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The Prevalence of High Blood Pressure and Its Relationship with Anthropometric Indicators; a Population Based Study in Fars Province, IR Iran

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ABSTRACT

Background: The burden of non-communicable diseases is rising globally. The present study was carried out to examine the relationship between different anthropometric indices and blood pressure in the Iranian population.

Methods: A cross-sectional descriptive study was conducted on 3916 subjects including 1976 males and 1940 females, aged 15- 64 years from a healthy population in Shiraz, IR Iran. Anthropometric variables of each person including weight, height, waist circumference (WC), waist to height ratio (WHR) and body mass index (BMI) were calculated along with measuring systolic and diastolic blood pressures (BP). The relationship between blood pressure and different anthropometric variables was determined in both genders.

Results: The mean±SD systolic blood pressures were 123.9±20.0 and 121.2±17.7 mmHg while the mean diastolic blood pressures were 78.3±11.9 and 77.4±12.9 mmHg in men and women respectively (P<0.001). The prevalence of hypertension in men (23.8 %) was significantly more than that of women (21.1 %). Mean systolic and diastolic blood pressures increased with age and BMI in both genders. Anthropometric indices showed a positive association with systolic and diastolic blood pressures.

Conclusion: The BMI and WC showed a strong association with systolic and diastolic blood pressure. The suggested lower cut-off values of the anthropometric indicators will cover maximum of the population with higher odds of having hypertension and may help reduce the levels of population's mean blood pressure.

►*Implication for health policy/practice/research/medical education:*
Close relationship between obesity and various disease conditions such as hypertension it was demonstrated that BMI and WC were strongly associated with systolic and diastolic blood pressure, an issue of serious consequence.

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Introduction

According to the World Health Organization reports, chronic diseases will cover three-quarters of all the deaths in the developing world by the year 2010 (1). Occupation-related stress has been considered as a potentially important cardiovascular risk factor (2). The burden of non-communicable disease is rising dramatically and shows increasing trend in regard to the developing countries of the Middle East (3).

While cardiovascular diseases and their main risk factors including hypertension, diabetes, obesity, lack of sufficient exercise, smoking and high blood fats are the most important causes of mortality and morbidity in most developed countries, non-communicable diseases among middle-income population have affected the communities and are also are the leading cause of death worldwide (4).

In IR Iran as a middle-income country, in addition to the burden of non- communicable diseases, absolute burden and risk factors are likely to increase in the future. During the past 20 years, obesity has had an increasing trend in United States so that in 33 states of America the prevalence of obesity is more than 25 percent and in 9 states such as

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Mississippi it is equal or more than 30 percent. In central Argentina, the prevalence of diabetes is between 6-8 percent while that of obesity is 26 percent; hypertension and high blood fat have afflicted 1.3 percent of the population (5).

Hypertension is one of the most common and important risk factors for cardiovascular diseases (6). In addition, coronary artery diseases and stroke are caused due to the body's response to certain risk factors such as hypertension, diabetes type 2 and hyperlipidemia (7). On the other hand, several factors are considered as predisposing factors to hypertension such as obesity and increased Body Mass Index (BMI) (8).

The accelerated development and economic transition of IR Iran has been accompanied by cultural changes, reduction in communicable diseases, Life expectancy, changes in dietary habits and activity.

Obesity refer to a threatening fat storage in the body (9). Several indices such as BMI, waistline, hip circumference, waist to hip ratio and waist to height ratio (WHtR) are used as indicators of obesity (8). Although previous reports have shown an association between high BMI and hypertension, fewer studies have surveyed the relationship between hypertension and other anthropometric indices that are representative of body fat distribution. Nevertheless there are still some debates on an obesity-based index which predicts the risk of cardiovascular diseases.

Since it is essential to determinate anthropometric indices which are more associated with hypertension, the present study was carried out to evaluate these relationships in the population of Fars province, IR Iran .The data obtained will also serve as the baseline for long term future studies.

Materials and Methods

Fars is the fourth populated region of IR Iran and the second largest province located in southwestern IR Iran. In order to carry out non-communicable disease risk factor surveillance, the Department of Health of Shiraz University of Medical Sciences gathered relevant data from 2007 to 2010. The study included 3916 subjects aged from 15-64 years, who were categorized into five age groups of 15-24, 25-34, 35-44, 45-54 and 55-64. Annually, a total of 200 individuals (100 men and 100 women) were selected from each Category.

The first stage involved stratified sampling which included villages, cities and areas of large cities followed by cluster sampling in each stratum. Clusters were selected according to postal districts.

