



Full Length Research Paper

The prevalence and associated risk factors for Isolated Systolic Hypertension in Mongolia: Results from a Nationwide Population Based Survey

Dechmaa Jagdal*¹, Narantuya Davaakhuu², Riitta Antikainen³, Bolormaa Idesh⁴,
Otgontuya Dugee⁴, Oyunbileg J⁴, Davaalkham Dambadarjaa⁵, Dejeekhuu Genden⁶

^{1,2}Department of Cardiology, School of Medicine, Health Sciences University of Mongolia

³Sciences of Health Oulun University and Oulu City Hospital Oulu, Finland

⁴Public Health Institute of Mongolia

⁵Department of Epidemiology and Biostatistics, School of Public Health, Health Sciences University of Mongolia

⁶“Humuun”Hospital

Abstract

The aim of the study was to determine the prevalence of Isolated systolic hypertension and associated risk factors among people aged 15-64 years in Mongolia. We examined the prevalence and risk factors of Isolated systolic hypertension (ISH) using the data from the “Mongolian STEPS Survey on the Prevalence of Non-communicable Disease and Injury Risk Factors-2009”. ISH was defined as systolic blood pressure ≥ 140 mmHg and diastolic blood pressure < 90 mmHg. From a total of 5,456 people in the STEPS study, we selected those who had ISH for our population sample (n=377). The prevalence of ISH was classified in urban and rural areas. Using the approach of the World Health Organisation (WHO) “STEPS” Survey, consumption of alcohol, fruit and vegetables, tobacco smoking and salt intake were assessed by questionnaire. The study revealed that 6.9 % (n=377) of the 5456 individuals involved in the study had ISH. ISH occurred more in males (2.7 fold) compared to females. It was statistically significant that the prevalence of ISH increased with age (p=0.001). There was a significant difference in the prevalence of ISH between urban (6.03%) and rural (7.6%) respondents. The prevalence of ISH is high in the Western and Khangai regions of Mongolia among people aged 15-64 years. On logistic regression analysis, age OR:1.060 (95%CI:1.050-1.069); male gender OR:2.726 (95%CI:2.193-3.389); duration of smoking OR:1.033 (95%CI:1.016-1.050); alcohol consumption OR:1.026 (95%CI:1.011-1.041) and salt intake OR:1.036 (95%CI:1.015-1.057) were independently associated with higher risks of ISH among the population. On age and gender adjusted logistic regression, salt intake was found to be a significant independent risk factor for ISH (p=0.015).

Keywords: Isolated systolic hypertension, prevalence, advancing age, risk factors, regions.

INTRODUCTION

According to the report of the World Health Organization (2002), 50% of cardiovascular diseases and 75% of strokes are caused by arterial hypertension: World Health Organization. World health report (2002). Since the 20th

century the results of research studies have shown that the prevalence of isolated systolic hypertension (ISH) increases with age due to atherosclerotic changes of large and middle arteries (Burt VL et al., 1995a; Franklin SS et al., 1997a; Vokonas et al., 1988). ISH has been found to increase the risk of stroke and coronary heart disease (CHD) significantly among both middle-aged and elderly men and women (Nielsen et al., 1997; Petrovitch

*Corresponding Author E-mail: detsee56@yahoo.com

et al., 1995; Ueda et al., 1988). In the North Karelia project (1984) it was found that middle aged men with ISH had a 1.7 times higher relative risk of myocardial infarction compared to the middle aged men without ISH (Tuomilehto et al., 1984). The Multiple Risk Factor Intervention Trial (1988) revealed a 2.7 fold relative risk of fatal CHD among middle aged men with ISH compared to normotensive men (Rutan et al., 1988).

Health statistics information from Mongolia show that cardiovascular diseases (CVDs) have been growing steadily and have become the leading cause of mortality since 1995 (Report of Health Statistics, Mongolia, 2008). 41.8% of CVDs and 52% of CVD mortality are caused by arterial hypertension (Baasanjav, 1997). The prevalence of ISH as well as pulse pressure increases with age, particularly after the age of 50 years (Burt VL et al., 1995a; Vokonas et al., 1988; Whelton, 1994). ISH is a higher risk factor for cardiovascular diseases than isolated diastolic hypertension (Helen et al., 2001). Because of this it is important to determine the prevalence of ISH and its associated risk factors in order to reduce CVD mortality and morbidity in Mongolia.

