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Original article

The prevalence of pre-hypertension and hypertension and their related metabolic or anthropometric parameters in rural elderly population in northwest of Iran

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Summary. *Methods:* Data from the 248 elderly subject (n = 110 for men and 138 for women) were obtained from the routinely collected health- center records in four health centers in rural areas of East Azarbayjan, Iran. Data on anthropometric and demographic variables were extracted from the health records. Joint National Committee (JNC)-7 criteria were used to classify hypertension in participants. *Results:* There was a high prevalence of overweight and obesity (44.6% in men and 53.7% in women) and pre-hypertension (16.36% of men and 22.46% of women). Prevalence of hypertension in men and women was 30.90% and 34.04% respectively. Systolic blood pressure (SBP) was significantly correlated with body mass index (BMI) (r = 0.3; P = 0.019) and fasting serum glucose (FSG) (r = 0.3; P = 0.03) in men and women respectively. *Conclusions:* High prevalence of pre-hypertension and hypertension in the present study reinforced the need for routine evaluation of blood pressure for detecting the subjects at high risk of cardiovascular events and referring of vulnerable elderly subjects to other health care providers.

Key words: hypertension, rural elderly population, body mass index

Introduction

Hypertension as defined by Joint National Committee - 7 (JNC-7) is an important health problem and is associated with metabolic abnormalities (1, 2). Hypertension is as a known modifiable risk factor of cardiovascular disease, cerebrovascular disease and end stage renal disease (3). Hypertension can also intensify the effects of other cardio- metabolic risk factors such as obesity, dyslipidaemia and diabetes (4). It has been estimated that the worldwide epidemic of hypertension is about one billion per year and approximately 7.1 million deaths per year may be attributable to it (5). World Health Organization (WHO) cites a "second wave" epidemic of cardiovascular disease (CVD) related to hypertension and other factors in developing countries (5). The prevalence of hypertension in Iran is also rising (6, 7). In Tehran lipid and glucose study (TLGS) the prevalence of age adjusted hypertension in men and women were 19.4% and 23.3% respectively (4).

Hypertension is a common health problem in elderly persons and its prevalence dramatically increases in higher ages reaching a prevalence as much as 60 to 80% (8-12). Moreover, rural population have higher incidence of cardiovascular events due to their lower access to health screening programs compared with urban population (13, 14).

Previous reports about the epidemiology of hypertension in Iran identified that the prevalence of hypertension in Iranian population was strongly age dependent and by each year increase in age, the hypertension prevalence increases around 0.54% after the age

of 20. After age 50 the prevalence increases to 49.5% (9). However to our review of literature, there was no study exploring the prevalence of hypertension and its determinants in rural residents in East Azarbayjan of Iran. The current study was aimed to evaluate the prevalence of pre-hypertension and hypertension and related metabolic, anthropometric and socio-demographic parameters in elderly rural population of this province.

Methods

Study area and population

All data of the present study was collected from the health records of 248 elderly men and women (n = 110 for men and 138 for women) aged 60 to 94 years old referring to public health centers in four rural areas in East Azarbayjan-Iran between March 2012 and February 2013. The rural cites chosen in this study were as follows: Akhula, Anakhatun, Shadabad – Mashayekh and Shadabad-Olya. In the primary health care system in Iran, a trained health worker interviewed with each elderly and recorded the health information in a standard questionnaire. These records included information about age, marital status, living arrangement, smoking habits, educational level and disease history. For ethical considerations, clear explanation of the study aims and methods anteceded taking written informed consent from participants. Data were handled confidentially and de-identified. Each subject had the right to withdraw his/her consent at any time. The project was completely free of charge for all participants.

Biochemical and anthropometric assays

Weight was measured with a balanced beam scale to the nearest 0.1 kg and height to the nearest 0.5 cm with a wall scale while subjects wearing light clothes and no shoes. Body mass index (BMI) was calculated as weight (kg) / Height ^{2} (m). Subjects with BMI: 18.5-24.9 kg/m^2, 25-29.9 kg/m^2 and ≥ 30 kg/m^2 were classified to normal, overweight and obese respectively (15, 16).

