of this study was to determine the prevalence of OH among elderly patients aged ≥ 65 years (an accepted definition of old age in most developed countries)[14] who attended a typical public primary care clinic (i.e. polyclinic) in Singapore. The secondary objective of this study was to assess the associations between OH and various clinical and non-clinical factors. Such information would allow us to identify factors that can increase the risk of OH, so that appropriate measures can be introduced to mitigate associated adverse outcomes in at-risk patients.

METHODS

The study was conducted over two weeks in February 2013. Participants attended SingHealth Polyclinics-Geylang, a typical public primary care clinic located in the mideastern part of Singapore. Elderly patients aged ≥ 65 years constituted about 27% of the clinic's 700–900 daily patient attendance in 2014 (according to unpublished data). Our target group consisted of community-dwelling, multiethnic Asian elderly adults who were ambulatory; aged ≥ 65 years and above; and managed at the study site for their existing chronic medical conditions, such as diabetes mellitus, hypertension and hyperlipidaemia. The exclusion

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criteria included: (a) non-ambulatory, including wheelchair-bound, patients;[15] (b) those who were unable to give verbal and written informed consent, and had no legal representative present; and (c) those who presented with acute conditions during the recruitment period, for whom blood pressure measurements could not be taken.

All eligible patients were provided with information sheets to help them understand the study. Research assistants were present to explain the study protocol and clarify any queries before written informed consent was obtained. The study protocol was approved by the SingHealth Centralised Institutional Review Board (CIRB Ref 2013/014/E).

The highest reported prevalence rate of OH, as identified from our literature review, was used to calculate the target sample size. The upper limit of the range of prevalence rates obtained from our literature review was 34% in a population of home-dwelling elderly ≥ 75 years of age in Finland.[16] Using the above prevalence, at a 95% confidence interval (CI) and margin of error of 5%, we calculated an estimated sample size of 400 (taking into account a buffer of 20%).[17]

A systematic approach was used for patient recruitment. During clinic registration, patients who met the inclusion criteria were 'tagged' with a sticker on their queue slip. Each 'tagged' patient, identified by the sticker, was placed into one of three categories: (a) patients who were ineligible as they met at least one exclusion criteria; (b) those who were eligible and consented ('responders'); and (c) those who were eligible but did not consent ('non-responders'). Responders were taken to designated rooms where the study questionnaire was administered and postural blood pressure measurements were taken, prior to consultation with their respective doctors. The risk of double-counting the number of patients identified as responders and non-responders was minimised via specific labelling of the stickers on their queue slips to indicate that they had previously been approached and their response recorded.

Trained interviewers conducted face-to-face interviews with the responders using a standardised script. Apart from basic demographic information such as age, gender, race, height and weight,[18] the presence of symptoms of interest based on the literature review was also sought. These included lightheadedness or dizziness, syncope, headache, visual disturbances, neck or chest discomfort, palpitations, nausea, and generalised weakness experienced both during the measurement of postural blood pressure as well as over the previous year prior to the study.[19] Selected aspects of the patients' social history were also assessed, including their physical activity at work or during recreation, ambulatory status,[3] history of falls,[8,9] alcohol intake,[18] caffeine intake, and smoking history.

Calibrated DINAMAP® blood pressure (BP) machines (Procare 100; GE Healthcare, Little Chalfont, Buckinghamshire, UK) currently in use in the clinic were used to measure the blood pressure of all participants throughout the study. BP and pulse rates were recorded from the right arm three times after (a) resting supine for five minutes; (b) standing unaided for one minute; and (c) standing unaided for three minutes. If either BP reading during erect posture at one or three minutes showed a reduction of systolic blood pressure ≥ 20 mmHg or diastolic blood pressure ≥ 10 mmHg, the patient would qualify as having postural hypotension. Measures were in place to ensure patients' safety. They were told to inform the investigator immediately upon experiencing any symptoms possibly relating to OH. Patients who were unable to stand during the study for any reason had their BP taken while they sat upright unaided.

Table I. Demographic profiles of the overall study population (n = 364).