In cluster sampling the association within each cluster was reduced to minimum. Data was collected by trained interviewers who were University employees. Weight, height, waist circumference (WC) and systolic and diastolic blood pressure of each participant were also measured. A digital weight scale with a maximum difference of 0.1 kg was used for measuring weights. The individual heights were measured in upright position with the SECA (Germany) height scale with a maximum difference of 0.05 centimeters. The standard measurement of the waist and hip circumference were carried out using a measuring tape with intervals of 0.05 centimeters. Waist circumference represented an average of three measurements of waist diameter at midpoint between iliac crest and lower border of tenth rib. The hip circumference was determined by measuring the distance around the human body at the level of maximum posterior extension of the buttocks.

To be accurate, blood pressure was taken three times on the right arm and at the level of the heart after relaxing for 5 minutes while sitting in vertical position, and using a standard mercury sphygmomanometer (Omron M6 Comfort, Blood Pressure Monitors, Japan).

According to the definition of the seventh report of the joint national committee on prevention, detection, evaluation, and treatment of high blood pressure (10),

Table 1. Age-dependent description of blood pressure in relation to gender.

	Blood Pressure	Age	Number	Mean	Standard Deviation	95% confidence interval		P Value
						Low	High	
Male	Systolic	15-24	393	118.2	13.5	116.8	119.5	<0.001
		25-34	396	121.2	14.0	119.8	122.6	
		35-44	396	122.8	16.1	121.2	124.4	
		45-54	399	127.0	17.3	125.3	128.7	
		55-64	378	130.8	23.2	128.4	133.1	
	Diastolic	15-24	393	74.8	10.6	73.7	75.8	<0.001
		25-34	396	77.7	10.1	76.7	78.7	
		35-44	396	79.0	10.7	77.9	80.0	
		45-54	399	81.3	12.2	80.1	82.5	
		55-64	378	82.1	14.1	80.7	83.5	
Female	Systolic	15-24	393	111.0	12.2	109.8	112.2	<0.001
		25-34	396	113.4	15.0	111.9	114.9	
		35-44	385	119.9	17.3	118.2	121.6	
		45-54	399	129.6	21.4	127.5	131.7	
		55-64	374	132.5	22.8	130.2	134.9	
	Diastolic	15-24	393	72.4	10.4	71.3	73.4	<0.001
		25-34	396	74.2	11.6	73.1	75.4	
		35-44	385	78.4	12.1	77.2	79.6	
		45-54	399	82.6	14.1	81.2	84.0	
		55-64	374	82.5	12.8	81.2	83.8	

Table 2. Description of blood pressure in males and females.

Blood Pressure	Gender	Number	Mean	Standard Deviation	95% confidence interval		P Value
					Low	High	
Systolic	Male	1962	123.9	17.7	123.2	124.7	<0.001
	Female	1947	121.2	20.0	120.3	122.1	
Diastolic	Male	1962	78.9	11.9	78.4	79.5	0/019
	Female	1947	78.0	12.9	77.4	78.6	

blood pressures were categorized into four groups of normal blood pressure (systolic blood pressure less than or equal to 120 and diastolic blood pressure less than or equal to 80), prehypertension (systolic blood pressure between 120-139 and diastolic blood pressure between 80-89), hypertension stage I (systolic blood pressure between 140-159 and diastolic blood pressure between 90-99) and hypertension stage II (systolic blood pressure more than or equal to 160 and diastolic blood pressure more than or equal to 100).

According to World Health Organization, in terms of BMI individuals are divided into four groups of low weight (less than 18.5), normal weight (18.5to 25), overweight (25 to 30) and obese (more than 30). The WC exceeding 102 centimeters in men and 88 in women are considered as abdominal obesity. Also waist to hip ratio (WHR) higher than 1 in men and 0.9 in women were considered as abdominal obesity and WHR 0.9-1 in men and 0.8-0.9 in women considered borderline abdominal obesity.

Statistical Analysis

Statistical Analysis was performed using statistical analysis software SPSS version 11.5. and descriptive variables such as mean, median, standard deviations were used. One-way Analysis of variance (ANOVA) was performed to determine significant differences among anthropometric characteristics and blood pressure based on sex, and for comparison between age groups in regard to systolic and diastolic blood pressure. The independent sample t-test was used to establish differences between sex and systolic and diastolic blood pressure. P value less than 0.05 was considered significant.

