Research Article

Prevalence and risk factors of isolated systolic hypertension among the elderly population in Davangere, Karnataka

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Received: December 20, 2017; **Accepted:** January 12, 2018

ABSTRACT

Background: The WHO has estimated that globally hypertension is directly responsible for about 62% of cerebrovascular disease and 49% of ischemic heart disease. The risks of stroke and coronary heart disease are directly related to both levels of systolic and diastolic blood pressure. Research studies have shown that isolated systolic hypertension (ISH) confers a substantial cardiovascular risk and stroke; however, prevention and treatment lead to lowering of cardiovascular morbidity and mortality. **Objectives:** The objectives of this study were (1) to assess the prevalence of ISH in population aged ≥60 years in the rural field practice area of JJM Medical College, Davangere, and (2) to identify risk factors of ISH. **Materials and Methods:** It is a community-based cross-sectional study conducted among the elderly ≥60 years of age in the rural field practice area of JJM Medical College, Davangere. Statistical analysis was performed using, percentage, proportion, Chi-square, and multivariate analysis. **Results:** A total of 780 subjects were studied. Majority of the elderly in our study belonged to the age group of 60–69 years (59.5%) with the mean age of 65 years (standard deviation ± 5.44). It was observed that majority of the elderly were males (55.4%) and majority were Hindu by religion (93.3%). In the present study, the overall prevalence of ISH was 25%, which was 26.4% in males and 23.6% among females. A significant increase in the prevalence of ISH was seen with an increase in age. **Conclusion:** Multivariate analysis showed age, high salt intake, less fruits consumption, lack of physical activity, and high body mass index which were significant independent risk factors of ISH.

KEY WORDS: Age; Isolated Systolic Hypertension; Risk Factors

INTRODUCTION

Person who is more than 60 years is considered old. It is estimated that there are currently more than 600 million people aged sixty and above all over the world. India, as the second most populous country, has 76.6 million people at or over the age of 60 constituting about 7.7% of its total population.[1] Projected numbers of 60+ in India will increase to 198 million by 2030. People more than 60 years is 8% of the total population, which would be 19% in 2050.[1] The elderly, by themselves, are a vulnerable group and non-communicable diseases (NCDs) are clearly a major morbidity in this age group.[2] Multiple clinical and observational studies in the elderly have demonstrated that elevated systolic blood pressure(SBP) is a more potent predictor of adverse cardiovascular outcomes than elevated diastolic blood pressure (DBP) and treating isolated systolic hypertension (ISH) in the elderly reduces the risk of cardiovascular disease events.[3,4] Despite the strength of these observational and intervention studies, only about one-quarter of hypertensive individuals are being treated to goal.[5,6] ISH is strongly age dependent. Both the Framingham Heart Study and the nationally representative National Health and Nutrition Examination Survey (NHANES) III showed that a similar

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Website: http://www.ijmsph.com	Quick Response code
DOI: 10.5455/ijmsph.2018.1233512012018	

pattern of progressively increasing SBP occurs throughout adult life in untreated individuals.[7,8]

Developing countries, like India, are likely to face an enormous burden of NCDs in future, and of these diseases, hypertension is one of the most important treatable causes of mortality and morbidity in the elderly population.[9] ISH is an important risk factor for cardiovascular events (myocardial infarction and stroke) and premature mortality, particularly in the elderly population.[10] ISH is the most common type of hypertension in people over 60 years of age and increase in SBP being the principal characteristic in this population. ISH, defined as a raised systolic pressure but normal diastolic pressure, was originally considered part of aging and like essential hypertension and benign.[4] There is a paucity of reliable estimates of the burden of disease and distribution of cardiovascular risk factors. Disaggregated data on burden of disease and risk factors in the community are required for the prevention of cardiovascular disease. Epidemiological studies provide a scientific foundation for such an approach by quantifying the potential value of treating and preventing high blood pressure in a population. With this background, the present study was taken up with the following objectives. Objectives: The objectives of this study were (1) To assess the prevalence of ISH among the population aged ≥ 60 years and (2) To identify the risk factors of ISH.

