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Dietary Habit and Anthropometric Status in Hypertensive Patients Compared to Normotensive Participants in the North of Iran

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Abstract**—**Hypertension is one of the important reasons of morbidity and mortality in countries, including Iran. It has been shown that hypertension is a consequence of the interaction of genetics and environment. Nutrients have important roles in the controlling of blood pressure. We assessed dietary habit and anthropometric status in patients with hypertension in the north of Iran, and that have special dietary habit and according to their culture. This study was conducted on 127 patients with newly recognized hypertension and the 120 normotensive participants. Anthropometric status was measured and demographic characteristics, and medical condition were collected by valid questionnaires and dietary habit assessment was assessed with 3-day food recall (two weekdays and one weekend). The mean age of participants was 58 ± 6.7 years. The mean level of energy intake, saturated fat, vitamin D, potassium, zinc, dietary fiber, vitamin C, calcium, phosphorus, copper and magnesium was significantly lower in the hypertensive group compared to the control ($p < 0.05$). After adjusting for energy intake, positive association was observe between hypertension and some dietary nutrients including; Cholesterol [OR: 1.1, *P*: 0.001, B: 0.06], fiber [OR: 1.6, *P*: 0.001, B: 1.8], vitamin D [OR: 2.6, *P*: 0.006, B: 0.9] and zinc [OR: 1.4, *P*: 0.006, B: 0.3] intake. Logistic regression analysis showed that there was not significant association between hypertension, weight and waist circumference. In our study, the mean intake of some nutrients was lower in the hypertensive individuals compared to the normotensive individual. Health training about suitable dietary habits and easier access to vitamin D supplementation in patients with hypertension are cost-effective tools to improve outcomes in Iran.

Keywords**—**Hypertension, dietary intake, weight, waist circumference, North of Iran.

I. Introduction

HYPERTENSION is chronic disease by diastolic blood pressure of 90 mmHg or greater and systolic blood pressure 140 mmHg or greater. Hypertension is an important risk factor for mortality, cardiovascular disease and chronic disease throughout the world. This disease affects about 20% to 35% of adult population in the world [1]. Recently, it has been shown that about one fourth of adults are hypertensive, and this is predicted to reach to about a third by 2025 [2].

According to recent data, hypertension is one of the main reasons of morbidity and mortality in developing countries including Iran [3]. Furthermore, in middle income countries, the numbers of people with high blood pressure who are undiagnosed, untreated and uncontrolled are higher compared to high-income countries, maybe for the reason of weak health systems [4]. It has been shown that hypertension is a consequence of the interaction of genetics and environment. Macronutrients and micronutrients have important roles in the regulation of blood pressure and target organ damage. For example, many studies have demonstrated an association between intake of protein and blood pressure [5]. Some studies also show that a balance of sodium with some nutrients, especially potassium, magnesium and calcium has an important role in reducing blood pressure, cardiovascular and cerebrovascular events [6]. On the other hand, obesity and a sedentary lifestyle result in an increase in nutritionally-related diseases [7]. Furthermore, it has been shown that vitamin D deficiency is also an effective factor in hypertension [8], although there is not any consistency regarding to the role of vitamin D deficiency in cardiovascular diseases [9]. There is some evidences from both animal [10] and human studies [11] showing that vitamin D increase activation of the renin–angiotensin–aldosterone system. It is known as the main regulator of electrolyte and volume homeostasis that has an important role in arterial hypertension.

Vitamin D has also considerable effects on vascular endothelial function, vascular stiffness, oxidative stress and up-regulation of endothelial nitric oxide syntheses [12]. Limited data in urban areas of Iran showed a high prevalence and low awareness about hypertension [13], [14]. A recent study conducted on people in this area showed that more than 25% of adults are hypertensive. The demographic and social transition has been associated with the emergence of hypertension during the last decade in Iran, as in other East Mediterranean countries [15].

Since Iran is a country that will face with the aging phenomenon; it is recommended urgent actions about education for healthy lifestyle and treatment of middle age patients [16]. On the other hand, it has been shown that cardiovascular disease risk factors are correlated with psychological distress, especially depression [17], [18].

Iran, as an Islamic country, is socially different from Western countries. Such differences can be seen in the limited outdoor sport for women. According to the limited and inconclusive data and to the role of nutrients and lifestyle as modifiable environmental factors associated with

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hypertension, we assessed the dietary habit and anthropometric status in hypertensive patients in northern Iran.

II. Subjects and Methods

This study was done on 247 people aged 30 years to 70 years that were referred to the outpatient clinic of Dr. Heshmat Hospital of Guilan, northern Iran; the participants had gone to clinic for routine checkup during spring of 2015. Those participants who had a special condition such as, take oral contraceptives or hormone replacement therapy or had diabetes, renal disease, chronic inflammatory disease were excluded.

According to the blood pressure status, participants assigned into two groups. The first group included 127 patients with newly recognized hypertension (case group) and the second group included 120 normal blood pressure people (control group).

