

Original Article

The Prevalence of Isolated Systolic Hypertension at a Tertiary Care Hospital in Eastern India : An Observational Study

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Background and Objectives : Hypertension is a significant public health issue. Isolated Systolic Hypertension (ISH) was once considered to be a benign aspect among the aging population, but an association with an increased risk of Cardiovascular Disease is now known. ISH shows an increasing prevalence with increase in age. This study was undertaken to determine the incidence of ISH among adults in Eastern India.

Methods : This study evaluated the adult population (aged 18-70 years) attending the NRS Medical College and Hospital, a Tertiary Care Center in East India. The clinical characteristics and echocardiographic findings were also evaluated.

Results : A total of 800 patients met the inclusion criteria, of whom 75 (9.37%) had ISH. Blood Pressure increased with age. The most common echocardiographic change observed in ISH patients was increased Left Ventricular Mass Index (LVMI), while concentric Left Ventricular Hypertrophy (LVH) was more common in women than men with isolated Systolic Hypertension. The incidence of LVMI increased as the severity of ISH increased. Furthermore, patients with stage 3 ISH were nearly 4 times more likely to develop Proteinuria.

Conclusion : The findings of this study are in line with previous studies evaluating the presence of ISH in the adult Indian population. There is need for effective population screening along with effective treatment for Blood Pressure to reduce morbidity and mortality. Primary prevention strategies may be the need of the hour in the Indian population which is at risk of cardiovascular Disease associated with Hypertension.

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Key words : Blood Pressure, Cardiovascular Disease, Hypertension, Left Ventricular Hypertrophy, Proteinuria, Systolic Hypertension.

Hypertension is a major public health issue across the globe, with predictions indicating that 1.5 billion adults would be hypertensive in the year 2025. The increased prevalence of this silent killer is attributed to a changing lifestyle. Factors that predispose to Hypertension often vary from region to region and even across Urban and Rural populations. The incidence of Hypertension in India is estimated to be 29.8%, with an evident Urban-rural difference¹.

There are various types of Hypertension. Isolated Systolic Hypertension (ISH) is defined as Systolic Blood Pressure (SBP) of >140 mmHg with a Diastolic Blood Pressure (DBP) of <90 mmHg. It is the most common form of Hypertension with 80% of hypertensive patients aged over 60 years having ISH². The Framingham Study reported that 57.4% men and 65% women above 65 years suffered from ISH³. However,

Editor's Comment :

- Isolated Systolic Hypertension (ISH) is associated with an increased risk of Cardiovascular disease.
- ISH was noted in nearly 10% of outpatients at a Tertiary Care Hospital in Eastern India.
- Patients with ISH commonly had increased Left Ventricular Mass Index (LVMI).
- Patients with stage 3 ISH were nearly 4 times more likely to develop Proteinuria.
- Primary prevention strategies may be the need of the hour in the Indian population

ISH the most difficult to treat. In fact, the most common form of Hypertension that is untreated in persons aged over 50 years is ISH⁴. ISH was once considered to be a benign facet of the process of aging^{2,4}, but it has been demonstrated over the years that ISH is in fact associated with an increased risk of Cardiovascular Disease (CVD)². SBP tends to increase with age and conversely, DBP tends to decrease with age. Consequently, the prevalence of ISH increases with age. This is reflected in guidelines recommendations that give more importance to SBP, especially in the elderly³.

ISH in older adults stems from a stiffening of the Central Arteries². This is a result of hyperkinetic

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circulation which leads to elevated cardiac output, Stroke volume and Heart rate. ISH is also associated with Obesity, Smoking, Insulin resistance and Metabolic Syndrome. It is reported that ISH increases the risk of CVD mortality by 28% and that of Coronary Heart Disease (CHD) mortality by 23% in men, and a twofold higher risk of CVD mortality and 55% higher risk of CHD mortality in women⁵.

The aim of this study was to estimate the prevalence of Isolated Systolic Hypertension in the adult population of the catchment area of Nilratan Sircar Medical College and Hospital. Additionally, the clinical characteristics and echocardiographic findings of patients with Isolated Systolic Hypertension were elucidated.

MATERIALS AND METHODS

Study Design and Setting :

This was a prospective, observational study of in-hospital BP for all adult patients who met the eligibility criteria described below. Patients attending the Outpatient Department (OPD) and those admitted to the Nilratan Sircar (NRS) Medical College and Hospital, which had an Urban and Rural catchment area, were evaluated.