MATERIALS AND METHODS

Study Design

This was community-based cross-sectional study.

Study Setting

The study was conducted among the elderly population aged ≥60 years in the rural field practice area of JJM Medical College, Davangere (Anaji-9701, Kakkaragolla-10000, Kodaganuru-8490 population).

Ethical Approval

The study was approved by the ethics committee of JJM Medical College, Davangere.

Study Period

The study duration was 6 months from 1st June to 31st December 2015.

Sample Size

The sample size for the present study was calculated based on the available information from the previous studies. Prevalence of ISH of the elderly was taken 20%. Using this information, following formula was used and number of persons to be screened was determined: $n = 4pq/l^2$ where P = estimated prevalence (20%); $q = 100-P = 80$; d = allowable error (15%); n = sample size. Sample size calculated was 711 which was rounded off into 780.

Inclusion Criteria

The following criteria were included in the study:
1. All the subjects aged ≥60 years in the selected houses.
2. Permanent residents of the study area.
3. Those who were willing to participate in the study.
4. Previously diagnosed hypertensives with or without treatment.

Exclusion criteria

The following criteria were excluded from the study:
1. Physically or psychiatric morbid subjects.
2. Visitors of the house.
3. Those who were not willing to participate and non-cooperative.

Study Tool

The study was conducted using a predesigned, pretested, semi-structured questionnaire. Informed verbal consent was obtained from each of the participants and confidentiality of their responses was assured, and also the purpose of study was explained. Ethical Clearance was taken by the Ethical Committee of JJM Medical College.

BP Measurements

Subjects were made to sit quietly for 15 min with his/her leg uncrossed. Subjects were instructed to place the left arm on the table with the palm facing upward. Clothing was rolled up/removed on the arm, appropriate cuff size was used, 3 BP recordings with 3 min apart were recorded, and an average of the 2nd and 3rd reading was considered. Blood pressure was recorded to the nearest 1 mmHg using the electronic OMRON machine (Omron Corporation, Tokyo, Japan) which is validated and calibration of the OMRON monitor was done by mercury sphygmomanometer. Definition of ISH: ISH is defined as SBP of 140 mmHg or more and DBP <90 mmHg.

Data Analysis

Data analysis was done using SPSS version 17. The results were explained in percentage, proportions using z test, Pearson's Chi-square tests for categorical data. Data were analyzed using percentage, proportions using z test, and Pearson's Chi-square tests for categorical data. Multivariate analysis was used to estimate the association between the selected sociodemographic and lifestyle-related characteristics. The adjusted odds ratio with their 95% confidence interval (CI) was given as final predictors in the model.

RESULTS

A total of 780 subjects were studied. Majority of the elderly in our study belonged to the age group of 60–69 years (59.5%) with the mean age of 65 years (standard deviation ± 5.44). It was observed that majority of the elderly were males (55.4%), Hindu by religion (93.3%), married (86.2%), and part of a nuclear family (67.2%). The modified Prasad classification revealed that majority of the elderly belonged to Class III (40.5%) socioeconomic status, majority being educated up to high school (25%), and majority were housewives (42%). Table 1 presents the sociodemographic profile of the study subjects.

Table 1: Sociodemographic profile of study subjects (*n*=780)

Parameters	*n* (%)
Age group	
60–69	464 (59.5)
70–79	232 (29.7)
>80	84 (10.8)
Sex	
Female	348 (44.6)
Male	432 (55.4)
Religion	
Hindu	568 (93.3)
Muslim	212 (6.2)
Christian	4 (0.5)
Education	
Illiterate	184 (23.6)
Primary	172 (22)
Secondary	88 (11.2)
High school	196 (25)
College	68 (9.2)
Graduate	72 (8.7)
Occupation	
Skilled	52 (6.6)
Semi-skilled	48 (6)
Unskilled	40 (5)
Semi-professional	124 (16)
Professional	36 (4.6)
Retired	104 (13.3)
House-wife	328 (42)
Unemployed	48 (6.2)
Type of family	
Nuclear	524 (67.2)
Joint	228 (29.7)
Three generation	28 (10.8)
Socioeconomic status	
Class I	160 (20.5)
Class II	216 (27.6)
Class III	316 (40.5)
Class IV	84 (10.7)
Class V	4 (1)
Marital status	
Married	672 (86.2)
Widow	108 (13.8)