Hypertension in participants was diagnosed by cardiologist through checking drugs, medical history and also controlling blood pressure. All of participants signed the informed consent for participation in the study. Blood pressure in participants was measured by a trained nurse, by using a single mercury sphygmomanometer, with appropriate cuffs.

The blood pressure was recorded as two serial measurements, at intervals of 5 minutes. The mean of the two blood pressure measurements was used in our analysis. Hypertension was defined as SBP> 140 mmHgor DBP> 90 mmHg.

In this study, demographic characteristics were collected by questionnaire. The weight of each participant was measured with a standard scale to an accuracy of ± 0.1 kilogram, and height was measured to an accuracy of ± 0.1 centimeter. Body mass index (BMI) was calculated as weight (kg) divided by height squared (m^2).

In study, waist circumference was measured at the level of the umbilicus (at the level midway between the lower rib margin and the iliac crest) to an accuracy of ±0.1 centimeter. Dietary habit was assessed with 3-day food recall (two weekdays and one weekend), by trained interviewers.

The 24-hour recalls were collected from all 247 participants in two groups. The 24-hour recall is based on actual intake and may be used to estimate absolute rather than relative intake.

After coding the diaries, Nutritionist IV software (First Databank, Hearst Corp, San Bruno, CA, USA) was used to compute dietary intakes of macronutrients and energy.

Data are expressed as mean (standard deviation; SD) or frequency (%). Between-group comparison was performed by independent t-test or Chi-square test as needed.

Logistic regression and adjusted model for general characteristics was performed to detect the value of association between two groups of study with dietary intake and anthropometric data. This analysis was performed using SPSS version 11.5, with the level of significance being $p < 0.05$ (two-tailed).

III. Results

A total of 247 participants (127 patients in cases group, 120 healthy participants in control group) were recruited to the study with mean age of 58±6.7 years.

Approximately 28.3% of participants were men and 71.7% were women. The frequency of smokers in the total population was 21%. General characteristics of participants are shown in Table I. As shown in the table, there was no significant difference between two groups in general characteristics ($p< 0.05$).

There was no statistically significant difference in the mean of body weight, waist circumference and BMI between two groups in the study (p> 0.05).

The result of logistic regression analysis showed there was no significant association between hypertension and body weight, waist circumference as well as BMI (Table II).

TABLE I
Demographic Characteristics in Participants

	Total (n=247)	Case (n=127)	Control (n=120)	P*
Age, (years)	58(6.7)	61(8.3)	56(5.1)	0.1
Sex, men, n (%)	70(28.3)	38(29.9)	32(26.7)	0.5
Smoker, n (%)	21(8.5)	9(7.1)	12(10)	0.4
Drinking alcohol, n (%)	2(0.8)	0	2(1.7)	0.1
Education, n (%)				0.2
Illiterate	77(31.1)	44(34.6)	33(27.5)	
School	152(61.5)	73(57.3)	79(65.2)	
University	18(7.2)	10(7.9)	8(6.7)	

Data represent mean (SD) or number of subjects (percentages).
*Comparisons between case and control subjects based on the t-test or Chi-square, as appropriate.

TABLE II
Logistic Regression Analysis between Anthropometric Measurements with Hypertension

Variable	Case (127)	Control (120)	P*	B	OR#	P †
Body weight, kg	75.1(15.6)	74.5(11.6)	0.6	0.007	0.9	0.5
Waist circumference, cm,	91.3(23.4)	86.1(26.8)	0.08	0.01	1	0.08
BMI, kg/m^2	28.7(15.6)	27.4(10)	0.6	0.004	1	0.6
BMI category, n%						
Normal (20-24.9kg/m^2)	36(30)	31(27.4)	0.1	ref		
Overweight (25-29.9kg/m^2)	57(47.5)	44(38.9)		0.4	1.4	0.3
Obese (≥30kg/m^2)	27(22.5)	38(33.6)		0.6	1.5	0.29

Data represent mean (SD) or number of subjects (percentages).
*Comparisons between case and control subjects based on the t-test or Chi-square, as appropriate.
OR, odds ratio, † logistic regression after adjustment for age, sex and supplement vitamin.

As shown in Table III, the mean level of energy intake, saturated fat, vitamin D, potassium, zinc, dietary fiber, vitamin C, calcium, phosphorus, copper and magnesium was statistically significantly lower in the hypertensive group compared to the control group ($p< 0.05$).

After adjusting energy intake in the model, a positive association was observed between hypertension and some dietary nutrient such as; Cholesterol[OR:1.1, P:0.001, B:0.06], zinc[OR:1.4,P:0.006,B:0.3], fiber[OR:1.6, P:0.001, B:1.8], and vitamin D[OR:2.6,P:0.006,B:0.9] intake.