Results

The mean age of the participants was 39.6± 14.2. Out of 1976 participants (50.2 %) were males and 876 (22.4%) of them had high blood pressure. The prevalence of hypertension in men (23.8 %) was significantly higher ($P<$ 0.001) than women (21.1 %). The prevalence of obesity, abdominal obesity and obesity based on waist to height ratio were 21.0, 67.5 and 46.7 percent in women and 8.4, 56.0 and 12.6 percent in men respectively. The prevalence of obesity in women was significantly higher than in men ($P<0.001$).Tables 1 and 2 show the values of systolic and diastolic blood pressure in terms of gender and age.

Descriptions of height, weight, obesity, BMI, WC, and WHR are presented in Tables 3 and 4 in relation to gender and blood pressure groups.

The prevalence of hypertension in obese men and women (Based on BMI, WC and WHR) was significantly higher than those with normal weight ($P<0.001$).

According to the Figures 1 and 2, the areas under ROC

Table 3. Description of height, weight, obesity, BMI, WC and WSR in terms of blood pressure groups in men.

Index	Blood Pressure	Number	Mean	Standard Deviation	95% confidence interval		P Value
					Low	High	
Height	Normal	909	171.00	7.80	170.50	171.50	0.026
	Prehypertension HTN	585	171.30	7.60	170.70	171.90	
	HTN stage I	343	170.00	7.90	169.20	170.90	
	HTN stage II	122	169.00	7.40	168.30	170.90	
Weight	Normal	909	76.60	12.90	66.40	68.40	<0.001
	Prehypertension HTN	585	72.00	13.90	70.80	73.10	
	HTN stage I	343	74.10	13.40	72.70	75.50	
	HTN stage II	122	74.50	13.20	72.10	76.90	
WC	Normal	909	84.30	12.80	83.50	85.10	<0.001
	Prehypertension HTN	585	88.10	13.90	87.00	89.10	
	HTN stage I	343	91.90	13.30	90.50	93.30	
	HTN stage II	122	93.70	12.70	91.40	96.00	
BMI	Normal	909	23.10	3.90	22.10	23.30	<0.001
	Prehypertension HTN	585	24.50	4.30	24.20	24.90	
	HTN stage I	343	25.60	4.30	25.20	26.10	
	HTN stage II	122	25.90	4.50	25.10	26.70	
WHR	Normal	909	0.50	0.10	0.50	0.50	<0.001
	Prehypertension HTN	585	0.50	0.10	0.50	0.50	
	HTN stage I	343	0.50	0.10	0.50	0.50	
	HTN stage II	122	0.60	0.10	0.50	0.60	

HTN: Hypertension; WC: waist circumference; BMI: Body mass index; WHR: waist to hip ratio

Table 4. Description of height, weight, obesity, BMI, WC and WSR in terms of blood pressure groups in women.

Index	Blood Pressure	Number	Mean	Standard Deviation	95% confidence interval		P Value
					Low	High	
Height	Normal	1057	157.80	6.80	157.40	158.20	<0.001
	Prehypertension HTN	479	157.10	7.80	156.40	157.80	
	HTN stage I	264	155.40	6.90	154.60	156.30	
	HTN stage II	146	154.90	7.30	153.70	156.10	
Weight	Normal	1057	61.70	12.10	61.00	62.50	<0.001
	Prehypertension HTN	479	66.10	12.30	65.00	67.20	
	HTN stage I	264	68.40	12.80	66.90	69.90	
	HTN stage II	146	67.80	13.00	65.60	79.90	
WC	Normal	1057	82.60	13.30	81.80	83.40	<0.001
	Prehypertension HTN	479	88.60	13.30	87.40	89.80	
	HTN stage I	264	93.40	13.60	91.70	95.00	
	HTN stage II	146	94.00	12.10	92.00	96.00	
BMI	Normal	1057	24.80	4.90	24.50	25.10	<0.001
	Prehypertension HTN	479	26.80	5.00	26.40	27.30	
	HTN stage I	264	28.30	4.90	27.70	28.90	
	HTN stage II	146	28.20	4.80	27.40	29.00	
WHR	Normal	1057	0.50	0.10	0.50	0.50	<0.001
	Prehypertension HTN	479	0.60	0.10	0.60	0.60	
	HTN stage I	264	0.60	0.10	0.60	0.60	
	HTN stage II	146	0.60	0.10	0.60	0.60	

HTN: Hypertension; WC: waist circumference; BMI: Body mass index; WHR: waist to hip ratio

Curve is predictive of high blood pressure in terms of BMI, WC and WHR which represent 0.644, 0.655 and 0.662 in men and 0.662, 0.691 and 0.703 in, women respectively.

However, no significant differences were found between the various indices in both genders.

