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COMPLIANCE TO DASH DIET BY PATIENTS WITH ESSENTIAL HYPERTENSION

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Lifestyle modification, including dietary changes, is very important in the prevention and treatment of hypertension. It has been well documented that DASH (Dietary Approaches to Stop Hypertension) diet has the potential to lower blood pressure and to improve patients' overall health. The aim of this study was to evaluate compliance to DASH diet by patients with essential hypertension. A total of 159 patients with medically treated essential hypertension, 80 men and 79 women were included in the study. All patients were taking multiple antihypertensive drugs to achieve hypertension target goal (<140/90 mm Hg). Over 70% of hypertensive patients were obese (BMI ≥30 kgm^2) and abdominal obesity, confirmed by waist circumferences, was found in 94.3% of them.

The diets of hypertensive patients met daily nutritional guidelines only for protein and sodium intake. According to DASH diet, very high intakes of saturated fat and cholesterol, as well as a high intake of total fat were found. The intakes of hypotensive minerals such as calcium, potassium and magnesium were below the levels recommended by DASH diet. Daily intake of fiber was only 25.6±10.3 g among men and 21.6±6.5 g among women (70-80% of recommended value). This diet profile may contribute to an increased risk of cardiovascular diseases. Most of the hypertensive patients on DASH diet require major dietary changes. A comprehensive, tailored nutritional education, provided by dietitian, should be offered for motivated patients.

INTRODUCTION

High blood pressure is one of the most common vascular diseases worldwide. The estimated total number of people with hypertension in the whole world (defined as an average systolic blood pressure (BP) ≥140 mmHg, a diastolic BP ≥90 mmHg, or current use of antihypertensive medications) is about 1 billion [Chobanian *et al.*, 2003]. According to Tykarski *et al*. [2005], in Poland hypertension affects 42.1% of adult men and 32.9% of women. In a systematic review of the worldwide prevalence of hypertension, which was based on studies from 1980 to 2003, the lowest prevalence of hypertension was found in rural India (3.4% in men and 6.8% in women) and the highest prevalence in Poland (68.9% in men and 72.5% in women) [Kearney *et al.*, 2004]. Previous data from ARIC study (Atherosclerosis Risk in Communities) and Pol-MONICA Project indicated that the prevalence of hypertension and mean blood pressures was higher in Polish than in the U.S. subjects. In this study the prevalence of hypertension was similar in Polish urban and rural men (37% and 36%) however in women it was higher in the rural (43%) than in the urban population (40%) [Rywik *et al*., 1998].

Chronic essential hypertension is a major risk factor for cardiovascular and cerebrovascular complications [Das, 2001]. Controlling hypertension is a complex problem involving medical treatment plan and adherence to treatment as well as tailored diet and compliance to this diet [Spranger *et al*., 2004]. Well-documented lifestyle modifications that lower blood pressure include: reducing sodium intake to less than 2.4 g per day; increasing physical activity to at least 30 minutes per day; achieving a weight loss goal of 10% and more, and limiting alcohol consumption [Whelton *et al*., 2002]. The multicenter United States study – Dietary Approaches to Stop Hypertension (DASH) – has clearly indicated that diet can significantly lower blood pressure [Sacks *et al.,* 2001]. The DASH eating plan that is low in saturated fat, cholesterol, and total fat is recommended for both, preventing and managing hypertension (Table 1). This diet emphasizes the consumption of fruits, vegetables, and low-fat or fat free milk

TABLE 1. Daily nutrient goals used in the DASH studies (for 2100 kcal) [NIH, 2006].

Nutrient	Recommendation
Total fat	27% of calories
Saturated fat	6% of calories
Protein	18% of calories
Carbohydrates	55% of calories
Cholesterol	150 mg/d
Sodium	2300 mg/d
Potassium	4700 mg/d
Magnesium	500 mg/d
Calcium	1250 mg/d
Fiber	30 g/d

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and milk products, whole grain products, fish, poultry, and nuts. Sweets and sugar-containing beverages are restricted. The DASH diet is rich in potassium, magnesium, and calcium, as well as protein and fiber [Sacks *et al.,* 1995; NIH, 2006].

