BLOOD PRESSURE LEVELS AND TRENDS OF OBESITY IN HYPERTENSIVE PATIENTS VERSUS HEALTH INDIVIDUALS: ISFAHAN 1991-2001

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ABSTRACT

Introduction: Obesity is an independent risk factor for cardiovascular disease. Clinical studies have shown that body weight reduction, decrease blood pressure. The aim of this study was to illustrate the trend of hypertension and obesity according to body mass index in three cross-sectional studies conducted in the city of Isfahan during a period of ten years.

Methods: In a series of three cross-sectional studies among the population aged over 25, in Isfahan samples were selectaed in a multistage method (1991-1992, 1995-1996, and 2000-2001). 2438, 3234, and 2015 individuals were studied, respectively. The blood pressure of subjects was checked twice, one week apart. Blood pressure measurement was conducted by trained nurses.

Results: Mean systolic blood pressure (SBP) have been decreased significantly in all groups ($P<0.005$). However, reduction of diastolic blood pressure (DBP) mean was significant only in men and women who were under treatment with antihypertensive drugs ($P<0.05$). In all hypertensive groups and in health subjects, there was an increase in body mass index (BMI). This increase had a more notable trend in hypertensive groups, compared with healthy individuals. The prevalence of obesity in hypertensive patients was higher than that of the healthy group.

Discussion: Obesity has had a rising prevalence during the last ten years in hypertensive and healthy individuals. In light of the importance of weight control in hypertensive patients, it is recommendable as a primary prevention measure.

Keywords: Trend, Hypertension, Obesity, Isfahan

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INTRODUCTION

Obesity is recognized as an independent risk factors of cardiovascular disease (CVD) [1, 2]. Body weight has the identified role in beginning and progress of CVDs [3, 4]. Blood pressure is controlled by weight reduction [5, 6].Hence, weight reduction in overweight individuals has been recommended as a key principle for prevention and control of hypertension [7, 8]. Obesity, especially abdominal type, is often accompanied by hypertension, hyperlipidemia, hyperinsulinemia, and diabetes, leading to poor prognosis of Coronary Artery Disease (CAD) in hypertensive obese individuals [9, 10].

Some studies have shown that hypertension is an important risk factor for CVD-related mortality, compared to obesity [11, 12], although different studies have yielded varying results [12]. Of great importance is the control and treatment of hypertension, as well as weight reduction and decreasing central obesity [11]. Given the absence so far of any studies on the trend of body mass index (BMI) and blood pressure levels in large populations in Iran, this study was conducted to investigate the changes in systolic and diastolic blood pressure and BMI, as well as the trend of changes in BMI in the population of individuals aged 25 or higher in Isfahan city during a period of ten years.

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METHODS

This study consisted of three cross-sectional surveys conducted in 1991-1992, 1995-1996, and 2000-2001 in the population over 25 year old in Isfahan and a total of 2438, 3234, and 2015 individuals were studied, respectively.

Random clustering method was used for sampling. Blood pressure of subjects was checked twice, one week apart. Upon every referral, the person's blood pressure was taken in the right hand in sitting position after 5 minutes of rest. Blood pressure was measured twice and the mean of the two measurements was recorded as the person's blood pressure. The measuring device was a mercury sphygmomanometer with a cuff matching the subject's arm size (width: 13 cm, length: 42 cm). The subject's heights were measured in centimeters, and their weights were Measured using by Seca scale, that it's due to kilogram and were blood pressure upon auscultation of the First sound was SBP and the forth Krotokoff sound was considered as the DBP.

In all three studies, trained individuals were used to collect and record data. They were examined twice to ensure all measurements were performed correctly. To eliminate distorting data in weight and height measurement, all subjects underwent measurements under identical conditions, while they were dressed lightly and did not wear shoes. For analysis purposes, 4 distinct BMI ranges were considered as follows *(WHO definition of BMI was used)* [13]

1- 18 < BMI ≤ 25 kg/m2 was normal weight

2- 25 < BMI < 29.99 kg/m2 was overweight Grade

3- 30 < BMI < 39.99 was overweight Grade II

4- BMI ≥ 40 was overweight Grade III

People with a minimum SBP and DBP of 140 and 90 mmHg, respectively, and those who had begun receiving antihypertensive medications at least 7 days before entering the study were considered as hypertensive. Hypertensive subjects were divided into four groups:

1- Individuals unaware of their hypertension.