Characteristic	No. (%)
Gender	
Male	180 (49.5)
Female	184 (50.5)
Ethnicity	
Chinese	317 (87.1)
Malay	28 (7.7)
Indian	16 (4.4)
Others	3 (0.8)
Age* (yr)	74.6 (64.1–98.0)

*Data presented as mean (range)

Patients' responses were recorded on serially numbered questionnaire forms. The data was then anonymised and analysed using IBM SPSS Statistics version 19.0 (IBM Corp, Armonk, NY, USA). Independent sample *t*-test was used to analyse the association between OH and various factors for continuous data, and chi-square test was used for categorical data. Prevalence rate ratios and their corresponding 95% CIs were calculated for categorical data analysis.

RESULTS

A total of 668 patients were eligible for participation, based on age alone, over the recruitment period of four days. We were able to approach 597 (89.4%) patients in the waiting areas of the study site. 511 patients fulfilled the inclusion criteria; of these, 364 (71.2%) patients consented to and completed the study. Their demographic profiles are shown in Table I.

About one in ten patients in our study (n = 40) were found to have OH, giving a prevalence rate of 11.0% (95% CI 8.2–14.8). Higher proportions of older patients (i.e. aged > 70 years) and patients who were not physically active at work were found to be associated with OH (Table II). OH was also associated with symptoms of fatigue during postural blood pressure measurement and lightheadedness/dizziness experienced in the past year (Table III).

Patients with comorbidities such as congestive cardiac failure, stroke and chronic renal disease (also known as kidney disease) were more likely to experience OH. The list of chronic renal diseases was based on a specified diagnosis list of renal diseases in the electronic health records of the participants, such as renal failure, glomerular nephritis, nonspecific nephritis and nephropathy. For medications, patients who were on loop diuretics were more likely to have OH (Table IV).

Table II. Demographics, social factors and functional status by orthostatic hypotension (OH) status (n = 364).

Characteristic	No. (%)		Prevalence rate ratio (95% CI)
	With OH (n = 40)	Without OH (n = 324)	
Age (yr)			
≤ 70	5 (4.9)	97 (95.1)	1
> 70	35 (13.4)	227 (86.6)	2.73 (1.10–6.67)‡
Gender			
Male	14 (7.8)	166 (92.2)	1
Female	26 (14.1)	158 (85.9)	1.81 (0.98–3.33)
Ethnicity			
Non-Chinese	8 (17.0)	39 (83.0)	1
Chinese	32 (10.1)	285 (89.9)	0.59 (0.29–1.21)
Social factor			
Consumes alcohol*			
No	34 (11.0)	276 (89.0)	1
Yes	5 (9.4)	48 (90.6)	0.86 (0.35–2.10)
Current smoker			
No	37 (11.3)	290 (88.7)	1
Yes	3 (8.1)	34 (91.9)	0.72 (0.23–2.21)
Consumes caffeinated beverages*			
No	6 (14.6)	35 (85.4)	1
Yes	33 (10.2)	289 (89.8)	0.70 (0.31–1.57)
Functional status			
Physically active at work*			
No	37 (12.5)	260 (87.5)	1
Yes	2 (3.0)	64 (97.0)	0.24 (0.06–0.98)‡
Physically active in leisure/recreation*			
No	10 (8.3)	111 (91.7)	1
Yes	29 (12.0)	213 (88.0)	1.46 (0.73–2.87)
Needs to climb stairs in daily life†			
No	30 (12.0)	219 (88.0)	1
Yes	10 (8.8)	104 (91.2)	0.73 (0.37–1.44)
Presence of daily caregiver†			
No	33 (10.6)	279 (89.4)	1
Yes	7 (14.0)	43 (86.0)	1.32 (0.62–2.82)
Needs walking aids at home†			
No	35 (10.4)	303 (89.6)	1
Yes	5 (20.8)	19 (79.2)	2.01 (0.87–4.67)
Needs walking aids in the community†			
No	30 (10.4)	258 (89.6)	1
Yes	10 (13.7)	63 (86.3)	1.32 (0.68–2.57)

*Numbers do not add up to n = 40 due to missing data. †Numbers do not add up to n = 324 due to missing data. ‡Difference is statistically significant (p < 0.05).
CI: confidence interval

DISCUSSION

Singapore faces a rapidly greying population; the number of Singapore citizens and permanent residents aged ≥ 65 years grew by 6.5% to 459,700 in 2015.[20] The 11.0% OH prevalence found in our study compares well with other studies that reported rates of 15.9%–16.6% and 6.1%.[6,21] The Finnish study reported a markedly higher prevalence rate of 34.0%, which could be related to differences in study population and methodology.[16]

