Panacea Journal of Medical Sciences 2021;11(2):245–252

Content available at: https://www.ipinnovative.com/open-access-journals

Panacea Journal of Medical Sciences

Journal homepage: http://www.pjms.in/

Original Research Article

Clinical profile of isolated systolic hypertension in elderly

Asmita Samal[1],*, J S Dhadwad[1], Varun Tiwari[1], Narendran Sairam[1], Namrata Chaware[1], Abhishek Borle[1], Ashritha Reddy[1]

[1] *Dept. of General Medicine, Dr. D. Y. Patil Medical College, Hospital and Research Centre, Pimpri, Pune, Maharashtra, India*

ARTICLE INFO

Article history:
Received 23-12-2020
Accepted 29-01-2021
Available online 25-08-2021

Keywords:
Hypertension
Cardiovascular disease
Isolated Systolic Hypertension
Essential hypertension

ABSTRACT

Isolated systolic hypertension is the most common hemodynamic form of hypertension in the elderly. With a rapidly aging population, the prevalence of hypertension, particularly isolated systolic hypertension, is increasing steadily. Isolated systolic hypertension is associated with substantial mortality and morbidity, particularly of cerebrovascular disease. It is a rapidly growing public health concern and its management continues to remain a challenge to practicing physicians. Recent studies like the Systolic Blood Pressure Intervention Trial (SPRINT) and Heart Outcomes Prevention Evaluation (HOPE)-3 have implications for antihypertensive therapy in general and for the management of isolated systolic hypertension in particular.

1. Introduction

Globally, cardiovascular disease accounts for 17 million deaths per year, almost 24% of deaths overall.[1,2] Hypertension, is at the heart of this. Almost 7.6 million of these deaths (19% overall) can be attributed to hypertension and its complications.[2,3] As expected of a disease known for a very long time, the treatment of hypertension, and the rationale behind it, has advanced in heaps and bounds over the years. After the mercury sphygmomanometer was introduced in the early 1900s, the general purview stated that diastolic blood pressure was a more significant determinant of cardiovascular disease than systolic blood pressure.[4] Systolic blood pressure was thought to vary throughout the day, and elevated levels were considered evidence of a "strong" left ventricle.[4,5] Further, it was discovered that essential hypertension correlated directly with increased peripheral vascular resistance which reflected more on diastolic blood pressure than systolic,[5] thus making the former, the prime contributor and target of initial treatment plans. Hence, systolic blood pressure being elevated with advancing age (owing to a resultant decreased compliance of the arterial wall) was generalised as an eventual aftermath of ageing.[4] However, over the past few years, several studies have shown systolic blood pressure to be a better predictor of eventual morbidity and mortality than diastolic blood pressure.[6,7] Despite this, ISH remains largely under-diagnosed and untreated.[5]

In India, hypertension is the foremost non-communicable modifiable risk factor involved in the massive burden of cardiovascular morbidity and mortality carried by its population. Drawing a parallel with significant worldwide studies and data from other nations, India too has seen a surge in the number of hypertensives over the years. Adult hypertension prevalence has risen from 5% overall to 40% in urban areas and 17% in rural areas, in India[8] and has been implicated in several, often fatal, complications.[8,9] Indian estimates of ISH in the elderly (aged 60 years and more) vary from 56%[10] to 65%.

ISH is a potential dynamite, under diagnosed and under treated often until it's fatal. This is, in part, due to

* *Corresponding author*.
E-mail address: samley7@gmail.com (A. Samal).

https://doi.org/10.18231/j.pjms.2021.051

the asymptomatic nature of the disease. Complaints from the patient may be infrequent and far in between, often presenting after the advent of several complications already in a state that markedly diminishes QALY and overall life expectancy.[10] While some patients present with innocuous headaches, chest discomfort and mild breathlessness on exertion, others present with gross, often refractory heart failure and other debilitating complications! Even among the patients whose blood pressure seemed controlled at regular hospital visits - one in three subsequently develop myocardial infarction, cerebrovascular accident or heart failure.[11]

Furthermore, the guidelines for both the diagnosis and treatment of ISH are not something most authors agree on. As a baseline, systolic blood pressures above 140 mm Hg with a diastolic below 90 mm Hg are considered requisite for a diagnosis of ISH.[13] The predominant drug classes used for treatment are Angiotensin Convertase Enzyme Inhibitors, Angiotensin Receptor Blockers and Calcium Channel Blockers.[12,13]

Thus while, ISH is better understood now than it was 20 years ago, it is not better treated. In a population like the elderly that is the bread and butter of a physician's practice, ISH, its early diagnosis and treatment needs more focus and prioritisation so as to allow for a longer lifespan for those burdened by heart disease.