2- Individuals who were aware of their hypertension, but did nothing to treatment it.

3- Individuals who were aware of their hypertension but did nothing to treatment it,

4- Individuals who were aware of their hypertension and their blood pressure were under control.

***Statistical analysis*:** The data was entered into computer via EPI5 software and statistically analyzed with SPSS10. Variance analysis test was used to determine significant difference between parameters.

P-value less than 0.05 with a Confidence Interval of 95% was considered as showing a significant difference between dependent and independent variables [14].

RESULTS

Mean age of individuals in the hypertensive group was higher than that of healthy individuals. However, mean age of subjects was nearly the same in all hypertensive groups. Between 1991 and 2001, the mean age of men whose hypertension remained uncontrolled despite treatment decreased 15 years. However, the mean age of men successfully treated for hypertension increased 5 years. Mean age of individuals who were aware of their hyper-tension but did not seek treatment decreased 2 years. In women, mean age of all subjects (i.e. hypertensive and health individuals) decreased, except in women who had uncontrolled hypertension despite treatment. Between 1991 and 2001, mean SBP decreased significantly in all hypertensive groups in both sexes, except in those who were unaware of their hypertension (Table 1).

Mean SBP showed a significant difference between hypertensive groups. SBP was also significantly different between healthy individuals and those in hypertensive groups ($P<0.05$). During the last ten years, mean SBP in both sexes has had a decreasing trend (Table 2). This difference is significant only in hypertensive women whose blood pressure has been controlled by drug treatment ($P<0.05$).

In general, a significant difference was observed between different years of the study in terms of SBP ($P<0.05$).

Study of the trend of obesity versus BMI and its changes in all hypertensive and healthy groups in both sexes during the last ten years shows an increase in mean BMI, with a statistically significant difference between different years of the study ($P<0.05$). However, in 1996 and 2001, there was no significant difference between hypertensive women in terms of BMI ($P<0.05$). The trend of obesity or BMI change in hypertensive women and men who were under drug treatment but their hypertension remained uncontrolled was more striking, and statistically significant ($P<0.05$). Mean of changes in BMI in women who were unaware of their hypertension during the last ten years was lower than other groups under study (Table 3).

Table 1: Mean of Systolic Blood Pressure among Population with High Blood Pressure based on Sex and Survey

	High Blood Pressure Individuals				Total HTN	No-HTN
	Unaware	**Aware but Uncontrolled**	**Treated but Uncontrolled**	**Controlled**		
Male						
1991	144.03±15	152.3±14.2	165±13	130±11	160±15	112±11
1996	150±14	151±18.9	158±20.3	128±9.4	157±12.2	123±9.8
2001	141±15	144±13	150±15	120±5.2	146±14	110±11
Difference	-3.03	-8.3	-15	-10	-14	-2
Female						
1991	144±31	152±18	166±19	134±6	165±30	110±12
1996	154±15.05	157±15.8	173±17.4	128±8.4	163±25	121±11
2001	142±19	149±15	155±18	120±9.8	145±21	106±12
Difference	-2	-3	-1	-14	-20	-4

(All differences are significant P<0.05)

Table 2: Mean of Diastolic Blood Pressure among Population with High Blood Pressure based on Sex and Survey

	High Blood Pressure Individuals				Total HTN	No-HTN
	Unaware	**Aware but Uncontrolled**	**Treated but Uncontrolled**	**Controlled**		
Male						
1991	91±10	94±8	95±12	85±2	91±7.3	73±7
1996	92±9	93±11	97±11	81±5	94±13	78±6
2001	90.6±11	92.6±11.8	92.6±12	79±4	89.4±11.9	71.3±8.6
Difference	-0.4	-1.4	-2.4	-6	-1.6	-1.7
Female						
1991	92±11	93±9	96±11	91±4	92±10	72±8
1996	92±8	94±9	100±10	81±3	96±11	76±7
2001	91.8±12	92±12	95±13	89±1.2	89.9±13	71.5±9.1
Difference	0.2	-1	-1	+2	-2.1	-0.5

(All differences are significant P<0.05)

Table 3: Mean of Body Mass Index among Population with and without High Blood Pressure based on Sex and Survey