Determinants of ISH

The overall prevalence of ISH in the present study was 25%. In our study, the highest (27.2%) prevalence of ISH was observed in 70–79 years of age group. ISH prevalence increased with increase in age. Our study revealed that prevalence of ISH was seen high among males (26.4%) compared to females (23.6%). In the present study, prevalence of ISH was observed high among subjects who had a positive family history of hypertension (35.8%), subjects who had mixed type of diet (25.6%), subjects who had amount of salt intake more than 5 g/day (26.4%), and among subjects who consumed more saturated fatty acids (27.9%). ISH prevalence was found high among subjects who consumed fruits of <5 servings/day (26.5%) and among subjects who had inadequate intake of green leafy vegetables per day (25.2). Prevalence of ISH was found high among those who had moderate type of physical activity (29.3%), subjects who were ex-smokers (50%), and among current alcoholics (38.9%). ISH prevalence increased with increase in body mass index (BMI) and subjects who had increased waist-hip ratio (35.7%). Significant predictors for ISH included education, occupation, family history of hypertension, amount of salt intake >5 g/day, consumption of fruits <5 servings per day, smoking, BMI, and waist-hip ratio.

DISCUSSION

The present study showed that the prevalence of ISH was significantly higher in the individuals more than 60 years and above Table 2. ISH increase with the increase of age is a well-known fact now. The present study showed that the overall prevalence of ISH was 25%. The present results of ISH were comparable with the similar studies done by Gupta *et al*.[11] in Shimla (7.8%), Jagdal *et al*. in Mongolia (7%), and Xu *et al*. in China (10.6%).[4,5] Compared to the other studies, prevalence of ISH was found higher in our study. The difference in prevalence could be due to study subject being the elderly. In our study, the highest (27%) prevalence of ISH was observed in 70–79 years of age group. The prevalence of ISH was found to rise with increase in age, and this was comparable and found almost similar with the study done by Mandal *et al*. (21.2% in ≥60 years) in Uttaranchal and a study done in China by Xu *et al*. (26% in ≥65 years).[3,5] Epidemiologic transition and increase in life expectancy accompanying the demographic change had been associated with an increase in a number of the elderly and the burden of NCDs like hypertension and its subtypes. The present study also adds to this evidence. In our study, prevalence of ISH was found

Table 2: Determinants of ISH

Parameters	Total subjects (*n*=780)	Number of ISH cases (*n*=196)	Prevalence of ISH	*P* value
Age group				
60–69	464	111	23.9	*P*=0.633
70–79	232	63	27.2	
>80	84	22	26.2	
Sex				
Male	432	114	26.4	*P*=0.366
Female	348	82	23.6	
Religion				
Hindu	728	195	26.8	Fisher's exact test=20.038, *P*=0.001w*
Muslim	48	1	2.1	
Christian	4	0	0.0	
Education				
Illiterate	184	38	20.7	*P*=0.001*
Primary	172	61	35.5	
Secondary	88	13	14.8	
High school	196	65	33.2	
College	72	10	13.9	
Graduate	68	9	13.2	
Occupation				
Skilled	52	13	25	*P*=0.001*
Semiskilled	48	12	25	
Unskilled	40	19	47.5	
Semi-professional	124	40	32.3	
Professional	36	0	0	
Retired	104	12	11.5	
House wife	328	82	25	
Unemployed	48	18	37.5	
Type of family				
Nuclear	524	125	23.9	*P*=0.472
Joint	228	64	28.1	
Three generation	28	7	25	
Socioeconomic status				
Class I	160	30	18.8	Fisher's exact test=10.105, *P*=0.033*
Class II	216	61	28.2	
Class III	316	74	23.4	
Class IV	84	30	35.7	
Class V	4	1	25	
Family history				
Yes	176	63	35.8	*P*=0.001*
No	604	133	22	
Diet				
Vegetarian	420	104	24.8	*P*=0.799
Mixed	360	92	25.6	
Amount of salt intake per day				

(contd...)