Translating the DASH diet into a practical set of recommendations that patients can follow may be a challenge [Windhauser *et al*., 1999]. Implementation of the DASH diet involves modifications of a dietary pattern, so dietitians should help patients to change their eating behavior and to adopt the DASH diet. It is not clear which educational strategy is the most effective in helping patients to make long-term lifestyle changes. Some authors suggest that individualized nutrition counseling bring about the greatest behavioral change and tailoring is now recognized as a crucial strategy for delivering affective behavior change intervention [Johnson *et al*., 2008]. In pharmacologically treated patients, diet therapy can facilitate medication reduction in certain individuals.

The objective of the present study was to evaluate compliance to DASH diet by patients with essential hypertension. We analysed the intake of energy and nutrients in the diet of hypertensive patients with special attention given to nutritional factors which may influence arterial tension.

MATERIALS AND METHODS

All patients were recruited from the Outpatient Clinic of Hypertension at the National Institute of Cardiology in Warsaw. There were 159 patients with well controlled essential hypertension, 80 men and 79 women, aged between 24 and 81 years. Mean age of the subjects was 59.9±10.4 years.

Anthropometric measurements, including height, body weight, waist and hip circumferences were done, following standardized procedures [WHO, 1995]. Body weight was measured to the nearest 0.1 kg, height and abdominal circumference were measured to the nearest 0.5 cm. Central obesity was defined as waist circumference ≥94cm for Europid men and ≥80 cm for Europid women [IDF, 2006]. Body mass index (BMI) was calculated as subject's weight (kg) divided by the square of their height (m^2). Obesity was defined as a BMI ≥30 kg/m^2 according to WHO classification [2000]. Body fat mass was determined by bioelectrical impedance using a portable device model BIA 101S, AKERN – RJL Systems (Italy) according to the method described by Lukaski *et al.* [1985].

The BP (Korotkoff phases I and V) was determined twice, using standard mercury sphygmomanometers with appropriate bladder size, between 8:00 and 10:00 AM after the subject had been sitting upright for at least 10 minutes. BP measurements were averaged and provided as a single value per individual.

Energy and nutrient intakes of hypertensive patients were assessed by three-day food record which was completed during two weekdays and 1 weekend day [Johnson, 2002; Moore, 2005]. Subjects were asked and instructed to record the weights or household measurements (*i.e.* cups, spoons) of all consumed food. They were taught how to describe food items used singly or in combination as well as how to measure amounts consumed. The diary record was reviewed by the dietitian during an individual interview with the subject. All details concerning meal preparation, portion size and seasoning were verified. ENERGIA® software, based on the Polish food composition tables [Kunachowicz *et al*., 2005], was used to calculate energy and nutrient intakes.

The study protocol was approved by the Medical Ethics Committee of the National Institute of Cardiology in Warsaw. The research was conducted during the period between September 2006 and January 2008.

Statistical comparison between men and women was performed using unpaired Student's *t*-test. P value of ≤0.05 was considered an indicator of statistical significance. All calculations were carried out using the statistical software STATISTICA version 6.0 (StatSoft. Inc. USA).

RESULTS AND DISCUSSION

The characteristics of hypertensive patients are provided in Table 2. The mean age of the subject was 59.9±10.4 years, 57.0±10.5 and 62.8±9.5 for men and women respectively. All patients were receiving two or more antihypertensive medications and their hypertension was well controlled in the clinical setting. An average SBP was 129.9±6.4 and DBP was 84.1±4.2. These results confirm good adherence of the patients to a medical treatment plan. Attendance in a hypertension clinic and use of a goal-oriented management approaches has been shown to improve BP to a significant level [Bansal *et al.,* 2003].

In the current study less than 4% of the patients achieved healthy weight according to BMI classification. Over 70%

TABLE 2. Demographic and clinical characteristics of patients with essential hypertension (n=159).

Parameters	Values*
Age (y)	60 (54 – 68)
Gender (males)	80 (50%)
Mean duration of hypertension (y)	9.8 ± 6.6
Anthropometric parameters	
Body weight (kg)	89.9 (79.6 – 101.5)
BMI (kg/m^2)	32.2 (29.0 – 35.0)
Healthy weight BMI <25 (kg/m^2)	6 (3.8%)
Overweight BMI 25-29.9 (kg/m^2)	41 (25.8%)
Obesity class 1 BMI 30-39.9 (kg/m^2)	101 (63.5%)
Obesity class 2 BMI ≥40 (kg/m^2)	11 (6.9%)
Waist circumference (cm)	110.5 (104.1 – 117.2)
Abdominal obesity#	150 (94.3%)
Men	73 (91.3%)
Women	77 (97.5%)
Fat mass (%)	
Men	29.3 ± 5.5
Women	39.9 ± 6.2
Blood pressure	
Systolic (mmHg)	130.1 (126 – 136)
Diastolic (mmHg)	84.2 (82 – 88)