MATERIALS AND METHODS

We examined the prevalence of ISH and behavioural and intermediate risk factors of ISH using data from the "Mongolian STEPS Survey on the Prevalence of Non communicable Disease and Injury Risk Factors-2009". The STEPS Survey used a multistage cluster sampling method to select a representative sample. A total of 5,456 people participated in the STEPS Survey. In our study we selected those from the STEPS study with confirmed ISH (n=377). We also took a sample of 3,912 people from the STEPS study with normal blood pressure as a control group. The ISH group was further separated into urban (n=154) and rural groups (n=223). The rural group was further classified into 4 different regions according to Mongolian economical regions.

Blood pressure measurement

Blood pressure was measured three times on the survey participant's right arm in a sitting position using OMRON Model M5 automatic blood pressure monitors. The mean of the last two measurements were taken for analysis of blood pressure. ISH was defined as SBP \geq 140 mmHg and DBP $<$ 90 mmHg. The Control (normotensive) group comprised subjects whose SBP $<$ 140 mmHg and DBP $<$ 90 mmHg.

Assessing risk factors

This study used "standard drinks" to assess alcohol consumption as used by the WHO "STEPS Survey". In this study respondents reporting alcohol use within the

past 1 month were classified as "current drinkers". "Binge drinking" was defined as consuming 5 or more standard drinks for males and 4 or more standard drinks for females on one occasion in the last month. Consumption of fruits and vegetables was assessed by "number of portions" - one portion size being equal to 80 grams. Standard fruit and vegetable consumption was classified as more than 400 grams per day. Duration of smoking, exposure to secondhand smoke and salt intake were assessed by questionnaire. A smoker was defined as a subject who smoked any number of cigarettes daily. Average daily intake of salt was assessed by asking for how many days it took a household to consume one 500 gram packet of salt, dividing 500 g by the number of days and then dividing again by the number of people in the household.

Statistical analysis

Statistical analysis was performed using SPSS software-18.0 statistical programs. The prevalence rates were given as percentages. Two tailed p values less than 0.05 were considered significant. Discrete data was analyzed using Pearson's Chi-square test. Differences among the groups (ISH and normotensive) were analyzed with one-way ANOVA in the case of continuous variables. Means in two groups were analyzed with independent "T" test. The significance of risk factors was calculated by multivariate logistic regression analysis in which the Odds ratio and 95% confidence intervals were calculated.

RESULTS OF THE STUDY

The Survey participants included 5438 respondents aged 15-64 years from 21 provinces and Ulaanbaatar city. Of which, 2217 were males and 3221 were females. In terms of age groups there were 899 person aged 15-24, 1525 persons aged 25-34, 1444 persons aged 35-44, 1046 persons aged 45-54 and 524 persons aged 55-64 respectively. In terms of locality, 2546 persons were from urban and 2892 persons from rural areas (Table 1).

The study revealed that 6.9 % (n=377) of total 5438 individuals involved in the study had ISH. The age-standardised overall prevalence of ISH was 10.4 % (233) among men and 4.4% (144) among women aged 15-64 years. ISH was dominant in males (p=0.001). The prevalence of ISH increased with age (p=0.001). Each age group was segregated into gender: ISH was dominant in males in each age group. The prevalence of ISH was 6.2% among khalkhas, 19.6% among kazaks and 8.7% among other ethnics groups. There was a significant difference in the prevalence of ISH between urban (6.0%) and rural (7.6%) respondents.

According to the economical regions of Mongolia, prevalence of ISH was 11% in the Western, 7.7% in Khangai, 5.5% in Central and 4.5% in Eastern region.