2. Aims and Objectives

To study the clinical profile of Isolated Systolic Hypertension in the Elderly.

1. To establish correlation of Isolated Systolic Hypertension in the elderly population with age, gender, BMI and socio-economic class.
2. To establish correlation between clinical findings and degree of Isolated Systolic Hypertension.
3. To predict complications and morbidity profile of subjects included in the study and correlation with degree of Isolated Systolic Hypertension.

3. Materials and Methods

3.1. Study site

Out-Patient Department and In-Patient Wards of the Department of General Medicine in Dr. D. Y. Patil Medical College and Hospital, Pimpri, Pune.

3.2. Study duration

Two years from August 2018 to July 2020.

3.3. Study design

This was an observational, cross-sectional study. 100 patients above 60 years of age and had a Systolic Blood Pressure (SBP) of more than or equal to 140 mm Hg with a Diastolic Blood Pressure (DBP) of less than 90 mm Hg were enrolled in this study. All consecutive cases who meet the criteria were included in this study till the desired sample size was obtained. Study was conducted after Institutional Ethics Committee Clearance and Informed Consent was obtained from all patients.

An Indian study[6] showed that the prevalence of Isolated Systolic Hypertension in the study population was 65%. Assuming the same prevalence with an acceptable difference of 10% at a confidence level of 95%, the required sample size is 88. Assuming 5% non-respondent rate, a total of 93 cases would be the final sample size as calculated. Sample size taken for study was 100. (https://www.calculator.net/sample-size-calculator.html?type=1&cl=95&ci=10&pp=65&ps=&x=64&y=13).

3.4. Inclusion criteria

1. Age more than 60 years
2. Systolic Blood Pressure more than equal to 140 mm Hg

3.5. Exclusion criteria

1. Age less than 60 years
2. Diastolic Blood Pressure more than 90 mm Hg
3. Hyperthyroidism
4. Aortic Regurgitation
5. Severe Anemia
6. Beri-beri
7. Obstructive Sleep Apnea
8. Subjects on long term NSAID, corticosteroid or cytotoxic therapy
9. Hyperaldosteronism

3.5.1. History

History: was taken from the patients having Isolated Systolic Hypertension, including but not limited to onset, progression and frequency of symptoms if any, screening for other cardiovascular risk factors, screening for secondary causes of hypertension, identification of impending or concurrent complications of hypertension and/or other co-morbidities, prior drug history, dietary habits, lifestyle and potential for intervention.

3.5.2. Clinical examination

Clinical examination conducted on the patients having Isolated Systolic Hypertension including but not limited to body habitus (weight and height), blood pressure measurements in bilateral upper limb in sitting, standing and supine positions by mercury sphygmomanometer (as per hospital protocol), heart rate, examination of neck, fundoscopic examination and examination of the cardiovascular system.

3.5.3. Clinical examination

Laboratory investigations Haemogram, Erythrocyte Sedimentation Rate, Urine Routine and Microscopy, Blood Urea, Serum Creatinine, Serum Electrolytes (Sodium, Potassium, Chloride, Calcium, Phosphorous and Magnesium, Liver Function Tests, Serum Total Proteins, Cardiac Enzymes (Troponin I and CPKMB), Thyroid Function Tests, Fasting Blood Glucose, Post-Prandial Blood Glucose, Glycated Haemoglobin and Fasting Lipid Profile were done. Electrocardiogram, 2D Echocardiography, Chest Radiography, Ultrasonography of the Abdomen and Pelvis, Renal Doppler and Carotid Doppler were also be done in all subjects. CT/ MRI Brain was only done if required.

4. Results

100 consecutive subjects availing the In-Patient/ Out-Patient care facilities were examined and included in this study (omitting those who did not fit the aforementioned criteria).