Blood pressure measurements and classifications

Resting blood pressure was measured with a calibrated sphygmomameter. These readings were classified as normotensive and hypertensive according to JNC7 guidelines (17). In this classification, systolic blood pressure (SBP) / diastolic blood pressure (DBP) less than or equal to 120/80 was considered as normal blood pressure, 120-139/80-89 as pre hypertension and ≥ 140/90 was hypertension. Among hypertensive group, subjects with SBP/DBP ratio between 140-159/90-99 and ≥ 160/100 have stage one and two of hypertension respectively.

Biochemical assessments

At their first visit to the health center, elderly subjects were referred to the laboratory for biochemical assays including fasting serum glucose (FSG) and low density lipoprotein cholesterol (LDL); the lab results then were recorded in the questionnaire up to one or two day after. FSG was classified into three groups according to the American Diabetes Association (ADA) guidelines: those with FSG < 100 mg/dl, those with impaired fasting glucose (IFG) or serum FSG 100-125 mg/dl and those with FSG > 126 mg/dl (18). Serum LDL was classified according to the pre-specified categorizes of LDL (<100 mg/dl, 100-129.9 mg/dl and >130 mg/dl) as suggested by National Cholesterol Education Program Adult Treatment Panel III (NCEP-ATP III) (19).

Statistical analysis

Statistical analysis was performed by Statistical Package for Social Sciences (SPSS for Windows, release 11.5, 2002, Chicago, IL, USA). Normality of data was analyzed by Kolmogorov-Smirnov test. Comparison of the variables between men and women were carried out by independent sample t-test. Comparison of the variables between BMI categorizes was evaluated with one-way ANOVA using Tukey's post-hoc comparison. Pearson correlation analysis was used for evaluation the relationship between variables. Chi-square analysis was used to compare the proportions of subjects in each BMI category by levels of lipids or FSG.

Results

General characteristics of study participants are shown in Table 1. Mean weight and height in men was higher than women (P < 0.05); However age and

BMI were not significantly different. Majority of men (73.6%) and women (54.34%) were married and were living with spouse. Additionally more than 86% of men and 73% from women had no formal education. Approximately 45% of men and 54% of women were overweight or obese (BMI ≥ 25 kg / m^2); The prevalence of pre-hypertension and hypertension in men and women were 16.36 % , 22.46 % and 31%, 34% in men and women respectively (Table 2).

Comparison of systolic and diastolic blood pressure, FSG and serum LDL cholesterol concentrations between different BMI categorizes has been presented in Table 3. SBP and DBP in both men and women were increased gradually in accordance of increase in BMI; however these increments were not significant except for the levels of SBP in men with BMI ≥ 30 kg/m^2.

Approximately 16% of men and 20% of women had LDL greater than 130 mg/dl. The corresponding values for men and women with LDL 100-129.9 mg/dl were 32.7% and 34.7% respectively. Additionally, over half of elderly men (51.8%) and women (52.9%) were in

Table 1.General characteristics of elderly participants based on gender and body mass index

Variable	Men	Women	Total	P
	N= 110	N= 138	N=248	
Age (year)	72.20±7.29	71.10±7.93	71.99±7.60	0.72*
Weight (kg)	71.61±8.44	65.26±14.11	67.92±16.33	0.003*
Height (cm)	165.99±8.91	156.24±9.05	160.73±10.03	0.000*
BMI (kg/m^2)	26.52±6.54	26.45±5.10	26.35±5.62	0.74*
Marital status [n (%)]				
Married	94 (85.4)	62 (45)	156 (62.9)	0.000**
Widowed	15 (13.6)	71 (51.4)	86 (34.6)	
Divorced	1 (1.81)	5 (2.8)	6 (2.1)	
Living arrangement [n (%)]				
Live with spouse	81(73.6%)	75 (54.34%)	156 (62.90%)	0.000**
Live with others	15 (13.63%)	44(31.88%)	59 (23.79%)	
Alone	14 (12.72%)	19 (13.76%)	33 (13.30%)	
Educational attainment [n (%)]				
Illiterate	89 (86.40%)	141 (73.24%)	230 (92.74)	0.001**
1-6 years of schoolings	14 (13.59%)	4 (26%)	18 (7.2%)	0.001**

**P values are for t-test, **P values are for chi-square*

Table 2. Prevalence of overweight and different stages of hypertension according to the JNC7 classification in study participants