Discussion

Our findings indicated that the prevalence of overweight and obesity in men and women was 21 % and 8.4 %, respectively. The results obtained confirmed the results of other studies in IR Iran (6, 7, 11, 12) and several countries (13-15).

Based on the results of most studies, obesity is more prevalent in women than men and on occasion it is twice among certain age groups (16). According to this study, the prevalence of obesity among women was significantly

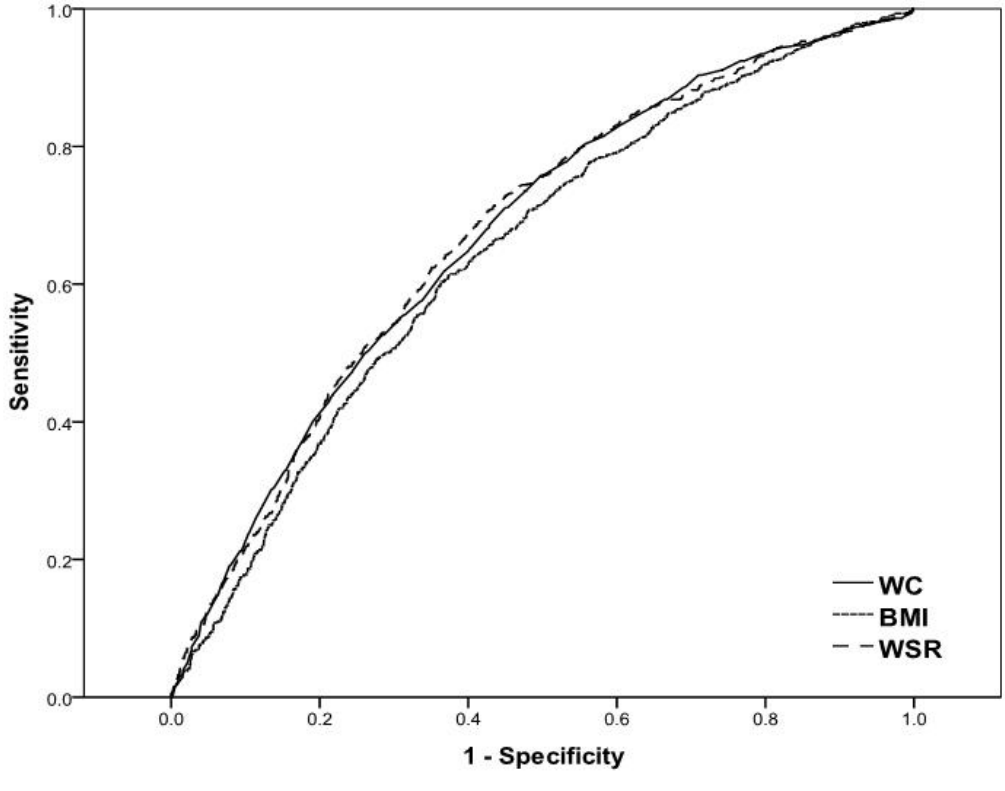

Figure 1. ROC curve for the prediction of high blood pressure in relation to BMI, WC and WHR in males.