4.1. Interpretation: Table 2

1. Age is not a determinant of Isolated Systolic Hypertension.
2. Among the 100 patients with Isolated Systolic Hypertension studied, females form the majority. The converse held true for the 50 patients with Essential Hypertension, as males formed the majority.
3. Among the 100 subjects with Isolated Systolic Hypertension studied, incidence was highest in the Upper Lower Class (36%), closely followed by the Lower Middle Class (34%) as per the Modified Kuppuswamy Classification. Those studied under the EH group had similar outcomes as well.
4. Among the 100 patients with Isolated Systolic Hypertension studied, 29% admitted to smoking/oral tobacco use. Among the 50 patients with Essential Hypertension, 68% admitted to the same.
5. BMI could be a determinant of Isolated Systolic Hypertension.
6. Symptomatology – analysis
7. Among the 100 patients with Isolated Systolic Hypertension, majority were asymptomatic (58%).
8. The commonest symptom observed was Dyspnea on Exertion (25%), followed by Chest Discomfort (17%) and Giddiness (14%).
9. The 50 patients with Essential Hypertension had a similar presentation as well.
10. One patient in this group however presented with altered sensorium, in the form of Haemorrhagic Stroke.

4.2. Interpretation: Table 2

Majority of test subjects presented with ISH Category I as per Escorts Heart Institute Classification (72%). Of these, 45 subjects were asymptomatic (62.5% of those with Grade I ISH).

4.3. Interpretation: Table 3

1. Diastolic Blood Pressure is a strong determinant of Isolated Systolic Hypertension.
2. Pulse Pressure is a strong determinant of Isolated Systolic Hypertension.
3. Haemoglobin is not a determinant of Isolated Systolic Hypertension
4. Fasting Blood Glucose is not a determinant of ISH.
5. Post Prandial Blood Glucose could be a determinant of ISH.
6. Fasting Serum Cholesterol is a strong determinant of ISH.
7. Fasting Serum Triglyceride is not a determinant of ISH.
8. Fasting Serum HDL is not a determinant of ISH.
9. Fasting Serum LDL is a determinant for ISH.
10. Fasting Serum VLDL is a strong determinant of ISH.
11. Serum Sodium is not a determinant of ISH.
12. Serum Potassium is not a determinant of ISH.
13. Serum Calcium is a determinant of ISH.
14. Serum Uric Acid is not a determinant of ISH.
15. Glycated Hemoglobin is not a determinant of ISH.
16. Urine Protein Creatinine Ratio may be a determinant of ISH.
17. Serum Creatinine is not a determinant of ISH.

4.4. Interpretation: Table 4

1. Among the 100 subjects with Isolated Systolic Hypertension studied, the Diabetes mellitus II was the most prevalent comorbidity at 49%, out of which, 26(73.5%) were previously diagnosed and 13(26.5%) were newly diagnosed diabetics. 13(13%) had Coronary Artery Disease, out of which 1(7.7%) was newly diagnosed. 4% had hypothyroidism in both groups, all previously diagnosed and on medication. 56 subjects (56%) had no comorbidities.
2. Out of the 16(16%) subjects presenting with Hypertensive Retinopathy, 3 had Grade II Retinopathy (18.75%) and 13(81.25%) had Grade I Retinopathy. One patient presented with Atrial Fibrillation (1%). One patient in the EH group suffered from Hypertensive Encephalopathy (2%). One patient in the EH group had an old intracranial hemorrage on MRI brain scan.

5. Discussion

Isolated systolic blood pressure in the elderly is an often ignored and frequently under-treated disorder. It carries a very high cardiovascular risk and overall risk for all-cause mortality as well.

Table 1: Comparison of complicationsbetween ISH and EH

Results	ISH	EH
Diabetes melliuts II	49 (49%)	19 (38%)
Coronary artery disease	13 (13%)	7 (14%)
Hypothyroidism	4 (4%)	2 (4%)
Anemia	67(67%)	42 (84%)
Renal function test	21(21%)	12 (24%)
Serum sodium	71(71%)	40 (80%)
Serum potassium	4 (4%)	3 (6%)
Serum calcium	30 (30%)	17 (34%)
Fasting lipid profile	67 (67%)	14 (28%)
Serum triglyceride	53 (53%)	34 (68%)
Serum high density lipoprotein	29 (29%)	18 (36%)
Serum very low density lipoprotein	41 (41%)	5 (10%)
Urine protein creatinine ratio	6 (6%)	4 (8%)
Glycated hemoglobin	31 (31%)	13 (26%)