Table 1. Characteristics of study population (n=5438) (by sex, age group and residence)

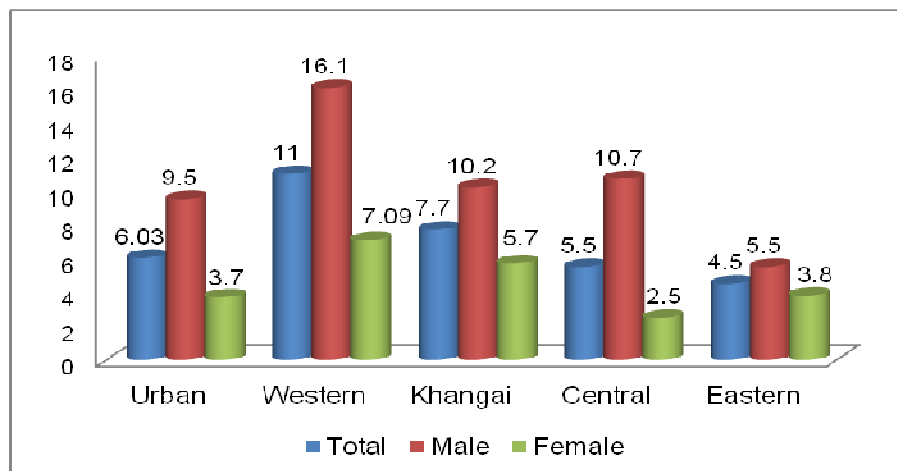
Age group	Male		Female		Total	
	n	%	n	%	N	%
15-24	403	44.8	496	55.2	899	16.5
25-34	603	39.5	922	60.5	1525	28.0
35-44	568	39.3	876	60.7	1444	26.6
45-54	420	40.2	626	59.8	1046	19.2
55-64	223	42.6	301	57.4	524	9.6
15-64	2217	40.8	3221	59.2	5438	100.0
Residence						
Urban	995	39.0	1551	60.9	2546	46.8
Rural	1222	42.2	1670	57.7	2892	53.1
Total	2217	40.7	3221	59.2	5438	100.0

Table 2. Prevalence of Isolated Systolic Hypertension (by sex, age group and regions)

Age group	Cases with ISH		Male		Female		p value
	N	%	n	%	n	%	
15-24	39	4.3	32	7.9	7	1.4	p=0.001
25-34	74	4.8	64	10.6	10	1.08	
35-44	79	5.4	45	7.9	34	3.8	
45-54	106	10.0	55	13.08	51	8.1	
55-64	79	14.8	37	16.5	42	13.9	
15-64	377	6.9	233	10.4**	144	4.4	

ISH- isolated systolic hypertension

**p<0.05 statistical significance

**Figure 1.** Prevalence of Isolated Systolic Hypertension (by regions, gender)

People who lived in the Western and Khangai regions of Mongolia had a higher prevalence of ISH than other

regions (p<0.05). ISH was found to be more common in males compared to females in each regions (p=0.001).

Table 3. Determinants of Isolated systolic hypertension

Blood pressure (BP)	Alcohol drinker (%)	Average duration of smoking (year)	Exposure to second-hand smoke (%)	Average daily salt intake (gram)	Consume of salt \geq 5gram per day (%)	Consumption of fruits every day in a week (%)	Consumption of vegetables every day in a week (%)
Normal BP	62.9	16 \pm 10.6*	74.1	6.9 \pm 4.8*	59.6	5.7	52.3
ISH	63.5	20.5 \pm 12.4*	75.6	8.0 \pm 6.4*	64.2	3.4	47.2

ISH- Isolated systolic hypertension

*p<0.05- statistical significance

Table 4. Logistic Regression analysis of behavioral risk factors associated for Isolated systolic hypertension

Findings	Crude OR	95% CI	P value	Adjusted OR§	95% CI	P value
Age	1.060	1.050-1.069	0.0001*	-	-	-
Gender (male)	2.726	2.193-3.389	0.0001*	-	-	-
Duration of smoking	1.033	1.016-1.050	0.0001*	1.000	0.955-1.048	0.993
©Alcohol consumption	1.026	1.011-1.041	0.001*	0.995	0.966-1.025	0.744
Salt intake	1.036	1.015-1.057	0.001*	1.052	1.010-1.096	0.015**