The finding that age was a factor in OH is consistent with the results of several studies in the literature.[6,18,22] Notably, our study did not find an association between ethnicity and the presence of OH. The number of participants of non-Chinese origin in this study may have been insufficient to show a significant difference. This factor requires further research using a sampling frame stratified by ethnicity. We also found that individuals who were physically active at work were less likely to be associated with OH compared to those who were inactive. Physical activity at work may promote better physical conditioning and activity outside the home environment, and hence a lower likelihood of having OH. This is consistent with previous reports of homebound status as a risk factor for OH.[16] Fatigue and lightheadedness,

Table III. Self-reported symptoms associated with orthostatic hypotension (OH) (n = 364).

Symptom	No. (%)		Prevalence rate ratio (95% CI)
	With OH (n = 40)	Without OH (n = 324)	
During postural BP measurement			
Lightheadedness/dizziness			
No	37 (11.1)	297 (88.9)	1
Yes	3 (10.0)	27 (90.0)	0.90 (0.30–2.75)
Visual disturbances			
No	40 (11.3)	313 (88.7)	1
Yes	0	11 (100.0)	0.40 (0.03–6.07)
Neck discomfort			
No	38 (10.8)	313 (89.2)	1
Yes	2 (15.4)	11 (84.6)	1.42 (0.38–5.26)
Chest discomfort			
No	40 (11.0)	322 (89.0)	1
Yes	0	2 (100.0)	4.51 (0.62 –32.68)
Palpitations			
No	39 (10.9)	319 (89.1)	1
Yes	1 (16.7)	5 (83.3)	1.53 (0.25–9.35)
Fatigue			
No	36 (10.3)	313 (89.7)	1
Yes	4 (26.7)	11 (73.3)	2.58 (1.06–6.33)*
Syncope			
No	40 (11.0)	324 (89.0)	1
Yes	0	0	4.51 (0.62-32.68)
Generalised weakness			
No	37 (10.5)	314 (89.5)	1
Yes	3 (23.1)	10 (76.9)	2.19 (0.78–6.17)
Nausea			
No	40 (11.0)	322 (89.0)	1
Yes	0	2 (100.0)	4.51 (0.62–32.68)
In past 1 yr			
Lightheadedness/dizziness			
No	20 (7.8)	236 (92.2)	1
Yes	20 (18.5)	88 (81.5)	2.37 (1.33–4.22)*
Visual disturbances			
No	35 (11.5)	269 (88.5)	1
Yes	5 (8.3)	55 (91.7)	0.72 (0.30–1.77)
Neck discomfort			
No	30 (10.6)	254 (89.4)	1
Yes	10 (12.5)	70 (87.5)	1.18 (0.60–2.31)
Chest discomfort			
No	36 (11.2)	286 (88.8)	1
Yes	4 (9.5)	38 (90.5)	0.85 (0.32–2.27)
Palpitations			
No	35 (10.9)	287 (89.1)	1
Yes	5 (11.9)	37 (88.1)	1.10 (0.45–2.64)
Fatigue			
No	28 (10.4)	240 (89.6)	1
Yes	12 (12.5)	84 (87.5)	1.20 (0.63–2.26)
Syncope			
No	38 (10.7)	317 (89.3)	1
Yes	2 (22.2)	7 (77.8)	2.07 (0.59–7.30)

(*Contd...*)

Symptom	No. (%)		Prevalence rate ratio (95% CI)
	With OH (n = 40)	Without OH (n = 324)	
Generalised weakness			
No	33 (10.3)	287 (89.7)	1
Yes	7 (15.9)	37 (84.1)	1.54 (0.61–4.05)
Nausea			
No	36 (10.6)	304 (89.4)	1
Yes	4 (16.7)	20 (83.3)	1.57 (0.61–4.05)
Fall(s)			
No	30 (9.9)	272 (90.1)	1
Yes	10 (16.1)	52 (83.9)	1.62 (0.84–3.14)

*Difference is statistically significant (p < 0.05). BP: blood pressure; CI: confidence interval

Table IV. Medical conditions and medications associated with orthostatic hypotension (OH) (n = 364).