1. Age distribution analysis reveals that majority of our subjects diagnosed with ISH were in the 60-65 years age group. This is similar to the data put forward in the Framingham Study where 57.4% men and 65% women [14] above 65 years suffered from ISH. The same study also delineated ISH as the predominant type of hypertension in the elderly.
2. In the Indian scenario, studies by Vrinda Kulkarni et al (56%) [10] and R Gupta et al (65%), [15] to favour a correlation between advancing age and the development of ISH.
3. Gender predilection favours women in subjects with Isolated Systolic Hypertension (58% in our study). This is similar to a study done by Richard Ephraim et al in Northern Ghana. [16]
4. In the Indian scenario, the Chennai Urban-Rural Epidemiology Study (CURES-52) found the reverse to be true. [17] A study done by in Davangere found males to be the predominant population affected by ISH as well. [18]
5. The SHEP Trial also found ISH to be a disease of the older population, markedly older women. [19] The prediliction of older women to have ISH is theorised to be because of the absence of protective effects of ovarian hormones in the menopausal woman. [18]
6. The predominant socioeconomic classes forming the crux of our study population were the Upper Lower (IV) - 36% and the Lower Middle (III) - 34% as per the Modified Kuppuswamy Scale. This is in contrast with the results seen in Davangere, Karnataka, [18] where the predominant classes were Lower Middle (III) - % and Upper Middle (II) - % classes. This however can be on account of a difference in economic standing and awareness of the populations catered by these two different studies.
7. While this study did not find a significant association ($p \leq 0.05$) between BMI and ISH, majority of the population did belong to the overweight (23-27.5 Kg/m^2) group. This is in conjunction with the findings of Gupta et al. [15] and Xu et al. [20]
8. Majority of the study population in this study was asymtomatic, like those in other studies as well - Vrinda Kulkarni et al. (56%) [10] and R Gupta (65%). [15] Majority of the asymptomatic subjects had Grade I ISH (80%).
9. The most common symptom the subjects of our study experienced was dyspnea on exertion (24%) and chest discomfort (16%). The Syst-Eur Trial [21] in 1997 found the most frequesnt complaints to be nocturia, giddiness and headache.
10. The same study [21] also recorded an increased number of complaints in the female group as opposed to the male group, the same also holds true for our study. (53.3% of those symptomatic were female)
11. Of all those with pre-existing comorbidities, 52.9% (18 out of 34 subjects) were symptomatic at presentation. Of those, 26.5% and 3% had Grade II and Grade III ISH respectively.
12. The commonest complication noted in this study was cardiac, ie Left Ventricular Hypertrophy (25%). Complications of ISH were more frequent in those with Grade II ISH (50% of all those with complications), while subjects with no complications were mostly of Grade I (84.3% with those with no complications). Other published studies do not comment on the grade of ISH as the Grading System that has been used here is unique to India [22] and not commonly used worldwide.
13. Systolic and Diastolic Blood Pressures both were demonstrated to have a significant association with ISH in this study (p value=0.00 for both), this can be explained by the loss of Windkeissel effect of medium-large arteries with age due to atherosclerosis.
14. Pulse pressure was a strong determinant of ISH (p=0.00) in our study. A rise in pulse pressure was

Table 2: Comparison of demography and symptomatology between ISH and EH

		ISH (n=100)				EH (n=50)			
		N (%)	**Mean**	**Median**	**SE of Mean**	**N (%)**	**Mean**	**Median**	**SE of Mean**
Age Category (years)	**60-64**	59 (59%)	64.38	62	0.505	26 (52%)	65.52	64	0.799
	65-69	22 (22%)				11 (22%)			
	≥70	19 (19%)				13 (26%)			
	Range- 60-80 years, X^2=12.37, df=17, p value is 0.77 which is not significant								
Gender	**Male**	42 (42%)				34 (68%)			
	Female	58 (58%)				16 (32%)			
Socioeconomic status – analysis	**Upper**	5 (5%)				1 (2%)			
	Upper Middle	14 (14%)				7 (14%)			
	Lower Middle	34 (34%)				18 (36%)			
	Upper Lower	36 (36%)				20 (40%)			
	Lower	11 (11%)				4 (8%)			
Smoking/Oral Tobacco Consumption	**Yes**	29 (29%)				34 (68%)			
	No	71 (71%)				16 (32%)			
Body mass index (BMI) – distribution Category (BMI in Kg/m2)	**Undernourished (<18.5)**	2 (2%)				2 (4%)			
	Normal (18.5-22.9)	14 (14%)				12 (24%)			
	Overweight (23-27.5)	68 (68%)				30 (60%)			
	Obese (>27.5)	16 (16%)				6 (12%)			
		Mean- 24.607 Kg/m^2				Mean- 24.321 Kg/m^2			
	Range- 16-34 Kg/m^2 , X^2=58.7, df=44, p value is 0.06, not significant (p value is significant if < 0.05).								
Symptomatology	**Headache**	12 (12%)				12 (24%)			
	Dyspnea on Exertion	25 (25%)				10 (20%)			
	Chest Discomfort	17 (17%)				18 (36%)			
	Palpitation	7 (7%)				2 (4%)			
	Giddiness	14 (14%)				15 (30%)			
	Syncope	1 (1%)				0 (0%)			
	Oedema	9 (9%)				6 (12%)			
	Altered Sensorium	0 (0%)				1 (2%)			
	Decreased Urine Output	7 (7%)				2 (4%)			
	Bleeding Manifestations	0 (0%)				0 (0%)			
	Asymptomatic	58 (58%)				20 (40%)			