*p<0.05-statistical significance

§-age and gender adjusted odds ratio (OR)

©- mean number of standard drinks on one occasion)

Isolated Systolic Hypertension and behavioural risks

Alcohol use

In the normotensive group 62.9% of respondents were current drinkers and reported alcohol use in the past 1 month. In the ISH group 63.5% were current drinkers. The survey findings demonstrated that of those current drinkers, 66.9% of respondents from the normotensive group and 74.8% of respondents from the ISH group drank more than the WHO recommended limits on 1 occasion. Binge drinking is an important factor which significantly increases the risks associated with ISH. Frequency of alcohol drinking was higher in males compared to females. After the 25-34 age group, frequency of alcohol drinking increased rapidly.

Smoking

The prevalence of current smokers in the ISH group was 37.9% with statistically significantly more male smokers as compared to female smokers. Among current

smokers, 89.5% reported smoking daily. The average duration of smoking in the ISH group was 20.5 \pm 12.4 years and in the normotensive group it was 16.0 \pm 10.6 years. This was a statistically significant difference between the 2 groups (p=0.029). The percentage of exposure to secondhand smoke in the last week was the same in both groups (ISH-75.6%, normotensive group-74.1%). 40.8% of the respondents in the ISH group were exposed to secondhand smoke daily at home. Daily exposure to second-hand smoke at home or work considerably increased the risk of ISH (p=0.002).

Consumption of fruit and vegetables

Of respondents in the normotensive group 5.7% consumed fruit daily and 52.3% consumed the recommended 5 portions of fruit and vegetables daily. Of respondents in the ISH group 3.4% consumed fruit daily and 47.2% consumed vegetables daily. There was no statistically significant difference in the average daily fruit and vegetable consumption between the two groups. The percentage of residents who consume less than 5

standard fruit and vegetables portions per day was the same in both groups (64.8% in normotensive, 68.6% in ISH group). These results show that the majority respondents are consuming less than the recommended standard portions of fruit and vegetables.

Salt intake

Average daily salt intake was 8.02 ± 6.4 gramm in the ISH group. Salt intake was higher in the ISH group than in the normotensive group (6.9 ± 4.8 gramm). 64.2% of respondents with ISH consumed more than 5 grams per day. These results show that excessive salt intake is a statistically significantly risk factor for ISH ($p=0.003$). Of all other risk factors, salt intake (OR:1.033, 95%CI:1.012-1.055) is a significant independent predictor of ISH as revealed in age and gender adjusted logistic regression analysis.

On univariate logistic regression analysis, age OR:1.060 (95%CI: 1.050-1.069), male OR:2.726 (95%CI: 2.193-3.389), duration of smoking OR:1.033 (95%CI: 1.016-1.050), alcohol consumption OR:1.026 (95%CI: 1.011-1.041), salt intake OR:1.036 (95%CI:1.015-1.057) were independently associated with higher risks of ISH among 16-64 year old adults. ISH occurs 2.7 times more in males than females. On age and gender-adjusted logistic regression, salt intake is a significant independent risk factor for ISH ($p=0.015$).

DISCUSSION

The prevalence of ISH in Mongolia was 6.9% among the population aged 15-64 years. In similar studies the prevalence of ISH was 7.78% among the population aged 20-60 in India (Gupta et al., 2010), $4.32 \pm 0.32\%$ in Korea (Kim et al., 2005) and 7.6% among the population of China (Huang and Wildman, 1999). Our study found that ISH occurred more commonly in men than women and increased with age. The prevalence of ISH was higher in rural respondents than urban respondents. This was similar to other study results where mean systolic blood pressure was increased with advancing age and prevalence of ISH was highest after the age 50 years (Grebla et al., 2010, Petrovitch et al., 1995). The study by Li J et al (2008) showed that the prevalence of ISH increased with age, and was more common in the older women than in the older men. This research also showed that there was no significant difference in prevalence of isolated systolic hypertension between north and south China, but rural residents had a higher prevalence of ISH than other type of arterial hypertension (Li et al., 2008). According to the results of a study by Rocha et al. (2003), "the proportion of hypertensive with ISH increased from 19% in people aged up to 40, to 30% in the fourth decade, 34% in the fifth decade and 44% in the sixth decade. In hypertensive aged up to 50, ISH was