Parameter	No. (%)		Prevalence rate ratio (95% CI)
	With OH (n = 40)	Without OH (n = 324)	
Past medical history			
Ischaemic heart disease			
No	33 (10.3)	287 (89.7)	1
Yes	7 (15.9)	37 (84.1)	1.54 (0.73–3.27)
Cardiac arrhythmia			
No	40 (11.3)	315 (88.7)	1
Yes	0	9 (100.0)	0.40 (0.03–6.07)
Congestive cardiac failure			
No	37 (10.5)	317 (89.5)	1
Yes	3 (30.0)	7 (70.0)	2.87 (1.06–7.75)*
Hypertension			
No	5 (11.1)	40 (88.9)	1
Yes	35 (11.0)	284 (89.0)	0.99 (0.41–2.39)
Diabetes mellitus			
No	23 (9.6)	217 (90.4)	1
Yes	17 (13.7)	107 (86.3)	1.43 (0.79–2.58)
Dyslipidaemia			
No	3 (4.9)	58 (95.1)	1
Yes	37 (12.2)	266 (87.8)	2.48 (0.79–7.81)
Stroke			
No	33 (9.7)	306 (90.3)	1
Yes	7 (28.0)	18 (72.0)	2.87 (1.42–5.85)*
Kidney disease			
No	32 (9.8)	293 (90.2)	1
Yes	8 (20.5)	31 (79.5)	2.08 (1.03–4.20)*
Arthritis			
No	40 (11.3)	314 (88.7)	1
Yes	0	10 (100.0)	0.40 (0.03–6.07)
Fall(s) with hospitalisation			
No	39 (10.9)	318 (89.1)	1
Yes	1 (14.3)	6 (85.7)	1.31 (0.21–8.20)
Osteoporosis			
No	40 (11.0)	322 (89.0)	1
Yes	0	2 (100.0)	4.51 (0.62–32.68)
Medication history			
Loop diuretic (e.g. frusemide)			
No	37 (10.4)	318 (89.6)	1
Yes	3 (33.3)	6 (66.7)	3.19 (1.21-8.47)*

(*Contd...*)

Parameter	No. (%)		Prevalence rate ratio (95% CI)
	With OH (n = 40)	Without OH (n = 324)	
Thiazide diuretic (e.g. hydrochlorothiazide)			
No	31 (10.0)	279 (90.0)	1
Yes	9 (16.7)	45 (83.3)	1.67 (0.84–3.30)
ACE inhibitor			
No	29 (11.0)	234 (89)	1
Yes	11 (10.9)	90 (89.1)	0.99 (0.51–1.9)
Angiotensin II receptor blocker			
No	33 (11.1)	263 (88.9)	1
Yes	7 (10.3)	61 (89.7)	0.92 (0.43–2.00)
Beta-blocker			
No	20 (9.7)	186 (90.3)	1
Yes	20 (12.7)	138 (87.3)	1.30 (0.73–2.34)
Calcium channel blocker			
No	19 (11.9)	140 (88.1)	1
Yes	21 (10.2)	184 (89.8)	0.86 (0.48–1.54)
Alpha-blocker			
No	38 (11.0)	309 (89.0)	1
Yes	2 (11.8)	15 (88.2)	1.07 (0.28–4.08)
Insulin			
No	39 (11.1)	313 (88.9)	1
Yes	1 (8.3)	11 (91.7)	0.75 (0.11–5.03)
Metformin			
No	28 (9.9)	254 (90.1)	1
Yes	12 (14.6)	70 (85.4)	1.47 (0.78–2.77)
Other oral hypoglycaemic agents			
No	31 (10.3)	269 (89.7)	1
Yes	9 (14.1)	55 (85.9)	1.36 (0.68–2.72)
Sedative			
No	37 (10.6)	313 (89.4)	1
Yes	3 (21.4)	11 (78.6)	2.03 (0.71–5.78)
Statin			
No	13 (9.8)	120 (90.2)	1
Yes	27 (11.7)	204 (88.3)	1.20 (0.64–2.24)
Aspirin			
No	29 (9.7)	271 (90.3)	1
Yes	11 (17.2)	53 (82.8)	1.78 (0.94–3.37)
Any antiplatelets (including aspirin)			
No	27 (9.5)	258 (90.5)	1
Yes	13 (16.5)	66 (83.5)	1.74 (0.94–3.21)
Nitrates			
No	37 (10.8)	305 (89.2)	1
Yes	3 (13.6)	19 (86.4)	1.26 (0.42–3.77)