Table 3: Grades of ISH

Grade of ISH	**Percentage**
I	72 (72%)
II	25 (25%)
III	3 (3%)

Table 4: Comparison of clinical and Laboratory parameters between ISH and EH

Category	ISH (N=100)			EH (N=50)		
	Mean	**Median**	**SE of Mean**	**Mean**	**Median**	**SE of Mean**
Systolic	155.5	150	1.083	149.4	144	2.578
	Range- 140-204 mm Hg, X^2=93.663, df=26, p value is 0.00 which is highly significant.					
Diastolic	81.4	80	0.362	96.88	96	0.918
	Range- 70-120 mm Hg, X^2=150, df=18, p value is 0.00 which is highly significant.					
Pulse Pressure	73.78	71	1.155	52.36	50	1.850
	Range- 34-108 mm Hg, X^2=102.66, df=33, p value is 0.00 which is highly significant					
Haemoglobin	10.78	10.90	0.154	10.18	10.1	0.180
	Range- 7.5-15.8 g/dL, X^2=34.23, df=36, p value is 0.55 which is not significant.					
Fasting blood sugar	111	100	3.888	97.46	95	2.516
	Range- 70-256 mg/dL, X^2=46.75, df=39, p value is 0.18 which is not significant.					
Post-prandial blood sugar	177.14	171	5.419	182.86	180	5.363
	Range- 90-425 mg/dL, X^2=78.21, df=62, p value is 0.08 which is not significant by a small margin (p value is significant if < 0.05)					
Fasting serum cholesterol	203.75	202	6.462	168.76	166.5	4.557
	Range- 78-384 mg/dL, X^2=93.19, df=64, p value is 0.01 is significant.					
Fasting serum triglyceride	172.96	156	7.975	171.24	165	6.686
	Range- 70-520 mg/dL, X^2=58.66, df=60, p value is 0.55 which is not significant.					
Fasting high density lipoprotein	52.19	54	1.223	51.98	54	1.954
	Range- 20-86 mg/dL, X^2=35.48, df=33, p value is 0.35 which is not significant.					
Fasting low density lipoprotein	73.98	70	2.930	86.62	86.5	3.045
	Range- 34-165 mg/dL, X^2=69.14 , df=51, p value is 0.0.04 which is significant					
Fasting very low-density lipoprotein	27.28	25	1.160	23.86	22	1.190
	Range- 8-56 mg/dL, X^2=69.39, df=32, p value is 0.005 which is highly significant					
Serum sodium	138.18	138	0.448	139.52	140	0.66
	Range- 128-154 mEq/L, X^2=23.04, df=20, p value is 0.29 which is not significant					
Serum potassium	4.15	4	0.039	4.27	4.2	0.061
	Range- 2.7-5.6 mEq/L, X^2=21.35, df=19, p value is 0.32 which is not significant.					
Serum calcium	8.7	8.9	0.053	8.7	8.8	0.076
	Range- 7.4-10 mg/dL, X^2=35.71, df=22, p value is 0.04 which is significant					
Serum uric acid	5.4	5	0.162	5.4	5.8	0.17
	Range- 0.8-11.5 mg/dL, X^2=39.91, df=34, p value is 0.25 which is not significant					
Glycated hemoglobin	6.35	6	0.116	6.37	6.15	0.105
	Range- 4-11 %, X^2=31.83, df=34, p value is 0.62 which is not significant					
Urine protein creatinine ratio	0.98	0.4	0.194	0.7	0.2	0.236
	Range- 0.1-11, X^2=26, df=16, p value is 0.054 which is not significant by a small margin (p value is significant if <0.05)					
Serum creatinine	1.12	1	0.092	1.07	0.8	0.138
	Range- 0.2-6.5 mg/dL, c^2=25.08, df=28, p value is 0.63 which is not significant					