Variable [n (%)]	Men	Women	Total	P
Overweight or Obesity (BMI ≥ 25 kg/m^2)	49 (44.66)	74 (53.79)	123 (50)	0.64
Normotensive	50 (45.45)	68 (49.27)	118 (47.58)	
Pre hypertensive	18 (16.36)	31 (22.46)	49 (19.75)	0.81
Hypertensive stage 1	23 (20.90)	29 (21)	52 (21)	
Hypertensive stage 2	11 (10)	18 (13.04)	29 (11.69)	

Table 3. Blood pressure, fasting serum glucose and LDL concentrations in elderly participants based on gender and body mass index

Variable	Total	BMI 18.5-24.9 kg/m²	BMI 25-29.9 kg/m²	BMI ≥ 30 kg/m²	Total	BMI 18.5-24.9 kg/m²	BMI 25-29.9 kg/m²	BMI ≥ 30 kg/m²
	(N = 110)	(n=58)	(n=36)	(n=16)	(N=138)	(n=58)	(n=41)	(n=39)
SBP (mmHg)	129.95±20.02	127.9±18.40	126.06±16.80	147.69±25.31*	129.47±19.12	127.05±15.80	129.00±23.07	133.65±18.84
DBP(mmHg)	87.55±12.32	77.30±10.12	78.79±12.37	83.85±9.60	77.37±15.21	75.54±16.14	76.25±17.96	81.36±8.79
LDL (mg/dL) [n (%)]								
<100	47(42.7)	26 (44.2)	15 (41.6)	6 (37.5)	52(37.6)	25(68.1)	20 (48.7)	7(17.9)
100-129.9	36(32.7)	24 (41.3)	6 (16.6)	6 (37.5)	48(34.7)	20(34.4)	13 (31.7)	15(38.4)
130≤	17(15.4)	8 (13.7)	5 (13.8)	4(25)	28(20.2)	13(22.41)	8 (19.5)	7(17.9)
FSG mg/dL [n (%)]								
< 90	53(48.2)	25(43.1)	20(55.5)	8 (50)	65(47.1)	25(43.1)	20(48.8)	20(51.2)
90-100	27 (24.5)	14(10.4)	8 (12.3)	5 (31.2)	24(17.4)	3 (5.1)	11(26.8)	10(25.6)
100-125	17 (15.5)	12(20.7)	2 (17.9)	3 (18.7)	25(18.1)	15(25.8)	2(4.8)	8(56.5)
126≤	13 (11.8)	7(2.4)	6 (16.6)	0	24(17.4)	15(25.8)	8(19.5)	1(2.5)

***A significant difference between SBP in this group and another groups (P = 0.002)**

different abnormal serum glucose groups; among them 11.8% from men and 17.4% of women had diabetes.

At the time of the blood pressure measurement, only 34 persons (13.70%) reported to be on antihypertensive drugs, among them only 5 persons (0.2% of total population or almost 0.4% of normotensive subjects) were in normotensive group; since they constituted a very low sample of normotensive subjects therefore the results were similar even after excluding the subjects on anti-hypertensive drugs (data not shown). Only 10 persons (4%) were in anti-diabetic drugs and all of them were in diabetic group. SBP was significantly correlated with BMI and FSG in men and women respectively (Table 4). In combined analysis of subjects SBP was positively associated with age, BMI and FSG in total participants.

The prevalence of socio-demographic factors in different hypertensive groups are presented in Table 5. Approximately 40% of hypertensive group were in widowed marital status and 14.8% were living alone. A high prevalence of pre-hypertensive group were living with others (38.77%) or alone (24.28%).

Discussion

The number of elderly subjects in developing countries is increasing; therefore it has been expected that the prevalence of chronic non-communicable disease such as hypertension reach to its enormous burden (20). Only a few published data analyzing the relationship between obesity and hypertension in developing coun-

Table 4. Relationship between systolic and diastolic blood pressure, body mass index and fasting serum sugar in elderly participants

	Males (N =110)		Females (N = 138)		Total (N = 248)	
Variable	SBP (mmHg) r (P)	DBP (mmHg) r (P)	SBP (mmHg) r (P)	DBP (mmHg) r (P)	SBP (mmHg) r (P)	DBP (mmHg) r (P)
Age (y)	0.136 (NS)	0.001 (NS)	0.143 (NS)	0.06 (NS)	0.141 (0.03)	0.009 (NS)
BMI (kg/m²)	0.30 (0.019)	0.03 (NS)	0.163 (NS)	0.11 (NS)	0.25 (0.003)	-0.008 (NS)
FSG (mg/dL)	0.22 (NS)	0.05 (NS)	0.30 (0.03)	0.18 (NS)	0.30 (0.004)	-0.06 (NS)