*Difference is statistically significant ($p < 0.05$). ACE: angiotensin-converting enzyme; CI: confidence interval

two other factors we studied, are symptoms which can be attributed to dysregulation in the cardiovascular response; they are often secondary to impairment in the baroreflex, leading to a transient drop in cerebral blood flow when standing.[23] However, we recognise that they are nonspecific symptoms with multifactorial causes, such as those related to patient medication, vestibular dysfunction, visual disturbances and disorders of the proprioception.[24,25]

Medical conditions that affect circulation, such as congestive cardiac failure, stroke and kidney disease, were found to be associated with OH in our study, as several other studies have reported.[21,26,27] Our resultsare compatible with Eigenbrodt et al's

findings, which showed a similar association between OH and raised supine systolic and diastolic BP at baseline.[26] Medications are important modifiable factors associated with OH.[28] In the present study, the use of loop diuretics was linked to the presence of OH. Loop diuretics inhibit sodium and water reabsorption by the renal tubules, which in turn reduce left ventricular filling pressure, thereby reducing stroke volume and cardiac output via the Frank-Starling mechanism.[28] Loop diuretics are also thought to cause dose-dependent vasodilatation by stimulating prostaglandin production in the renal and peripheral vasculature.[29]

This study highlighted several key determinants of OH to raise awareness of OH risk factors in the elderly among clinicians. OH will be a growing challenge given the rapidly ageing population in Singapore, leading to greater risks of falls and fractures, repeated or prolonged hospitalisations and increased care burden to the families. However, risk factors relating to medications such as loop diuretics are potentially modifiable. Clinicians should consider substituting such medications with alternatives if it is feasible for the respective patients. In line with efforts by the local health authority to promote active ageing, primary healthcare professionals should consistently encourage the elderly to take part in physical activity that is compatible with their fitness level, interests and environment. Policies that extend the retirement age should also favour engaging senior patients in the workforce, encouraging them to be more physically active to mitigate the adverse effects of OH.

This study had its limitations. Firstly, its short recruitment period may have affected the representativeness of the target population; hence, care needs to be exercised in generalising the prevalence rate to the local elderly population. Next, the sample size was small and calculated using prevalence data from a foreign study. The power of the study was likely inadequate to examine the relationships among all the postulated risk factors (such as ethnicity) and OH. Thus, we did not perform regression analysis of the statistically significant factors. It is likely that the factors that occurred more frequently in patients with OH were only associations and not necessarily causative; moreover, some of the associated factors were possibly a consequence of OH, such as the use of walking aids and being inactive. Considering these limitations, the observations on risk factor associations should be interpreted with caution. However, this study can provide pilot data to design a future study that has adequate power to assess specific risk factors and develop interventions that target modifiable risk factors.

In conclusion, 11.0% of the elderly patients at a local polyclinic were affected by OH. Comorbidity, and demographic, clinical and pharmacotherapeutic factors were associated with OH. Some of these factors are modifiable and should be addressed by physicians managing these elderly patients.