*Values are: mean (SD, median (interquartile range) or number and (%)
#Waist circumference >94 cm in men, >80 cm in women.

of them were obese and 11 patients had BMI ≥40 kg/m^2. An average BMI was 32.5±3.7 kg/m^2 among men and 32.3±4.3 kg/m^2 among women. The mean body fat estimated by the bioelectrical impedance analysis differed significantly between men and women, and was 29.3±5.5 and 39.9±6.2, respectively. In a study by Rywik *et al.* [1998], hypertension was significantly positively related to BMI in both Polish and U.S. populations.

Abdominal obesity, assessed using waist circumferences, was found among 94.3% of the hypertensive individuals. The new IDF definition of metabolic syndrome identifies central obesity as a waist circumference ≥94 cm for Europid men and ≥80 cm for Europid women [IDF, 2006]. Gus *et al.* [2008] found that the best cut-off values for waist circumference to predict hypertension in Brazil population were 87 cm in men and 80 cm in women. They confirmed that the values proposed by the IDF guidelines probably better evaluated the excess of abdominal fat. Chuang *et al.* [2006] found that visceral obesity and its progression were predictors of future incidence of hypertension, independent of the general obesity effects. Thus all adults with a BMI >30 kg/m^2 and large waist circumferences should be encouraged to loose weight. Weigh loss is considered the most effective nonpharmacological intervention [Davy & Hall, 2004]. Das [2001] emphasizes that in view of the importance of different nutrients in the pathophysiology of hypertension, reduction of body mass should be achieved with hypocaloric diet with adequate micronutrients.

Table 3 summarizes the intake of energy and selected nutrients by the hypertensive patients, not indicated in DASH diet plan. Intakes of all measured nutrients except for vitamin B_{12}, folates and vitamin C, were significantly higher among men. Within the analysed vitamins and minerals, only folate intake by hypertensive men and women was below the Polish RDA [Jarosz & Bułhak-Jachymczyk, 2008].

Compliance to the DASH diet eating plan is presented in Table 4. The diets of hypertensive patients in the recent study met daily nutritional guidelines only for protein and sodium intake (96.3 and 95.8% of DASH recommendation, respectively). A very high intake of saturated fat and cholesterol, as well as a high intake of total fat were found as well. The intakes of hypotensive minerals such as calcium, potassium and magnesium were below levels recommended by the DASH diet.

Daily protein intake in the current study and percentage of energy from protein reached an appropriate level. Hodgson [2007] suggests that it is possible that higher protein intakes could benefit blood pressure. The INTERSALT study reported an inverse relationship between urinary nitrogen and urea (as markers of total protein intake) and blood pressure [Stamler *et al*., 1996]. It is likely that the reduction of blood pressure with protein may be due to partial replacement of some other macronutrients such as carbohydrates (particularly refined carbohydrates) or amino acids composition of protein (mainly arginine and taurine) [Hodgson *et al*., 2006]. Delbridge *et al*. [2006] comparing a high-protein *versus* high-carbohydrate diet, found a 6.6 mmHg lower systolic BP in subjects randomized to high-protein diet. Hodgson [2007] emphasizes that many dietary sources of plant protein are also good sources of other active components, such as phytochemicals and fiber, which could contribute to lower blood pressure.

In the recent study, carbohydrates supplied less than 50% of the total energy in groups of both men and women, and it was associated with high total fat ingestion. Fat intake averaged 34.1±6.6% and 32.5±7.4% of the total energy in men and women respectively, whereas DASH diet recommend limit intake of this macronutrient to 27% of calories. A high intake of saturated fatty acids (SFA) by hypertensive patients, amounting to 11.4% of the total energy, was also much higher

TABLE 3. Energy and selected nutrient intakes by hypertensive patients.

