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An assessment of dietary intake and state of nutritional in hypertensive patients from rural and urban areas of Greater Poland

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Abstract

The aim of this study was to determine the nutritional factors connected with the prevalence of hypertension in rural and urban areas of Greater Poland. The study consisted of 308 people aged 35-62, with essential hypertension but without any other coexisting disorders. The studied group consisted of 154 residents of Poznań (79 women and 75 men) and 152 inhabitants of rural areas in Greater Poland (78 women and 74 men). Participants were randomly assigned to the study. Nutritional state assessment was based on Body Mass Index (BMI) and body fat percentage. Dietary intake were assessed with a 24-hour nutritional survey from 3 consecutive days. Analysis of anthropometric examination results showed a large prevalence of obesity in the studied group. Moreover people living in rural areas had a significantly higher BMI and body fat percentage than those living in a city. It has been proved that the patients with hypertension consume food with an excess of fat and a shortage of fibre, antioxidant vitamins, potassium, calcium and magnesium. The total food rations of rural dwellers consisted of larger amounts of fat, cholesterol and vitamin A compared to those of city dwellers. Present studies have shown incorrect dietary intake among patients with hypertension, often related to the coexistence of overweight and obesity. Obtained results indicate significantly worse eating habits and state of nutrition among rural inhabitants.

Key words

dietary intake, obesity, hypertension, urban area, rural area

INTRODUCTION

It is estimated that each year over 7 million people worldwide die because of hypertension and its complications [1]. It is assumed that with the observed aging of populations in civilized countries the prevalence of hypertension will increase. The first epidemiological studies concerning hypertension in Poland – Pol-MONICA – were conducted in the 80s and 90s of the 20th century. It showed a prevalence of hypertension in over 40% of the population. The results of the NATPOL III PLUS programme in year 2002 showed a 30% decrease in the prevalence hypertension in Polish adults [2]. Epidemiological studies assessing hypertension morbidity in Polish outpatients (the PENT studies) indicated its existence in 65% of the subjects. It also showed the highest percentage of undiagnosed hypertension among patients aged 35-44 [3]. Recent studies conducted in eastern Poland showed the prevalence of hypertension in nearly 40% of the subjects. It was also indicated that farmers more often have hypertension, although no difference in hypertension morbidity was found between rural and urban dwellers [4]. Studies by other authors showed a more frequent existence of overweight, cigarette smoking, and lower level of physical activity among people living in the rural areas than in the city, although no significant health hazards related to residence in rural areas were indicated [5].

Recent studies conducted on residents, aged 50-79, from 10 different European countries indicated that over half of them suffer from overweight or obesity, although no difference between urban and rural areas was found [6].

There are many reasons for the high morbidity through hypertension in Poland and other civilized countries, some of which are: low percentage of hypertension diagnosis, low level of knowledge about the risk factors, poor health care, incorrect lifestyle, low treatment effectiveness. These factors are particularly evident in rural areas [7, 8]. Data obtained from literature indicate low state of health, higher prevalence of obesity, incorrect eating habits and a lack of motivation for improvement of the nutritional state and rational eating among village dwellers [9, 10]. The aim of this study was to determine the nutritional factors associated with hypertension prevalence in rural and urban areas of Greater Poland.

MATERIALS AND METHODS

Consent to conduct this study was granted by the Research Ethics Committee (No. 346/02) of the Karol Marcinkowski University of Medical Sciences in Poznań.

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Study group. The study consisted of a total of 308 subjects with essential hypertension without any other coexisting disorders, aged 35-62. Mean age 44.3±5.6.

Subjects participating in the study were informed about the objectives, range and the basic measurement methods. Each participant gave a written consent to be included in the study.

The studied group consisted of 154 residents of Poznan (79 women and 75 men) and 152 inhabitants of rural areas in Greater Poland (78 women and 74 men). Participants were randomly assigned to the study. Patients with coexisting disorders, such as: coronary disease, chronic kidney disease, diabetes, gout, high cholesterol level or past myocardial infarction, were excluded from the study.

Nutritional state assessment. Nutritional state assessment was carried out based on BMI evaluated by measuring the subjects' mass and height according to the formula: body mass (kg)/height^2 (m). The percentage of body fat was also assessed by measuring and calculating the total sum of thickness of 4 skinfolds – the Durnin-Womersley method [11].

A SIBERHEGNER Co. AG caliper with a measuring range of 0-45mm was used for measuring the skinfolds. The total sum of 4 skinfolds was the basis for determining the body fat percentage from the Durnin chart.