	High Blood Pressure Individuals				Total HTN	No-HTN
	Unaware	**Aware but Uncontrolled**	**Treated but Uncontrolled**	**Controlled**		
Male						
1991	26±3	25±3	21±2	21±1	25±3	23±3
1996	30±3.6	29±4	29±2	28±2	28±3	27±3
2001	32±4.2	29±3.4	29.9±7.2	28.8±3.6	29.54±3.9	26±4.6
Difference	+6	+4	+8	+7	+4	+3
CI 95%	+6.07 to +5.93	+4.01 to +3.98	+8.2 to +7.2	+7.3 to 6.7	+3.3 to +2.7	+2.15 to +1.85
Female						
1991	28±4	28±8	25±3	24±2	28±5	26±4
1996	27±2	25±8	27±3	25±3	26±4.2	22±2.8
2001	28.4±7.3	30.5±3.4	31±8.7	29.2±7.9	31.7±6.9	26.5±5.8
Difference	+0.4	+2.5	+6	+5.2	+3.7	+0.5
CI 95%	+0.6 to +1.4	+0.3 to +2.9	+0.4 to 0.8	+5.1 to 4.7	+3.1 to +4.5	+0.3 to +0.8

(All differences are significant P<0.05)

Table 4: Prevalence of Population with and without High Blood Pressure according to their BMI categories based on Sex and Year of Survey

	BMI categories among Hypertensive Individuals																BMI categories among Non-Hypertensive Individuals			
	Unaware				Aware but Uncontrolled				Treatment but Uncontrolled				Controlled							
	<25	25-30	30-40	>=40	<25	25-30	30-40	>=40	<25	25-30	30-40	>=40	<25	25-30	30-40	>=40	<25	25-30	30-40	>=40
Male																				
1991	32.4	51.6	15.8	0.2	41.7	47.21	11.1	0	93.8	6.3	0	0	88	7	5	0	55.5	38.1	6.2	0
2001	38.7	43.2	15	2.5	16.7	45.8	37.5	0	28.4	49.4	19.8	19.8	2.5	25	62.5	12.5	58	31.8	9.7	0
Difference	6.2	-8.4	-0.8	2.3	25	1.41	26.4	0	-64	43.1	19.8	19.8	-85.5	18	57.5	12.5	2.5	-6.3	3.5	0
Female																				
1991	29.3	5.3	37.3	1.3	26.6	43.8	26.6	0	50	27	5.2	6.8	33.13	66.7	94.7	0	38.5	40.5	20	0
2001	29.5	36.5	31.8	4.2	0	43.5	56.5	0	17.8	33.1	42	7	19.6	44.6	30.4	5.4	43.4	33.4	21.7	0
Difference	0.2	31.2	-5.5	2.9	-26	-0.3	30.1	0	-32	6.1	36.8	0.2	-13.5	-22	-64	5.4	4.9	-7.1	1.7	0

As shown in (Table 4), between 1991 and 2001, BMI displayed a different trend in men who were unaware of their hypertension compared with women, and the trend of obesity in this group of hypertensive subjects was more striking in women than in men, i.e. during the last ten years, the rate of obesity (25<BMI<30) was six-folded in women compared with men. The percentage of obese men under drug treatment increased significantly and this trend is more striking in subjects with uncontrolled hypertension.

Comparison of CVD risk factors between subjects with controlled and uncontrolled hypertension within two BMI ranges of < 30 and ≥ 30 revealed that mean SBP, cholesterol, and HDL-C in men with uncontrolled hypertension are significantly different from others ($P<0.05$). In women with uncontrolled hypertension, SBP and HDL-C measures were significantly different from others ($P<0.05$) (Table5).

DISCUSSION

Mean age of subjects in hypertensive groups was higher than that of healthy individuals; however, mean age of all four groups of hypertensive individuals was the same, hence age did not affect the severity of hypertension as an interventional factor. Other studies, however, have shown that blood pressure increases with age [15]. It was also observed that SBP had a significant deceasing trend in all hypertensive groups and healthy subjects (both male and female), except in those who were unaware of their hypertension. A similar trend has been reported in a study by Mika, et al. [16], which is probably due to more frequent and timely patient referral to physician, continuity of treatment, reduced salt intake, and the use of new and more effective antihypertensive medications.