Nutrient	Total (n=159)	Men n=80	Women n=79	p value*
Energy (kcal/d)	1979.9±509	2237.9±520	1718.6±337	< 0.001
Protein (g/d)	84.9±22.8	94.3.1±22.6	75.5±18.7	< 0.001
Fat (g/d)	73.5±25.8	84.9±26.6	61.9±19.2	< 0.001
Saturated Fatty Acids (g/d)	25.0±10.1	28.4±10.7	21.5±8.2	< 0.001
Monounsaturated Fatty Acids (g/d)	29.5±11.7	34.8±12.1	24.1±8.4	< 0.001
Carbohydrates (g/d)	260.8±76	287.8±80	233.4±60	< 0.001
Iron (mg/d)	12.4±4.3	14.3±4.8	10.5±2.5	< 0.001
Phosphorus (mg/d)	1352.4±376	1494±366	1208±330	< 0.001
Zinc (mg/d)	11.7±3.8	13.3±4.2	10.1±2.6	< 0.001
Vitamin B_1 (mg/d)	1.46±0.6	1.67±0.7	1.25±0.4	0.002
Vitamin B_2 (mg/d)	1.67±0.5	1.77±0.5	1.57±0.6	0.002
Vitamin B_6 (mg/d)	2.16±0.8	2.37±0.9	1.95±0.5	0.003
Vitamin B_{12} (μg/d)	4.68±3.2	5.02±3.3	4.33±3.1	0.088
Folates (μg/d)	308.1±102	318.6±114	297.5±88	0.097
Vitamin C (mg/d)	133.7±89	133.9±99	133.6±76	0.493
Vitamin E (mg/d)	12.6±7.1	14.2±8.3	11.0±5.0	0.002

*Student's *t*-test.

TABLE 4. Compliance to DASH diet eating plan by hypertensive patients (n=159).

Nutrient	Men (n=80)				Women (n=79)			
	Intake (mean±SD)	% of DASH recommendation (mean±SD)	% of DASH recommendation Q1-Q3	Compliance to DASH diet*	Intake (mean±SD)	% of DASH recommendation (mean±SD)	% of DASH recommendation Q1-Q3	Compliance to DASH diet*
Total fat (% of calories)	34.11±6.63	126.3±24.5	111.1-144.8	↑	32.46±7.41	120.2±27.5	102.8-135.9	↑
Saturated fatty acids (% of calories)	11.41±3.27	190.2±54.5	152.1-230.4	↑↑	11.35±3.66	189.1±61.0	146.0-222.1	↑↑
Protein (% of calories)	17.02±2.85	94.6±15.8	85.0-101.9	good	17.66±3.3	98.1±18.5	85.0-105.8	good
Carbohydrates (% of calories)	46.82±7.08	85.1±12.8#	75.9-92.7	↓	49.2±8.4	89.4±15.3	79.1-102.1	↓
Cholesterol (mg/d)	373.3±154	248.9±103.3#	172.8-317.2	↑↑	234.2±89.6	156.1±59.7	115.2-178.8	↑↑
Sodium (mg/d)	2505.3±895	108.9±38.9#	85.3-129.9	good	1897.9±672	82.5±29.3	64.4-94.8	↓
Potassium (mg/d)	3807.5±131	81.0±27.9#	60.1-94.2	↓	3295.2±896	70.1±19.1	56.2-80.4	↓
Calcium (mg/d)	628.1±255	50.3±20.5	40.4-55.3	↓↓	661.3±322	52.9±25.8	33.2-60.0	↓↓
Magnesium (mg/d)	371.3±143	74.3±28.6#	54.0-88.5	↓	283.1±80.2	56.6±16.1	46.5-62.4	↓↓
Fiber (g/d)	25.6±10.3	85.4±34.5#	62.2-106.4	↓	21.6±6.5	72.2±21.6	58.9-81.9	↓

*good compliance (90-110% of DASH recommendation); ↑ – high intake (111-130%), ↑↑ – very high intake (>130%), ↓ – low intake (70-89%), ↓↓ – very low intake (<70%) #*versus* women, Student's *t*-test, p≤0.05.

than the recommended value (6%). Because diets rich in SFA reduce the formation of vasodilator prostaglandins (PGE_1, PGE_2) and elevate blood pressure [Das, 2001], the importance of reducing total and saturated fat should be emphasized by dietitians counseling hypertensive patients. Many studies found that reduction in fat intake, particularly saturated fat, may reduce the risk of cardiovascular diseases and diabetes by producing an energy-independent improvement in insulin resistance, as well as by promoting weight loss [WHO/FAO, 2003].