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REFERENCES

1. Romero-Ortuno R, Cogan L, O'Shea D, Lawlor BA, Kenny RA. Orthostatic haemodynamics may be impaired in frailty. Age Ageing 2011; 40:576-83.
2. Consensus statement on the definition of orthostatic hypotension, pure autonomic failure, and multiple system atrophy. The Consensus Committee of the American Autonomic Society and the American Academy of Neurology. Neurology 1996; 46:1470.
3. Benvenuto LJ, Krakoff LR. Morbidity and mortality of orthostatic hypotension: implications for management of cardiovascular disease. Am J Hypertens 2011; 24:135-44.
4. Mehrabian S, Duron E, Labouree F, et al. Relationship between orthostatic hypotension and cognitive impairment in the elderly. J Neurol Sci 2010; 299:45-8.
5. Yap PL, Niti M, Yap KB, Ng TP. Orthostatic hypotension, hypotension and cognitive status: early comorbid markers of primary dementia? Dement Geriatr Cogn Disord 2008; 26:239-46.
6. Rutan GH, Hermanson B, Bild DE, et al. Orthostatic hypotension in older adults. The Cardiovascular Health Study. CHS Collaborative Research Group. Hypertension 1992; 19:508-19.
7. Tilvis RS, Hakala SM, Valvanne J, Erkinjuntti T. Postural hypotension and dizziness in a general aged population: a four-year follow-up of the Helsinki Aging Study. J Am Geriatr Soc 1996; 44:809-14.
8. Lagro J, Laurenssen NC, Schalk BW, et al. Diastolic blood pressure drop after standing as a clinical sign for increased mortality in older falls clinic patients. J Hypertens 2012; 30:1195-202.
9. van Nieuwenhuizen RC, van Dijk N, van Breda FG, et al; CAREFALL study group. Assessing the prevalence of modifiable risk factors in older patients visiting an ED due to a fall using the CAREFALL Triage Instrument. Am J Emerg Med 2010; 28:994-1001.
10. Protogerou AD, Stergiou GS, Lourida P, Achimastos A. Arterial stiffness and orthostatic blood pressure changes in untreated and treated hypertensive subjects. J Am Soc Hypertens 2008; 2:372-7.
11. Wu JS, Yang YC, Lu FH, Wu CH, Chang CJ. Population-based study on the prevalence and correlates of orthostatic hypotension/hypertension and orthostatic dizziness. Hypertens Res 2008; 31:897-904.
12. Siow BL. Postural hypotension in the elderly. Singapore Med J 1987; 28:338-41.
13. Low PA. Prevalence of orthostatic hypotension. Clin Auton Res 2008; 18 Suppl 1:8-13.
14. World Health Organization. Definition of an older or elderly person. Available at: http://www.who.int/healthinfo/survey/ageingdefnolder/en/index.html. Accessed March 14, 2013.
15. Baliga R, Prabhu G. Orthostatic hypotension in healthy elderly: Is it a myth? N Am J Med Sci 2010; 2:416-8.
16. Hiitola P, Enlund H, Kettunen R, Sulkava R, Hartikainen S. Postural changes in blood pressure and the prevalence of orthostatic hypotension among home-dwelling elderly aged 75 years or older. J Hum Hypertens 2009; 23:33-9.
17. International Fund for Agricultural Development. Calculating the Sample Size. Available at: http://www.ifad.org/gender/tools/hfs/anthropometry/ant_3.htm. Accessed March 14, 2013.
18. Kamaruzzaman S, Watt H, Carson C, Ebrahim S. The association between orthostatic hypotension and medication use in the British Women's Heart and Health Study. Age Ageing 2010; 39:51-6.
19. Poda R, Guaraldi P, Solieri L, et al. Standing worsens cognitive functions in patients with neurogenic orthostatic hypotension. Neurol Sci 2012; 33:469-73.
20. Department of Statistics Singapore. Latest data. Available at: http://www.singstat.gov.sg/statistics/latest-data#15. Accessed July 19, 2016.
21. Fedorowski A, Engström G, Hedblad B, Melander O. Orthostatic hypotension predicts incidence of heart failure: the Malmö preventive project. Am J Hypertens 2010; 23:1209-15.

22. Fedorowski A, Burri P, Juul-Möller S, Melander O. A dedicated investigation unit improves management of syncopal attacks (Syncope Study of Unselected Population in Malmo--SYSTEMA I). Europace 2010; 12:1322-8.
23. Smit AA, Halliwill JR, Low PA, Wieling W. Pathophysiological basis of orthostatic hypotension in autonomic failure. J Physiol 1999; 519 Pt 1:1-10.
24. Belal A Jr, Glorig A. Dysequilibrium of ageing (presbyastasis). J Laryngol Otol 1986; 100:1037-41.
25. Sloane PD, Baloh RW. Persistent dizziness in geriatric patients. J Am Geriatr Soc 1989; 37:1031-8.
26. Eigenbrodt ML, Rose KM, Couper DJ, et al. Orthostatic hypotension as a risk factor for stroke: the atherosclerosis risk in communities (ARIC) study, 1987-1996. Stroke 2000; 31:2307-13.
27. Franceschini N, Rose KM, Astor BC, Couper D, Vupputuri S. Orthostatic hypotension and incident chronic kidney disease: the atherosclerosis risk in communities study. Hypertension 2010; 56:1054-9.
28. Milazzo V, Stefano CD, Servo S, et al. Drugs and Orthostatic Hypotension: Evidence from Literature. J Hypertens 2012; 1:104.
29. Pickkers P, Dormans TP, Russel FG, et al. Direct vascular effects of furosemide in humans. Circulation 1997; 96:1847-52.