Table 5: Comparison of comorbidity profile between ISH and EH

		ISH (n=100)	**EH (n=50)**
Comorbidity	Diabetes mellitus II	49(49%)	19(38%)
	Coronary Artery Disease	13(13%)	7(14%)
	Hypothyroidism	4(4%)	2(4%)
	No comorbidities	56(56%)	29(58%)
Complication	Retinopathy	1(16%)	12(24%)
	Nephropathy	7 (7%)	5 (10%)
	Left Ventricular Hypertrophy	25(25%)	14(28%)
	Cerebrovascular Accident	6 (6%)	4 (8%)
	Bleeding Manifestation	0(0%)	1(2%)
	None	69(69%)	29(58%)

noted with a rise is SBP by Nichols WW, O'Rourke MF et al. in a study based on the Framingham Study as well.[23] This can be attributed to an increase in arterial stiffness and decreased pliability of the vessel wall usually expected with advancing age.[24]

15. As per the same study, there was an 11% increase in CVA risk and a 16% increase in risk of all-cause mortality for each 10-mm Hg increase in pulse pressure.[23] This provides credibility to the purpose of this study, which aims for better diagnosis, documentation and treatment of ISH.
16. Total cholesterol was not found to be of predictive value in a study done by Stanley S Frankil and William Gustin et al. However, in our study, Serum Cholesterol was found to be of significant predictive value (p=0.00)
17. Other laboratory parameters found predictive of ISH in our study were (in decreasing order of relevance) Serum LDL, Serum VLDL, Serum Calcium, and to a lesser extent, Urine Protein Creatinine Ratio.
18. Post Prandial Blood Sugar was found to have borderline significant p value, p=0.08, signfiying a possible correlation between those with Diabetes mellitus II and ISH. Indeed, studies have found ISH to be more prevelant that Essential Hypertension in the elderly diabetics.[14] In our study as well, among the 100 subjects with ISH studied, Diabetes mellitus II was the most prevalent comorbidity at 49%, out of which, 26(73.5%) were previously diagnosed and 13(26.5%) were newly diagnosed diabetics.
19. Our study was an attempt to prove that Isolated Systolic Hypertension is not a benign consequence of aging, rather, a separate clinical entity that requires constant vigilance at follow-ups, active interventions in both its prevention and treatment.

6. Conclusion

Isolated Systolic Hypertension being a definite clinical entity, it is important to study its determinants and prioritise its early diagnosis and treatment in those aged 60 and above. Regular screenings, half-yearly or so, would go a long was in diagnosing the same. While socio-economic and literacy-associated factors are beyond our control, an active investigation into subjects with ISH and interventions would go a long way in decreasing the overall cardiovascular and all-cause-mortality burden. Treatment should be initiated early and followed up. Every day is a beautiful day to save lives!

7. Conflict of Interest

The authors declare that there are no conflicts of interest in this paper.

8. Source of Funding

None.