In the current study, an average intake of hypotensive minerals such as calcium, potassium and magnesium were far from the recommended values (Table 4). An average daily calcium intake was only 628±255 mg and 661±322 mg in the diets of men and women, respectively, which was less than 53% of the recommended value. A relationship between calcium and potassium intake and blood pressure has been investigated for more than 20 years [McCarron *et al.,* 1982, 1998]. Inadequate ingestion of these minerals has been associated with a higher blood pressure. The Nurses' Health Study revealed an inverse association between relative risk of ischemic stroke and potassium, magnesium, and particularly calcium intake. In addition, the inverse relationship between risk of stroke and calcium intake was stronger for dairy calcium than for calcium from non-dairy sources [Iso *et al*., 1999]. Data from NHANES III and IV (National Health and Nutrition Examination Survey) established that a low dietary intake of minerals such as calcium, potassium and magnesium was associated with hypertension, but the BP effect of low mineral intake was most pronounced in subjects with only systolic hypertension. The authors concluded that the combination of naturally-occurring nutrients in food contributed to the BP-lowering effect [Townsend *et al.,* 2005]. McCarron & Reusser [2001] also underlined that the adequate intake of calcium and potassium, derived from food, contributed to cardiovascular and overall health.

The protective role of magnesium in cardiovascular diseases was summarized by Chakraborti e*t al.* [2002]. This mineral has been described as a nature physiological calcium blocker. Despite the fact that magnesium is widely distributed in food, in the current study, the intake of this mineral by hypertensive men was low (74.3% of the recommended value) and very low by hypertensive women (56.6% of the recommended value).

The DASH diet recommends for hypertensive patients at least 30 g of fiber per day [NIH, 2006]. A daily intake of fiber in our study was only 25.6±10.3 g among men and 21.6±6.5 g among women (70-80% of recommended value). In a study by He *et al.* [2004], a diet rich in fiber derived from oat bran (soluble fiber) had a moderate BP-lowering effect. To achieve an adequate fiber intake, gradually increasing consumption of fiber-rich foods, such as whole-grain cereals, fruits and vegetables is recommended. The increased amount of fiber may improve satiety, which may be helpful if weight loss is desired [Windhauser *et al*., 1999].

Comparing the results of the current study to our previous findings [Niegowska *et al.*, 2006] we confirmed once again that the diet of patients suffering from essential hypertension is far from the recommendations. Karppanen *et al.* [2005] highlighted that DASH diet is similar to the "Natural Diet" that is composed of unprocessed food and provides high amount of potassium, calcium and magnesium.

CONCLUSIONS

The result of the current study showed that the diet of hypertensive patients did not provide appropriate levels of total and saturated fat, as well as minerals such as potassium, calcium and magnesium. This diet profile may contribute to an increased risk of cardiovascular diseases. Most of the hypertensive patients on DASH diet require major dietary changes. Dietitians can play an important role in helping hypertensive patients to adopt the DASH dietary pattern. Nutritional advice should emphasize reducing total and saturated fat and increasing consumption of whole grain products, fruits and vegetables. A comprehensive, tailored nutritional education should be offered for motivated patients.