more frequent in females. However in those over age 50 it was predominant in males (Rocha et al., 2003). The proportion of people with ISH is a higher in each groups in the studies mentioned above was higher than in our study. Our study showed the prevalence of ISH was a higher in males in each age group. People who live in Khangai and Western regions had a higher prevalence of ISH compared to other regions. This was similar to the conclusions of other research findings in Mongolia (Chingerel and Davaalkham, 2011; Dejeekhuu et al., 1978).

It was expected that salt consumption in Mongolia would be high due to the tradition of drinking tea with salt. A study by Enkhtuya et al., in 1998 showed that that daily salt consumption was 12.6 ± 4.5 grams among reproductive age women and 14.9 ± 5.5 grams among men (Enkhtuya et al., 1998), 14.2 grams per person amongst the general population of Mongolian (4th National Nutrition Survey Report, 2010). Further studies showed the regions with the highest salt consumption also had a higher mean blood pressure than regions with a lowest salt consumption (Dejeekhuu et al., 1978). Our study showed that salt consumption is high in people with ISH. Of the respondents who had ISH 64.2% consumed more than the recommended daily amount of 5 grams of salt.

Tanu et al. demonstrated that a significant difference in the prevalence of ISH was seen between smokers (9.6%) and non-smokers (3.3%), and between alcoholics (22.2%) and non-alcoholics (4.8%) and multivariate logistic regression analysis of the determinants showed that age, BMI and smoking were significant independent risk factors of ISH among those aged 20 years and above (Tanu et al., 2008). We found that independent variables associated with risk for ISH included age, gender (male), salt intake, duration of smoking and binge alcohol drinking. This was similar to other study results (Gupta et al., 2010; Kim et al., 2005; Tanu et al., 2008). A study of adults older than 35 years of age in China reported that age, gender, BMI and salt intake were risk factors for ISH for Han people and Mongolians (Li et al., 2008).

In conclusion, our study shows that the prevalence of ISH is high in Western and Khangai regions of Mongolia among people aged 15-64 years and the risk of ISH is increasing with age. Men had a significantly higher prevalence of ISH than women. The results of the logistic regression analyses show that the advancing age, male gender, long duration of smoking, excessive salt intake and binge drinking of alcohol are the significant independent risk factors of ISH among the Mongolian population.

REFERENCES

- Baasanjav D (1997). Stroke mortality among population of Mongolia in 1993. Hemodynamic trend in last 20 years. Mongolian Med. J.; 2:3-8
- Burt VL Whelton P, Roccella EJ, Brown C, Cutler JA, Higgins M, Horan MJ and Labarthe D (1995a). Prevalence of hypertension in the US