Participants :

We examined patients aged 18-70 years and over who attended the OPD or were admitted to the NRS Medical College and Hospital between January, 2013 to December, 2014. All patients attending Medicine OPD or admitted in Indoor of Medicine have their history taken followed by thorough general and systemic physical examination. Blood Pressure was specifically recorded using a standard mercury Sphygmomanometer. Before the measurement, the individual was seated quietly in a chair with feet on the floor for 5 minutes. Care was taken that arm muscles were relaxed and the arm was supported at Heart level. Two measurements were recorded and the Mean Value was considered. Apart from Blood Pressure measurements, all patients underwent Complete Hemogram, Fasting Plasma Glucose and 75 gm glucose load test, glycosylated hemoglobin, Liver Function Test, Urea, Creatinine, Routine and Microscopic Examination of Urine, Proteinuria, Serum Electrolytes, Lipid Profiles, Thyroid Function Tests, Ultrasonography of the Abdomen, Chest X-ray, Electrocardiography, 2-D guided M-mode Echocardiography. Furthermore, Smoking status, Alcohol consumption and Anthropometric measures were recorded. The following exclusion criteria were applied: DBP more than 90 mmHg, Infection,

Malignancy, patients on anti-hypertensive medication, Liver Failure, Chronic Kidney Disease, Thyroid Disorder, Drug-induced Hypertension, Diabetes Mellitus, Heart Diseases and Lipid Disorders.

Outcomes :

The incidence of Isolated Systolic Hypertension (ISH) was determined. ISH was defined as a Systolic Blood Pressure (SBP) of more than 140 mmHg with a Diastolic Blood Pressure (DBP) of less than 90 mmHg. This definition is applicable when person is aged more than 18 years; in absence of illness; and is not on any anti-hypertensives.

Statistical Analysis :

The SPSS version 17 windows was used for statistical analysis of data and Microsoft Word and Microsoft Excel were used for generation of graphs. Chi square and Fisher Exact Test were used to find the significance of proportions between increased Left Ventricular Mass Index (LVMI; males: >131 g/m², females >100 g/m²) and normal LVMI. Odds Ratio has been used to find the strength of relationship of proportion of risk factors between categories of increased LVMI and normal LVMI and change of stage of BP. The Student 't' test has been used to find the significance of mean values of anthropometry between male and female patients.

Ethical Consideration :

Ethical approval was obtained from the Institutional Ethics Committee of the NRS Medical College & Hospital. Prior written consent was taken from the subjects who volunteered to participate in the study. Participants with ISH were referred to clinicians for appropriate treatment. All procedures were performed in accordance with the ethical standards of our institute as well as the 1964 Helsinki Declaration and its later amendments.

OBSERVATIONS

A total of 800 participants were evaluated for the presence of ISH. Of these, 75 participants had ISH, thus revealing a prevalence of ISH of 9.37% among the total study population. The mean age of these 75 patients was 64.9±15.3 years. Of the 75 participants, 66.7% were males; stage 1 ISH was noted in 34.6%, stage 2 ISH in 42.6% and stage 3 in 42.6% of participants. As age increases, level of BP also increases; no patient aged <35 years had stage 3 ISH (Fig 1). Mean BMI was significantly higher among females than males (27.8±5.6 kg/m² versus 23.9±4.7 kg/m², p=0.0022). Clinical characteristics of patients with ISH are depicted in Table 1. Among the

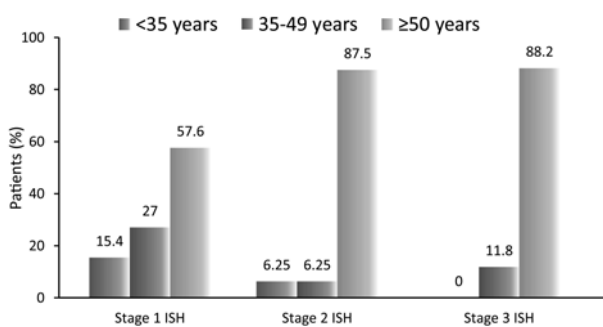


Fig 1 — Age distribution of patients with Isolated Systolic Hypertension (ISH)

Symptom	Number	Percent
Asymptomatic	46	61.3
Shortness of breath	29	37.4
Pedal edema	19	25.3
Chest pain	16	21.3
Headache	8	10.4
Giddiness	6	8
Blurred vision	6	8
Palpitation	8	10.4
S3	5	6.4
S4	6	8
Raised Jugular Venous Pressure	9	12
Cardiomegaly	6	8
Pulse	9	12
Hepatomegaly	8	10.4
Oliguria	5	6.4
Pallor	9	12
Motor weakness	4	5.3

symptomatic patients, the most common symptom observed was Shortness of breath on exertion (Table 1). Most of the symptomatic patients had Blood Pressure in stage 3 ISH. Risk factors for ISH such as BMI >25 kg/m², Diabetes Mellitus, Dyslipidemia and Smoking were noted in >40% of participants with ISH, while Alcohol consumption was noted in 26.4%.