REFERENCES

1. Bansal N., Tendler B.E., White W.B., Mansoor G.A., Blood pressure control in the hypertension clinic. Am. J. Hypertens., 2003, 16, 878–880.
2. Chakraborti S., Chakraborti T., Mandal M., Mandal A., Das S., Ghos S., Protective role of magnesium in cardiovascular disease: a review. Mol. Cell. Biochem., 2002, 238, 163–179.
3. Chobanian A.V., Bakris G.L., Black H.R., Cushman W.C., Green L.A., Izzo J.L.Jr., Jones D.W., Materson B.J., Oparil S., Wright J.T.Jr., Roccella E.J., The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of high blood pressure: the JNC 7 report. J. Am. Med. Assoc., 2003, 2560–2572.
4. Chuang S-Y., Chou P., Hsu P-F., Cheng H-M., Tsai S-T., Lin I-F., Chen C-H., Presence and progression of abdominal obesity are predictors of future high blood pressure and hypertension. Am. J. Hypertens., 2006, 19, 788–795.
5. Das U.N., Nutritional factors in the pathobiology of human essential hypertension. Nutrition, 2001, 17, 337–346.
6. Davy K.P., Hall J.E., Obesity and hypertension: two or one? Am. J. Physiol. Regul. Integr. Comp. Pysiol., 2004, 286, R803-R813.
7. Delbridge E., Prendergast L., Pritchard J., Proietto J., The effect of a high protein *vs*. high carbohydrate diet on cardiovascular risk factors. M.Walqvist, A.Okada (eds): Asia Pac. J. Clin. Nutr., 2006, 15, HEC Press, Australia S42 (abstract).
8. Gus M., Cichelero F.T., Moreira C.M., Escobar G.F., Moreira L.B., Wiehe M., Fuchs S.C., Fuchs F.D., Waist circumference cut-off values to predict the incidence of hypertension: an estimation from a Brazilian population-based cohort. Nutr. Metab. Card. Dis., 2008, 19, 15–19.
9. He J., Streiffer R., Muntner P., Krousel-Wood M.A., Whelton P.K., Effect of dietary fiber on blood pressure: a randomized, double-blind, placebo-controlled trials. J. Hypertens., 2004, 22, 73–80.
10. Hodgson J.M., Blood pressure. Nutr. Diet., 2007, 64 (suppl 4), S169-S172.
11. Hodgson J.M., Burke V., Beilin L.J., Puddey I.B., Partial substitution of carbohydrates with protein from lean red meat lowers blood pressure in hypertensive individuals. Am. J. Clin. Nutr., 2006, 83, 78–787.
12. IDF, The IDF consensus of worldwide definition of the metabolic syndrome. Alberti G., Zimmet P., Shaw P., Grundy S.M., International Diabetes Federation 2006. Available at: [http://www.idf.org/webdata/docs/MetS_def_update2006.pdf].
13. Iso H., Stampfer M.J., Manson J.E., Rexrode K., Hennekens C.H., Colditz G.A., Speizer F.E., Willet W.C., Prospective study of calcium, potassium, and magnesium intake and risk of stroke in women. Stroke, 1999, 30, 1772–1779.
14. Jarosz M., Bułhak-Jachymczyk B., Normy żywienia człowieka. 2008, Wyd. PZWL, Warszawa (in Polish).
15. Johnson R.K., Dietary intake – how do we measure what people are really eating? Obes. Res., 2002, 10, suppl 1, 63S-68S.
16. Johnson S., Cummins C., Evers K., The impact of transtheoretical model-based multiple behavior interventions on nutrition. 2008, *in*: Nutrition for the Middle Aged and Elderly (eds. N.E. Bernhardt, A.M. Kasko). Nova Science Publisher, Inc., pp. 195–212.
17. Karppanen H., Karpppanen P., Mervaala E., Why and how to implement sodium, potassium, calcium, and magnesium changes in food items and diets? J. Hum. Hypertens., 2005, 19, S10-S19.
18. Kearney P.M., Whelton M., Reynolds K., Whelton P.K., He J., Worldwide prevalence of hypertension: a systematic review. J. Hypertens., 2004, 22, 11–19.
19. Kunachowicz H., Nadolna I., Przygoda B., Iwanow K., 2005, Food Composition Tables. IŻŻ, Warszawa (in Polish).
20. Lukaski H.C., Johnson P.E., Bolonchuk W.W., Lykken G.I., Assessment of fat-free mass using bioelectrical impedance measurements of the human body. Am. J. Clin. Nutr., 1985, 41, 810–817.
21. McCarron D.A., Morris C.D., Cole C., Dietary calcium and human hypertension. Science, 1982, 217, 267–269.
22. McCarron D.A., Oparil S., Resnick L.M., Chait A., Haynes R.B., Kris-Etherton P., Pi-Sunyer F.X., Stern J.S., Morris C.D., Clark S., Hatton D.C., McMahon M., Holcomb S., Snyder W., Comprehensive nutrition plan improve cardiovascular risk factors in essential hypertension. Am. J. Hypertens., 1998, 11, 31–40.
23. McCarron D.A., Reusser M.E., Are low intakes of calcium and potassium important causes of cardiovascular disease? Am. J. Hypertens., 2001, 14, 6, 206S-212S.
24. Moore M.C., Nutritional Assessment and Care. Fifth edition, 2005, Elsevier Mosby.
25. Niegowska J., Gajewska D., Kucharska A., Sych A., Intakes of macronutrients and selected micronutrients by patients with essential hypertension. Pol. J. Food Nutr. Sci., 2006, 15/16, SI 2, 83–86.
26. NIH, U.S. Department of Health and Human Services, National Institutes of Health, National Heart, Lung, and Blood Institute, Your guide to lowering your blood pressure with DASH. DASH eating plan. 2006, NIH Publication, No.06–4082.
27. Rywik S.L., Davis C.E., Pająk A., Broda G., Folsom A.R., Kawalec E., Williams O.D., Poland and U.S. collaborative study on cardiovascular epidemiology hypertension in the community: prevalence, awareness, treatment and control of hypertension in the Pol-MONICA Project and the U.S. Atherosclerosis Risk in Communities Study. Ann. Epidemiol., 1998, 8, 3–13.
28. Sacks F.M., Obarzanek E., Windhauser M.M., Svetkey L.P., Vollmer W.M., Lin P.H., McCullough M., Karanja N., Steele P., Proschan M.A., Evans M.A., Appel L.J., Bray G.A., Vogt T.M., Moore T.J., Rationale and design of the Dietary Approaches to Stop Hypertension Trial (DASH): a multicenter controlled feeding study of dietary patterns to lower blood pressure. Ann. Epidemiol., 1995, 5, 108–118.
29. Sacks F.M., Svetkey L.P., Vollmer W.M., Appel L.J., Bray G.A., Harsha D., Obarzanek E., Conlin P.R., Miller III E.R., Simons-Morton D.G., Karanja N., Lin P-H., Effects on blood pressure of reduced dietary sodium and the Dietary Approaches to Stop Hypertension (DASH) diet. N. Eng. J. Med., 2001, 344, 1, 3–10.
30. Spranger C.B., Ries A.J., Berge C.A., Radford N.B., Victor R.G., Identifying gaps between guidelines and clinical practice in the evaluation and treatment of patients with hypertension. Am. J. Med., 2004, 117, 14–18.
31. Stamler J., Elliott P., Kesteloot H., Nichols R., Caleys G., Dyer A.R., Stamler M.A., Inverse relation of dietary protein markers with blood pressure. Findings for 10 020 men and women in the INTERSALT Study. INTERSALT Cooperative Research Group. INTERnational study of SALT and blood pressure. Circulation, 1996, 94, 1629–1634.