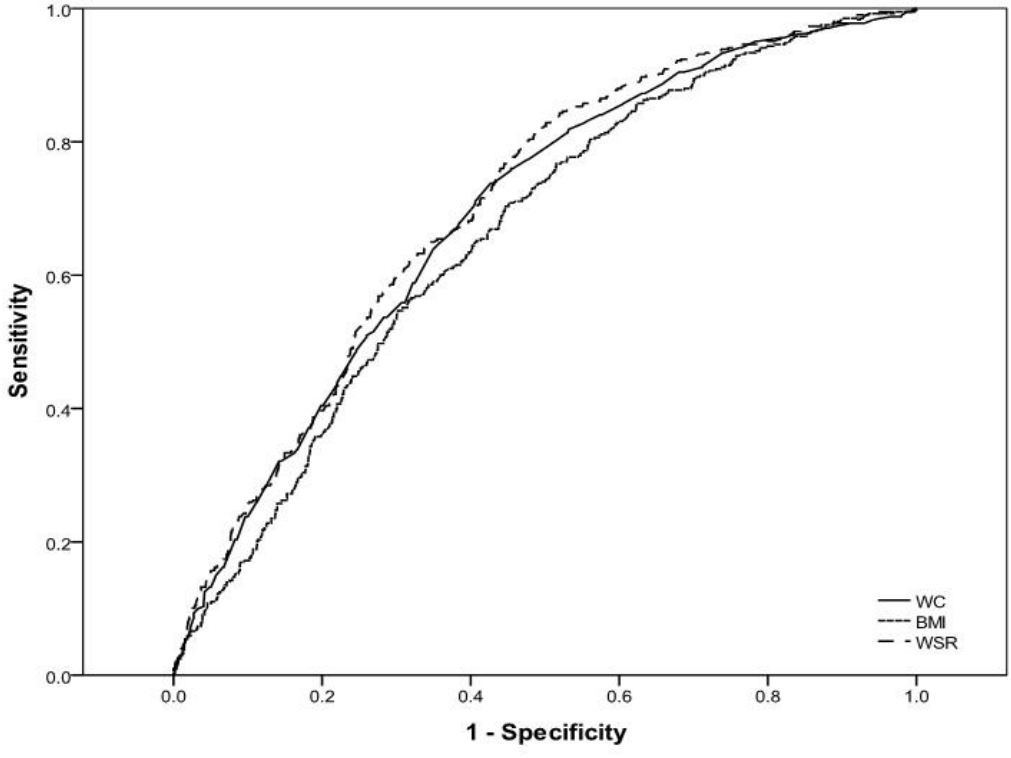

Figure 2. ROC curve for the prediction of high blood pressure in relation to BMI, WC and WHR in females.

higher than that in men ($P<0.001$). This difference may be due to physiological differences in the composition and distribution of adipose tissue. Furthermore, consistent with other reports from IR Iran, our study showed that the prevalence of obesity is increasing in both men and women (7, 12). Estimates of prevalence of overweight and obesity will depend on methodological factors, the definition of obesity, and the composition of the community in regard to age, ethnicity, and social class, making comparisons among studies of limited value.

A study carried out among adults in Thailand, found the prevalence of overweight and obese were 28.3% and 6.8%, respectively (17). Another study from Singapore found that 8.5% of women and 5.9% of men were obese (18). The researchers in China found the prevalence of overweight in men and women were 13.6% and 19.2% respectively, while the prevalence of obesity were 0.5% in males and 1.5% in females (19). Among Turkish, the prevalence of obesity was 32.4% in men and 14.1% in women, but among men and women the prevalence of overweight was 65.9% and 50.4% respectively (20).The prevalence of overweight and obesity in IR Iran is higher than those reported for China , Thailand , and Singapore but lower than the prevalence in Turkey. Interestingly, our finding in relation to WC and abdominal obesity showed a high prevalence in both genders, especially in the females (21). Our study also indicated that despite having normal weight, abdominal obesity in the population is of high prevalence, especially in women which can be due to inactivity and unsuitable dietary regimen. Substantially, central obesity is more common in IR Iranian women than men. The prevalence of central obesity among Turkish women (57.6%) is comparable to our estimate for Iranian females. The prevalence of central obesity among Tunisian males aged ≥ 20 years was (8.8%) (20). Finally, central obesity is more common in IR Iran than countries of Eastern Asia such as China (22) and Korea (23).

In accordance with other reports, our study showed a significant association between anthropometric measures and blood pressure.

In a study carried out on 3423 adults aged from 30 to 65 years in China, 1929 in Philippine and 7957 in USA, it was found that high BMI correlated with increasing rates of hypertension in different ethnic groups (24). Another study in Denmark on 13577 adolescents aged from 15 to 20 years confirmed an association between fitness and BMI with hypertension. It also showed that BMI was a stronger predictor of hypertension in people with low fitness, especially in girls (25).

An Iranian study showed that BMI and waist to hip ratio are factors that increase blood pressure in women (26). Obesity and overweight involve can increase blood pressure with physiological changes, including increased insulin resistance, elevated activity of rennin-Angiotensin system in the kidney and mounting pressure on the peripheral vessels (13). Consistent with the findings of other reports (26), our study also showed that blood pressure increases with age. We documented a strikingly high prevalence of a number of chronic non-communicable diseases and their risk factors in IR Iran, and showed that the prevalence of these metabolic abnormalities in IR Iran, as a developing country in the nutritional and lifestyle transition phase, is comparable if not higher than most developed countries. Continued and accelerating urbanization, are likely to escalate the prevalence of these disease conditions. Therefore, urgent preventive interventions on a national scale should target these highly prevalent metabolic abnormalities.

The findings of the present investigation indicated the high prevalence of overweight in the population under study. In addition, due to the close relationship between obesity and various disease conditions such as hypertension it was demonstrated that BMI and WC were strongly associated with systolic and diastolic blood pressure, an issue of serious consequence. It is thus important to find practical solutions to raise public awareness by providing appropriate and effective program, to modify lifestyle and improve nutritional status of the community.

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The authors declare that they have no conflicts of interest.

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