Electrocardiography and Cardiac Imaging :

Electrocardiographic findings were analysed using two criteria. The Sokolow-Lyons criteria identified 26/75 participants (34.4%) as having Left Ventricular Hypertrophy (LVH), while the Romhilt-Estes score identified 18/75 participants (24%) as having LVH. The most common echocardiographic change observed in ISH patients was increased LVMI (n=31; 41.3%) followed by ejection fraction <56% (n=24; 32%), regional wall motion abnormality (n=20; 26.4%) and left ventricular volume >90 mL/m² (n=13; 17.3%). Concentric LVH was more common among females than males (56% versus 44%; $\chi^2=0.96$; Odds Ratio [OR] 1.62. p=0.039). Female participants were more likely to have

increased LVMI compared with male participants (60% versus 32%; $\chi^2=5.39$; OR 3.19. p=0.02).

As severity of ISH increased, the incidence of LVMI also increased. Patients with stage 3 ISH were 7.22 times more likely to develop increased LVMI (Fig 2; p<0.001). Patients with Cardiovascular Disease risk factors like Diabetes (p=0.02), BMI (p=0.002) and Smoking (p=0.017) are more likely to develop increased LVMI (Table 2). As severity of ISH increased, the incidence of Proteinuria also increased. Patients with stage 3 ISH were 3.97 times more likely to develop Proteinuria (Fig 3; p=0.036).

DISCUSSION

Identification of ISH has important Cardiovascular implications, due to the significant Cardiovascular risk associated with this condition. The present study identified 9.37% of adults reporting to a Tertiary Care

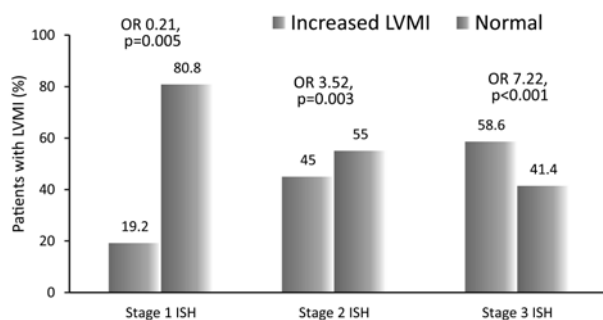


Fig 2 — Patients with stage 3 Isolated Systolic Hypertension (ISH) have a greater risk of developing Left Ventricular Mass Index (LVMI)

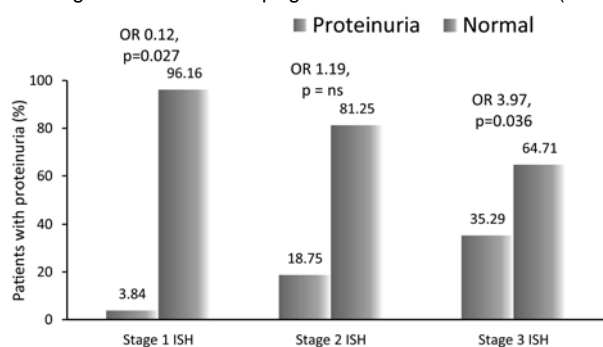


Fig 3 — Increased severity of Isolated Systolic Hypertension (ISH) is associated with increased risk of proteinuria

Variable	Increased LVMI, n (%)	Normal LVMI, n (%)	p-value	Odds ratio
BMI >25 kg/m ²	8 (22.9)	27 (77.1)	0.002	0.22
Diabetes Mellitus	15 (48.4)	16 (51.6)	0.02	1.64
Smoking	9 (26.5)	25 (73.5)	0.017	0.31
Dyslipidemia	11 (36.7)	19 (72.3)	0.502	0.72
Alcohol consumption	10 (50)	10 (50)	0.359	1.62

BMI : Body Mass Index; LVMI : Left Ventricular Mass Index

Center as having ISH with a male preponderance. Interestingly, a majority of the patients were asymptomatic. This study revealed increasing severity of ISH with increasing age.

A number of studies have been carried out in India to determine the prevalence of ISH. A study by Midha, *et al* in Urban and Rural North India demonstrated a higher prevalence in men than women (5.1% *versus* 3.6%; overall 4.3%)⁶. The cross-sectional STEPS survey identified ISH in 6.2% of adults, with a slightly higher proportion among males than females, while the older age group (45-69 years) had a higher prevalence than the group aged <45 years (11.5% *versus* 8.6%)⁷. The overall prevalence in these studies was lower than that in our study, but similarities were noted in terms of increasing prevalence with increase in age⁶.