Table 5. Socio-demographic factors according to the different hypertension stages in elderly subjects

Variable	Normotensive N = 118	Pre-hypertension N = 49	Hypertension N = 81	P*
Marital status [n (%)]				
Married	80 (67.79)	29 (59.18)	47 (58.02)	0.05
Widowed	34 (28.81)	20 (40.81)	32 (39.50)	
Divorced	4 (3.38)	0	2 (2.46)	
Living arrangement [n (%)]				
Live with spouse	78 (66.10)	18 (36.73)	60 (74.07)	0.004
Live with others	31 (26.27)	19 (38.77)	9 (11.11)	
Alone	9 (7.62)	12 (24.48)	12 (14.81)	
Educational attainment [n (%)]				
Illiterate	108 (91.52)	45 (91.83)	77 (95.06)	0.53
1-6 years of schoolings	10 (8.47)	4 (8.16)	4 (4.93)	

**P values are for chi-square*

tries (21-23) especially in rural elderly population (24) are available. In the present study, we found that elderly men with BMI ≥ 30 kg/m^2 have significantly higher SBP compared with other groups; additionally a positive relationship between SBP and BMI in men and in total participants has been reported. These results are in accordance with the results of several other studies (1, 25-27).

Higher BMI leads to hypertension via increase in body fluid volume, peripheral resistance and higher cardiac output (28). Other possible mechanisms explaining this relationship are insulin-dependent sympathetic nervous system stimulation (29), activation of the rennin-angiotensin system (30) and endothelial dysfunction in obese individuals (31). We also found that FSG was in positive association with SBP in women and in total participants ($P < 0.05$). This finding was in consistent with several other reports in general population (26) and in middle aged population (32). The mechanisms underlying this positive relationship have not been fully determined; however one possible mechanism is that high serum glucose concentrations can increase stiffness of joints and arteries and ultimately higher blood pressure via non-enzymatic glycosylation of collagen and elastin (33, 34). Additionally higher serum insulin can also directly increases arterial stiffness and hypertension (35).

The prevalence of hypertension in our study was higher compared with several other studies (36); The prevalence in men and women were 16.36%, 22.46 % for pre-hypertension and 31%, 34% for hypertension in men and women respectively; Gambassi G et al. reported the prevalence of hypertension 33% and 27% in elderly women and men respectively (37). There is a point of controversy that whether the hypertension prevalence will be higher in older women than in men which has been reported in several cross- sectional studies (38-41). It has been suggested that the protective role of estrogen is responsible to lower blood pressure in young women than in men (39) and menopause leads to increase in blood pressure in women (41, 42). However several factors other than menopause such as lower physical activity level might be responsible in higher blood pressure in older women (40). Moreover, the literature suggests that women are more likely to be unaware of treat to health that pre-hypertension or hypertension may pose (43).

Living arrangements can also be a potent predictor of cardiovascular risk factors and high blood pressure in elderly population; in our study the percent of elderly subjects who were living alone among hypertensive and pre-hypertensive group were 14.8% and 24.28% respectively. Consistent with our find-

ings, Gliksman et al. (48) found that elderly men living alone had the highest SBP in the Western Sydney Stroke Risk in Elderly Study.

The current study has several limitations; first of all we did not evaluate serum concentrations of other metabolic risk factors including total cholesterol, triglyceride or high density lipoprotein concentrations. Moreover the data about nutritional intakes as a major determinant of hypertension and its metabolic risk factors were not assessed. However, the current study was the first one evaluating the hypertension prevalence in rural areas of East Azarbayjan and the results of the current study can point to the high prevalence of pre- hypertension and hypertension in rural communities of Iran.

In conclusion, the high prevalence of hypertension and pre-hypertension among this elderly population in rural areas, and the positive relationships between blood pressure and body mass index, suggests that rural elderly individuals are especially vulnerable to cardiovascular disease and further confirms the need of additional counseling about the presence of health problems and refer to other health care providers for elderly rural people in East Azarbayjan-Iran.

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