References

1. Jameson JL, Fauci AS, Kasper DL, Hauser SL, Longo DL, Loscalzo J, et al. Harrison's Principles of Internal Medicine, 20e. In: 8th Edn.. vol. 10. McGraw Hill Education; 2041.
2. Global Status Report on Non- Communicable Diseases; 2010. Available from: http://whqlibdoc.who.int/publications/2011/9789240686458_eng.pdf.
3. Burden of NCD and their Risk Factors in India, 2014. (WHO/Non-Communicable Diseases) . Available from: http://www.searo.who.int/india/topics/noncommunicable_diseases/ncd_situation_global_report_ncds_2014.pdf?ua=1.
4. Fineberg MH. Systolic hypertension. *Am J Med Sci*. 1927;173:835–43.
5. Rowe JW. Systolic hypertension among the elderly. *N Engl J Med*. 1983;309(20):1246–7. doi:10.1056/NEJM198311173092011.
6. O'Donnell CJ, Elosua R. Cardiovascular risk factors. Insights from Framingham Heart Study. *Rev Esp Cardiol*. 2008;61(3):299–310.
7. Anderson C, Johnson AD, Benjamin EJ, Levy D, Vasan RS. 70-year legacy of the Framingham Heart Study. *Nat Rev Cardio*. 2019;16(11):687–98.
8. Burden of NCD and their Risk Factors in India, 2014. (WHO/Non-Communicable Diseases) . Available from: http://www.searo.who.int/india/topics/noncommunicable_diseases/ncd_situation_global_report_ncds_2014.pdf?ua=1.
9. Kishore J. National Health Programs of India: National Policies and Legislations related to Health. In: 12th Edn. New Delhi: Century Publication; 2017.
10. Kulkarni V, Bhagwat N, Hakim A, Kamath S, Soneji SL. Hypertension in the elderly. *J Assoc Physicians India*. 2001;49:873–6.
11. Gupta R, Kasliwal RS. Understanding Hypertension in the Elderly . *JAPI*. 2004;2:479–85.
12. Libby P, Zipes D. Braunwald's Heart Disease: A Textbook of Cardiovascular Medicine. In: Bonow R, Mann D, Tomaselli G, editors. 11th Edn.. vol. 1. Elsevier; 2018. p. 910–27.
13. Unger T, Borghei C, Charchar F, Khan NA, Poutler NR, Prabhakaran D, et al. 2020 International Society of Hypertension Global Hypertension Guidelines. *Int Soc Hypertens Global Hypertens*. 2020;75(6):1334–57.
14. Mahmood SS, Levy D, Vasan RS. The Framingham Heart Study and the Epidemiology of Cardiovascular Disease. *Lancet*. 2013;383(9921):999–1008.
15. Bhagwat N, Hakim A, Kamat S, St S.
16. Ephraim RKD, Saasi AR, Anto EO, Adoba P. Determinants of isolated systolic hypertension among diabetic patients visiting the diabetic clinic at the Tamale Teaching Hospital. *Afr Health Sci*. 2016;16(4):1151–6.
17. Mohan V, Deepa M, Farooq S, Datta M, Deepa R. The Chennai Urban-Rural Epidemiology Study (CURES-52) . *J Assoc Physicians India* . 2007;55:326–32.
18. Wassertheil-Smoller S, Anderson G, Psaty B, Black H, Manson J, Wong N, et al. Hypertension and its treatment in postmenopausal women: baseline data from the Women's Health Initiative. *Hypertension*. 2000;36:780–9.
19. SHEP Cooperative Research Group. Prevention of stroke by antihypertensive drug treatment in older persons with isolated systolic hypertension. Final results of the Systolic Hypertension in the Elderly Program (SHEP). *JAMA*. 1991;265(24):3255–64.
20. Xu C, Sun Z, Zheng L, Zhang D, Li I, Zhang X, et al. Prevalence of and risk factors for isolated systolic hypertension in the rural adult population of Liaoning Province, China. *J Int Med Res*. 2008;36:353–6.
21. Staessen JA, Fagard R, Thijs L. for the Systolic Hypertension in Europe (Syst-Eur) Trial Investigators. Randomized double-blind comparison of placebo and active treatment for older patients with isolated systolic hypertension. *Lancet*. 1997;350:757–64.

22. Classification of Isolated Systolic Hypertension by department of cardiology, escorts heart institute and research centre. New Delhi; 2014.
23. Nichols WW, O'Rourke MF. McDonald's Blood Flow in Arteries. Philadelphia, Pa; Lea & Febiger; 1990.
24. Domanski MJ, Davis BR, Pfeffer MA, Kastantin M, Mitchell GF. Isolated Systolic Hypertension : Prognostic Information Provided by Pulse Pressure. *Hypertension*. 1999;34:375–80.

Author biography

Asmita Samal, Post Graduate Resident

J S Dhadwad, Associate Professor

Varun Tiwari, Medical Resident

Narendran Sairam, Medical Resident

Namrata Chaware, Medical Resident

Abhishek Borle, Medical Resident

Ashritha Reddy, Medical Resident

Cite this article: Samal A, Dhadwad JS, Tiwari V, Sairam N, Chaware N, Borle A, Reddy A. Clinical profile of isolated systolic hypertension in elderly. *Panacea J Med Sci* 2021;11(2):245-252.