32. Townsend M.S., Fulgoni III V.L., Stern J.S., Adu-Afarwuah S., McCarron D.A., Low mineral intake is associated with high systolic blood pressure in the third and fourth National Health and Nutrition Examination Surveys. Am. J. Hypertens., 2005, 18, 261–269.
33. Tykarski A., Posadzy-Małaczyńska A., Wyrzykowski B., Kwaśniewska M., Pająk A., Kozakiewicz K., Rywik S., Broda G., Increased incidence of arterial hypertension and effectiveness of its treatment in adult Poles. Results of WOBASZ programme. Kardiol. Pol., 2005, 63, 6 (supl. 4), S1-S6 (in Polish).
34. Whelton P.K., He J., Appel L.J., Cutler J.A., Havas S., Kotchen T.A., Roccella E.J., Stoout R., Vallbona C., Winston M.C., Karimbakas J., Primary prevention of hypertension. Clinical and Public health advisory from the National High Blood Pressure Education Program. J. Am. Med. Assoc., 2002, 288, 1882–1888.
35. WHO, Diet, nutrition and the prevention of chronic diseases. Report of a joint WHO/FAO Expert Consultation. World Health Organization Geneva, 2003, WHO Technical Report Series No 916.
36. WHO, Obesity: preventing and managing the global epidemic. World Health Organization Geneva, 2000, WHO Technical Report Series No 894.
37. WHO, Physical status: the use and interpretation of anthropometry. Report of a WHO Expert Committee. World Health Organization, 1995, WHO Technical Report Series, No. 854.
38. Windhauser M.M., Ernst D.B., Karanja N.M., Crawford S.W., Redican S.E., Swain J.F., Karimbakas J.M., Champagne C.M., Kimberly P.H., Evans M.A., Translating the Dietary Approaches to Stop Hypertension diet from research to practice: dietary and behavior change techniques. J. Am. Diet. Assoc., 1999, 99 (suppl.), S90-S95.

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