Increased BMI is an independent risk factor for hypertension which must be prevented and controlled [16]. Mean BMI increased in both sexes in all hypertensive and healthy groups. This BMI increase was statistically significant over the years of the study. However, between 1996 and 2001, mean BMI did not change significantly in groups of hypertensive women. The unfavorable trend of changes in BMI may be due to reduced physical activity, increased consumption of grains and fat (especially of the hydrogenated type).

Insignificant reduction of DBP in men may be due to increased BMI. Interestingly, most hypertensive men and women said they had made several attempts to control their weight, although only few had managed to maintain their weight reduction. These findings underline the necessity of devising a simple and effective educational method of weight reduction in the health systems.

Based on the results of this study, mean BMI had an increasing trend between 1991 and 2002. The decreasing trend of SBP may stop or be reversed if BMI increase is not curbed. Weight reduction is of great importance in hypertensive obese individuals.

A study conducted in Finland between 1982 and 1997 showed a significant BMI increase in all hypertensive groups, compared to healthy individuals. In all hypertensive groups, BMI increased only in women who were unaware of their hypertension and hence did not seek treatment [17].

Tabel 5: CVDs Risk Factors among High Blood Pressure Individuals based on BMI and Sex

	Hypertension		Uncontrolled Hypertension	
BMI	**30>**	**30<=**	**30>**	**30<=**
Male				
AGE (years)	61±14.5	57.1±14.1	58.7±11.5	62±12
SBP (mmHg)	120±1	123±6*	158±23	158±19
DBP (mmHg)	77.5±3.5	79.7±4.7	96±11	91±13
Col-Total (mmol/L)	220±68	238±48	223±50	256±75*
HDL-C (mmol/L)	47±9	49±4.9	45±9	46±10
TG (mmol/L)	190±74	255±112	226±191	320±246
LDL-C (mmol/L)	129±53	137±65	139±36	134±40
Female				
AGE(years)	51.5±12.6	62.8±12.51	57.7±9.7	60±11.2*
SBP(mmHg)	119.7±10	120.9±9.7	154±17	156±19
DBP(mmHg)	77±5	75.5±7.7	94±15	95±11
Col-Total(mmol/L)	246±49	232±54	238±51	244±52
HDL-C(mmol/L)	49±9.7	49±10*	49±11	48±10
TG(mmol/L)	211±99	221±103*	250±155	235±106*
LDL-C(mmol/L)	155±40	141±42	142±43	144±41

*P value <0.05 is significant-student test
All variables are listed as mean±SD
SBP: Systolic Blood Pressure .DBP: Diastolic Blood Pressure. Col-total: Cholesterol Total. HDL: High Density Lipoprotein Cholesterol. LDL-C: Low Density Lipoprotein Cholesterol TG: Triglyceride

It was also seen in this study that 47% of men and 49% of women receiving antihypertensive treatment were obese [17]. Hypertension is 1.6-3 times more prevalent in obese or over-weight people compared with individuals with normal BMI [18].

A global study known as INTERSALT involving 52 world nations has shown that every 10 kg increase in body weight is associated with an increase of 3 mmHg in SBP, and an increase of 2.2 mmHg in DBP [19].

A 1990 prospective study known as TAIM (Trial of Antihypertensive Interventions and Management) found that overweight and obesity were associated with an increased risk of hypertension [20]. A decrease in BMI leads to a more notable reduction of SBP and DBP in hypertensive patients and even healthy individuals [16].

A study of hypertensive patients in 1993 showed a significantly better blood pressure control in patients who combined drug treatment with weight reduction, compared to patients who only received antihypertensive medications [21, 22]. Increased BMI leads to a higher CVD-related mortality in hypertensive individuals.

It was observed in the study that men with uncontrolled hypertension in the two groups with BMI ≤ 30 and BMI > 30 had a significant increase in their mean SBP, total cholesterol, and HDL-C. In women, there was a significant difference between the two groups with BMI ≤ 30 and BMI > 30, in terms of mean SBP and HLD-C.

Almost similar results have been obtained by other studies. A study of women and men aged between 25 and 64 years in Australia showed that hypercholesterolemia (total cholesterol ≥ 6.5 mg/L) in hypertensive men and women was 57% and 94% more prevalent than in healthy individuals, respectively, showing a statistically significant difference [23].

A population-based study (known as the Grub-bier study) showed that the prevalence of obesity had a significant exasperating effect on blood pressure in both sexes, when compared with healthy individuals [24].

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