TABLE III
LOGISTIC REGRESSION ANALYSIS BETWEEN DIETARY INTAKES WITH HYPERTENSION

Variable	Case (127)	Control (120)	P^*	B	OR[#]	$P^\dagger$
Energy (Kcal)	1696(648)	1938(799)	0.01	0.00	1	0.1
Calorie from carbohydrate (%)	45.5(11.5)	43.5(43.5)	0.1	0.05	1.06	0.2
Calorie from fat (%)	42.6(11.8)	41.6(9.7)	0.5	0.0	0.8	0.09
Calorie from protein (%)	13.1(4)	13.4(4.6)	0.6	0.06	1	0.07
Potassium (mg)	207(51)	288(98)	0.01	0.0	1	0.08
Magnesium (mg)	217(82)	316(65)	0.009	0.00	1	0.1
Cholesterol (mg)	268(62)	230(49)	0.1	0.06	1.1	0.001
Saturated fat (mg)	162(40)	144(40)	0.02	0.00	1	0.2
Fiber(mg)	97(7.6)	124(7.6)	0.008	0.03	1	0.3
Vitamin D (μg)	0.68(0.2)	0.88(0.1)	0.04	0.9	2.6	0.006
Vitamin C (mg)	81(19)	183(63)	0.000	0.00	1	0.09
Folic acid (mg)	288(87)	520(165)	0.01	0.00	1	0.08
Calcium (mg)	484(34)	673(54)	0.02	0.00	1	0.1
Zinc (mg)	68(3.7)	97(8.9)	0.002	0.3	1.4	0.006
Phosphorus(mg)	792(154)	1042(366)	0.01	0.00	1	0.1
Copper (mg)	1(0.5)	1.3(0.7)	0.01	0.00	1	0.1

Data represent mean (SD).
*Comparisons between case and control subjects based on the t-test or Chi-square, as appropriate.
[#] OR, odds ratio, † logistic regression after adjustment for energy intake

IV. DISCUSSION

Our study shows that there is a positive association between hypertension and vitamin D deficiency. Our results are consistent with the results from a recent meta-analysis conducted on healthy participants [19]. Some studies have shown that the effect of 25OHD on risk of hypertension may be more potent in people who have vitamin D deficiency compared with people with a sufficient level of vitamin D [20].

There are some mechanisms to explain why vitamin D deficiency can increase blood pressure. The active form of vitamin D in the body decreases the expression of the renin gene through a vitamin D receptor-dependent pathway. So, it cause decreasing in both renin and angiotensin II concentrations [21], [22]. Schroten et al. [23] showed that vitamin D insufficiency can increase the level of PTH that is associated with an increase in blood pressure.

According to legislation in Iran, direct exposure to the sun is limited because, most men wear long-sleeve shirts and all women wear a scarf and long-sleeved clothes. Also, the northern parts of Iran are mostly mountainous, and this geographical situation can be a factor that residences of these regions do not receive sufficient vitamin D from sunlight.

In the present study, the mean of energy intake and some nutrients was lower in the hypertensive patients compared to the normotensive participants. These results are similar with some of the previous studies that have shown correlations between dietary patterns, cardiovascular diseases and hypertension [24], [25].

One study that was conducted on patients with type 2 diabetes assessed the effect of some nutrients such as magnesium, vitamin C, vitamin E, and zinc supplementation on blood pressure, results showed that the using of these four elements for at least three months could reduce significantly both systolic and diastolic blood pressure [26]. The beneficial effects may be partially attributed to the important role of these nutrients in controlling vascular tone and function, membrane ion exchange, activation of Na+ K+-ATPase and the restoration of vasodilatation through NO mediated flow-dependent.

Some previous researches have shown that macronutrients and micronutrients are important in prevention, control and treatment of hypertension [27]. In our study, the percent of energy gain from carbohydrates, protein and fat did not have any difference between two groups of participants.

Some researchers have shown that an increase in dietary fat and protein intake is inversely associated with risk for heart stroke in women with hypertension [28].

In our study, it seems that the percent of energy gain from protein is lower and from fat is higher than the optimum recommended percent for these macronutrients (i.e. 15-20% for protein and 25-30% for fat). In animal models, a low protein diet coupled with low omega-3 fatty acid, may contribute to hypertension [29]. Optimum intake of protein is associated with improvement in endothelial function, decrease in SNS activity and increase in renal sodium loss [30]. However, lean animal protein with less saturated fatty acids and more omega-3 fatty acids may reduce blood pressure and cholesterol [31]. There are limited researches on the association between dietary cholesterol and blood pressure. The increase in cholesterol intake lead to an increase in serum cholesterol that is associated with endothelial dysfunction and reduced nitric oxide bioavailability and functional arterial stiffening [32].

According to our results, the mean intake of fiber in the case group is significantly lower than the control group. Some investigations have shown that 40-50 g/day intake of fiber may decrease 7.5/5.5 mmHg in blood pressure [33]. It seems that both groups participating in our study have low intake of fiber. Therefore, an increase in fiber intake is recommended for them, not only for the control of blood pressure, but also for the other benefits of fiber on health.

V. CONCLUSION

Undesirable intake of some nutrients are increases the risk of developing hypertension. Therefore, health training and increasing awareness about suitable dietary habits and changing behavior may play an important role in the

prevention and control of hypertension. Because of limitation in exposure to sun, easier access to vitamin D supplementation in this group of patients can be necessary.

Since the hypertension is a risk factor for incidence of some metabolic disorders, effective management is necessary to reduces the risk of heart stroke, myocardial infarction and mortality

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