Table 2: *(Continued)*

Parameters	Total subjects (*n*=780)	Number of ISH cases (*n*=196)	Prevalence of ISH	*P* value
<5 g/day	44	2	4.5	*P*=0.001*
>5 g/day	736	194	26.4	
Type of oil				
Saturated fatty acids	240	67	27.9	*P*=0.231
Unsaturated fatty acids	540	129	23.9	
Amount of green leafy vegetable intake				
Adequate	228	57	25	*P*=0.958
Inadequate	552	139	25.2	
Amount of fruits intake				
>5 servings/day	64	6	9.4	*P*=0.002*
<5 servings/day	716	190	26.5	
Physical activity				
Sedentary	504	125	24.8	*P*=0.249
Moderate	164	48	29.3	
Heavy	112	23	20.5	
Smoking				
Non-smoker	664	158	23.8	*P*=0.002*
Current smoker	80	20	25	
Ex-smoker	36	18	50	
Alcohol				
Non-alcoholic	692	163	23.6	*P*=0.14
Current alcoholic	72	28	38.9	
Ex-alcoholic	16	5	31.3	
Stress				
Present	456	108	23.7	*P*=0.246
Absent	320	88	27.5	
BMI				*P*=0.001*
<18.5	488	104	21.3	
18.5–22.99	136	38	27.9	
23–24.9	136	43	31.6	
>25	20	11	55	
Waist-hip ratio				
Normal	640	146	22.8	*P*=0.01*
Excess	140	50	35.7	

**P*<0.05 is considered statistically significant. ISH: Isolated systolic hypertension, BMI: Body mass index

high among males (26.4%) as compared to females (23.6%). A similar finding was seen in the study by Gupta *et al*.[11] in Shimla (males - 8% and females - 6.7%).[3] This sex difference may be due to low number of females in our study. In our study, prevalence of ISH was found high among Hindus (26.8%) compared to other religion, whereas a study done by Midha *et al*. in Lucknow reported higher prevalence in others (6.9% Muslim, Christian, and Sikh).[2] The present study revealed the significant association between education and ISH ($P < 0.001$). Prevalence of ISH was observed high among study subjects who had educated up to primary school (18.1%). A study by Mandal *et al*. in Uttaranchal stated higher prevalence (7.7%) among illiterates when compared to literates.[3] However, our study showed that education plays the important role regarding knowledge of hypertension and also even illiterates in the present study were aware and had little knowledge regarding hypertension. In our study, prevalence of ISH was seen high among unskilled workers (47.5%). Occupation as a risk factor was found statistically significant with ISH in the present study ($P < 0.001$). Occupation and related stress were independent risk factor of hypertension which is also supported by the study done in Kerala on bus drivers by arjun *et al*[12] Prevalence of ISH was seen high (35.8%) among subjects who had a family

history of hypertension. Prevalence of ISH and family history showed significant association (P = 0.01). The present observations were supported by Midha *et al*. (13.3%) study done at Lucknow and was found statistically significant.[2] In our study, the prevalence of ISH was observed high (26.4%) among study subjects who had daily salt intake of >5 g/day and association between intake of salt and ISH was found to be highly significant (P = 0.001). A similar finding was supported by Xu *et al*. in China.[5] In our study, prevalence of ISH was equally distributed (13.6%) among subjects who had <5 and >5 servings of green leafy vegetables/day (25%), and this observation was supported by the similar study done by Jagdal *et al*. (47.2%) in Mongolia.[4] In our study, prevalence of ISH (26.5%) was found high among the individuals who had <5 servings of fruits/day. The present study also stated the significant association between ISH with intake of fruits.