In another cross-sectional study, the prevalence of ISH was 13.3%, with a higher proportion of males having ISH than females (14.3% *versus* 12.4%), though this was not statistically significant. Furthermore, ISH was significantly more common among older individuals. Besides age, independent risk factors included lack of physical activity, lower consumption of fruits, high BMI and high salt intake¹. Among elderly individuals, a cross-sectional study has reported a higher prevalence of ISH (25%), with risk predictors such as family history of Hypertension, salt intake >5 g/day, Lower consumption of fruits, Smoking, BMI and Waist-hip ratio⁸.

A common thread across all these studies, which is also noted in our study, is the increasing prevalence of ISH with increasing age and a male preponderance. Prior studies have also shown that severity of ISH increases with increasing age and a male preponderance⁹. However, it is necessary to highlight that nearly 22% of subjects aged <35 years and 45% of subjects aged 35-49 years were detected with ISH, which could indicate that ISH may not be truly age-related, as suggested by Midha, *et al*⁶.

This study identified BMI >25 kg/m², Diabetes Mellitus, Dyslipidemia and Smoking as risk factors for ISH. These are also known risk factors for Hypertension and have been demonstrated as risk factors for ISH^{6,7,9,10}. Therefore, tackling modifiable risk factors such as BMI and Smoking may have a positive impact on the prevalence and prognosis of ISH⁶. Towards this, primary care practice would have a significant role to play in terms of educating the population, especially the younger age group so as to reap early benefits. Such lifestyle modification would have a positive impact on Cardiovascular and Metabolic

Health and could aid in reducing the burden of Hypertension.

Left ventricular remodelling is known to occur with age, driven by various modifiable and non-modifiable risk factors, the most important being Systemic Hypertension. Systemic Hypertension induces Myocyte Hypertrophy and Interstitial Fibrosis. This leads to altered LV contractility and relaxation. LVH ensues and is considered an important biomarker for Cardiac Disease¹¹. LVH is associated with an 8-fold increase in CV mortality, based on findings from the Framingham study. LVH can lead to ischemia, arrhythmias and ventricular dysfunction, each of which has significant CV consequences¹². Analysis of LVMI reveals that risk of CV events and all-cause mortality increase from the lowest to the highest quintile. In this study, LVH was evident in nearly a quarter of patients with ISH. In a study among elderly Indian subjects with ISH, 60% had LVH. The older age of patients could have been the reason for this high incidence¹³. In contrast, another study among elderly Indian subjects with ISH reported 35% subjects with ISH Sokolow-Lyon criteria and 26.7% as per Romhilt-Estes criteria⁹. Early identification of LVH followed by aggressive control of BP while also addressing other metabolic issues are important to prevent irreversible LVH¹⁴. Thus, identifying ISH could have potential benefits in preventing mortality.

Proteinuria is a known marker of CVD and Renal Disease in hypertensive patients. Hypertension is the second most common cause of end-stage Renal Disease¹⁵. Microalbuminuria also correlates with LVH independently of age and BP¹⁶, and correlates with higher LVMI, higher carotid femoral Pulse Wave Velocity (PWV) and Carotid Intima Media Thickness (CIMT)^{17,18}. The present study demonstrated increasing prevalence of Proteinuria with increasing severity of ISH, and reduction of Proteinuria is a key aspect of improving renal as well as CV outcomes. Conversely, as Renal function deteriorates, BP increases and BP control becomes difficult to achieve¹⁵.

The CV risks of ISH are well-known, with a 6-fold higher risk of CV death, 5.1-fold higher risk of Myocardial Infarction and 6.7-fold higher risk of Stroke reported in the LIFE study. Patients with ISH have stiffer large arteries and poorer prognosis compared to non-ISH patients with Hypertension. Thus, one aim of treatment should be normalization of ECG in all patients with ECG-LVH, as this would improve prognosis. Treatments that reduce LVH would be beneficial, as lower in-treatment echo-LVH has a reduced risk of CV events, irrespective of baseline Framingham Risk Score and BP lowering itself¹⁹.

CONCLUSION

In conclusion, the findings of the present study reveal that ~9% of patients reporting to a single Tertiary Care Center in Northeast India have ISH, which is in consonance with prior studies across India. Important findings include the incidence of LVH and LVMI in this population, as well as Proteinuria, which are indicators of increased CV risk in this subset of patients. An effective population screening strategy combined with timely initiation of treatment to achieve not just BP goals but also to improve Cardiac and Renal Function are required to reduce morbidity and mortality from this silent killer. This study also adds useful data indicating the need for primary prevention strategies calling for better patient education at early stages and addressing modifiable risk factors, to reduce the burden of CVD and CV mortality in a population which is known to be predisposed to CVD.

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