- adult population. Results from the Third National Health Survey and Nutrition Examination Survey, 1988-1991. *Hypertension* 25:305-313
- Chingereel H, Davaalkham D (2011). Prevalence and risk factors for hypertension and stenocardia among population aged over 40 years in Mongolia, Academic Dissertation, 80-81
- Dejeeekhuu G, Dondog No, Bold R (1978). Contents of sodium and potassium in urine sample and arterial hypertension, Report of Science Academia, 2:59-62
- Enkhtuya P, Yamada C (1998). Salt consumption and iodine content in iodized salt among Mongolian", *Am J. Public Health Asia-Pacific*
- Franklin SS, Gustin IV W, Wong ND, Larson MG, Weber MA, Kannel WB, Levy D (1997a). Hemodynamic patterns of age-related changes in blood pressure, The Framingham Heart Study. *J. Circulation* 96:308-315
- Grebla RC, Rodriguez CJ, Borrell LN, Pickering TG (2010). Prevalence and determinants of isolated systolic hypertension among young adults: the 1999-2004 US National Health And Nutrition Examination Survey", *J Hypertens.* 28(1):15-23
- Gupta AK, Negi PC, Gupta BP, Bhardwaj A, Sharma B (2010). Epidemiology and risk factors of Isolated systolic hypertension in Shimla, Departments of Community Medicine, Cardiology and Medicine, Indira Gandhi Medical College, Shimla 171001 Himachal Pradesh
- Helen Petrovitch, MD; J. David Curb, MD, MPH Ellen Bloom-Marcus, MD, MPH: (2001). Isolated Systolic Hypertension and Risk of Stroke in Japanese-American Men: the Honolulu Heart Program (H.P., J.D.C., E.B.-M.) and the University of Hawaii, John Burns School of Medicine (H.P., J.D.C.), Honolulu, Hawaii, *J Am Coll Cardiol*, 37:163-168
- Huang JF, Wildman RP (1999). Prevalence of isolated systolic hypertension in Chinese adult population, *J Hum Hypertens.* 13(7):467-472
- Kim BG, Park JT, Ahn Y, Kimm K, Shin C (2005). Geographical difference in the prevalence of isolated systolic hypertension in middle-aged men and women in Korea, the Korean Health and Genome Study, *J Hum Hypertens.* 19(11):877-83
- Li J, Xu C, Sun Z, Zheng L (2008). Prevalence and risk factors for isolated untreated systolic hypertension in rural Mongolian and Han populations", Division of Cardiology, Shengjing Hospital of China Medical University, Shenyang, PR China, *Acta Cardiol.*;63(3):389-93
- Nielsen WB, Lindstrom E, Vestbo J, Jensen GB (1997). Is diastolic hypertension an independent risk factor for stroke in the presence of normal systolic blood pressure in the middle-aged and elderly. *Am J Hypertens* 10:634-639
- Nutrition Status of Mongolian population, Fourth National Nutrition Survey Report, (2010). Salt consumption, 103, 131, 151
- Otgontuya D, Erjen D, Ulziiburen Ch (2005). Preventive diet from cardiovascular disease which caused by unhealthy diet, 283-288
- Petrovitch H, Curb JD, Bloom-Marcus E (1995). Isolated systolic hypertension and risk of stroke in Japanese-American men. *Stroke* 26:25-29
- Report of Health Statistics, Mongolia (2008).
- Rocha E, Mello e Silva A, Gouveia-Oliveira A, Nogueira P (2003). Isolated systolic hypertension—epidemiology and impact in clinical practice. *Rev Port Cardiol.* 22(1):25-6
- Rutan GH, Kuller LH, Neaton JD (1988). Mortality associated with diastolic hypertension and isolated systolic hypertension among men screened for the Multiple Risk Factor Intervention Trial. *Circulation.* 77:504-514
- Tanu Midha, MZ Idris, RK Saran, AK Srivastava, SK Singh (2008). Isolated Systolic Hypertension and its Determinant: A Cross-sectional Study in the Adult Population of Lucknow District in North India, Department of Community, Medicine (SPM), GSVM Medical College, Kanpur, India, *Indian J Community Med*, 35(1):89-93.
- Tuomilehto J, Salonen JT, Nissinen (1984). A Isolated systolic hypertension and its relationship to the risk of myocardial infarction, cerebrovascular disease and death in a middle-aged population. *Eur Heart J*, 5:739-744
- Ueda K, Omae T, Hasuo Y, Kiyohara Y, Fujii I, Wada J, Kato I, Kawano H, Shinkawa A, Omura T, Fujishima M (1988). Prognosis and outcome of elderly hypertensives in a Japanese Community: results from a long-term prospective study. *J Hypertens* 6:991-997
- Vokonas PS, Kannel WB, Cupples LA (1988). Epidemiology and risk of hypertension in the elderly: the Framingham Study. *J Hypertens (suppl)*:S3-S9
- Whelton PK (1994). Epidemiology of hypertension. *Lancet* 344:101-106
- World Health Organization. World health report (2002). Reducing risks, promoting healthy life. Geneva, Switzerland: WHO