In the present study, the prevalence of ISH was found high among subjects with a moderate level of activity (29.3%), and a similar study done by Midha *et al*. in Lucknow stated that prevalence of ISH increased with decreasing level of physical of activity and higher prevalence was found among those with sedentary lifestyle.[2] Our study also adds the similar evidence. In our study, the prevalence of ISH was found high among current smokers (50%), and the present observation was compared with Gupta *et al*. in Shimla (8.2%), Jagdal *et al*. in Mongolia (10.5%), and Xu *et al*. in China (6.5%), where prevalence of ISH was seen higher among current smokers compared to non-smokers.[11,4,5] In our study, the prevalence of ISH was found high among current alcoholics (38.95%). The present results correspond with the similar study by Midha *et al*. (22.2%) in Lucknow and Gupta *et al*. (22.2%) in Shimla.[2,11]

Our study showed a significant association between ISH and BMI (P = 0.01), higher the BMI more the risk of developing ISH was observed. The present observation was supported by Midha *et al*. in Lucknow, Gupta *et al*. in Shimla, and Xu *et al*. in China.[2,11,5] In our study, prevalence of ISH was found high among both males and females (22.8%) who had higher waist-hip ratio compared to normal. The present results were comparable with a study done by Gupta and Kashiwal Cherukuri.[13,14] Table 3 presents the multivariate analysis of the determinants of ISH. All the variables with $P < 0.05$ in bivariable analysis were entered as independent variables, and ISH was entered as the dependent variable. High BMI, more salt intake, and less fruits intake per day were found to have adjusted odds ratio (OR) significant and emerged as positive predictors of ISH by the model. The results of our study were comparable with the similar studies done by Midha *et al*., Fagard and Van den Enden, and Chobanian which stated increasing in age (OR 2.733, 95% CI [1.979–3.776] P = 0.001), lack of physical activity (OR 0.429,95% CI [0.184–1.001] P = 0.05), and high BM (IOR 2.204, 95% CI [1.318–3.686] P = 0.003) as significant independent predictors of ISH, and the present study also supports this evidence.[2,15,16]

Strength and Limitations

The principal strength of our study was three readings of BP measurement were obtained and done in the field. All the measurements were done in the field. Subjects with abnormal BP were advised regarding appropriate medical care and lifestyle modifications. Measuring the waist and hip circumference which correlates better with metabolic syndrome and BMI also adds the strength of our study.

LIMITATIONS

Prevalence estimate was done based on a single occasion measurement of blood pressure. The risk factors were assessed in a subjective manner based on self-reporting, and therefore, their accuracy may be less than expected. We tried our best to quantify ingestion of salt, fruits, and vegetables intake per day. Previously diagnosed hypertensives with or without treatment were also included in the study.

CONCLUSION

In our study, overall prevalence of ISH was found to be 25%. The prevalence of ISH among the elderly was found to be high among males (26.4%) compared to females (24%). The risk factors found to be significantly associated with ISH in our study were education, occupation, socioeconomic status, family history, amount of salt intake per day, amount of fruits intake per day, smoking, BMI, and waist-hip ratio. High BMI, more salt, and less fruits intake per day were found to have adjusted OR significant and emerged as positive predictors of ISH by the model.

ACKNOWLEDGMENTS

The authors would like to express their sincere thanks to all study participants for their cooperation throughout the study

Table 3: Multivariate logistic regression analysis for association of various determinants with prevalence of ISH

Risk factors	Cutoffs	Adjusted OR	95% CI		*P* value
			Upper	Lower	
Amount of salt intake	Excess versus normal	0.128	0.031	0.533	0.005
Amount of fruits intake	Adequate versus inadequate	3.602	1.527	8.496	0.003
BMI	High versus normal	0.305	0.124	0.748	0.010

OR: Odd ratio, CI: Confidence interval, BMI: Body mass index

period and to my dear teachers of JJMMC, Davangere, and to their dear colleagues of BGS GIMS, Bengaluru.

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How to cite this article: Revanna R, Davalgi SD, Swamy NSS. Prevalence and risk factors of isolated systolic hypertension among the elderly population in Davangere, Karnataka. Int J Med Sci Public Health 2018;7(3):209-215.

Source of Support: Nil,**Conflict of Interest:** None declared.