Dietary intake assessment. The dietary intake of participants was assessed based on their food list indicating the consumption scale during 3 days. The size of consumed meals was evaluated using "A photograph album of products' various portion sizes" [12]. Computer databases constructed using the 'Dietetyk' programme were utilized evaluate the amount of food, energy, and each nutrients in daily rations. After taking into account the culinary and technological losses, the results were reduced adequately.

Statistical analysis. Statistical analysis of the results was performed using the Statistica 6.0 programme (Mann-Whitney test, accepted relevance level $p<0.05$).

RESULTS

The mean BMI indicated the presence of overweight and obesity in a large percentage of subjects in both groups (Tab. 1). The results of analysis of the anthropometric measurement showd a significantly higher BMI in rural dwellers than urban dwellers. The body fat percentage was also higher in this group.

Table 1. Anthropometric parameters of patients in rural and urban areas

parameter		urban (n=154)	rural (n=152)
BMI (kg/m^2)	Mean ±SD	33.1 ± 10.2	37.2 ± 9.2
	median	30.5[a]	34.2[b]
% fat tissue	Mean ±SD	29.3 ± 7.3	33.6 ± 8.4
	median	30.3[a]	33.4[b]

The nutritional state is greatly influenced by eating habits. Data listed in Table 2 show that the participants' daily food rations (DFR) fulfilled their energy need. This is shown by a fulfillment level of energy need between 95-97%. The DFR indicated an excess of energy from fat above the established norm values of 30% in both groups. A significantly higher percentage of fat in DFR was observed in subjects living in the rural areas than in the city. The excess supply of energy originating from fat in the diet coexisted with a deficiency of carbohydrates, which constituted only about 50% of food energy, whereas at least 55% is recommended. The energy supply from proteins was correct (12-14%).

Table 2. Daily intake of energy and basic nutrients

parameter		urban (n=154)	rural (n=152)
energy (kcal) [%RDA]	Mean ±SD	2447.5±599 [94.9±31.0]	2511.9 ±548 [97.4 ±28.5]
	median	2403.6 [93.2]	2486.2 [96.4]
carbohydrate (% energy)	Mean ±SD	51.6 ± 9.3	47.5 ± 7.3
	median	51.2	46.9
fat (% energy)	Mean ±SD	34.3 ± 7.6	39.1 ± 6.6
	median	34.4[a]	40.0[b]
protein (% energy)	Mean ±SD	14.0 ± 3.7	14.2 ± 3.4
	median	14.0	13.4
cholesterol (mg)	Mean ±SD	398.1 ± 39.2	475.8± 52.1
	median	383.1[a]	461.7[b]
arginine (mg/kg m.c.)	Mean ±SD	50.8 ± 25.2	51.8 ± 26.2
	median	50.6	49.4
methionine (mg/kg m.c.)	Mean ±SD	22.6 ±11.4	22.5 ±11.2
	median	21,6	21.3
fibre (mg)	Mean ±SD	20.4 ± 8.2	17.2 ± 4.1
	median	19.9[b]	16.9[a]

RDA – recommended daily allowance [13].

Cholesterol consumption in both groups was high, greatly exceeding the highest recommended by the American Heart Association supply of 300mg. The cholesterol content in daily food rations of rural dwellers exceeded 475 mg and was significantly higher compared to the citizens of Poznan (Tab. 2).

It was been shown that the supply of amino acid arginine and methionine was equal in both groups. Fibre supply, however, was significantly lower in the urban dwellers group (Tab. 3).

Table 3. Daily intake of minerals and vitamins

parameter		urban (n=154)	rural (n=152)
vitamin A (mg) [%RDA]	Mean ±SD	1227.2 ± 543.2 [153.4 ± 112.2]	764.8 ± 312.5 [95.6 ± 55.4]
	median	949.6 [118.7][b]	709.6 [88.7][a]
vitamin E (mg) [%AI]	Mean ±SD	7.40 ± 4.72 [82.2±65.4]	7.80±4.12 [86.7±57.7]
	median	7.01 [77.9]	7.81 [86.8]
vitamin C (mg) [%RDA]	Mean ±SD	73.7 ±65.4 [89.4±75.3]	44.7±37.7 [54.2±43.2]
	median	61.5 [74.5][b]	40.9 [49.6][a]
Na (mg) [%AI]	Mean ±SD	3110.5 ± 1864.2 [207.7 ±111.3]	3168.9 ± 1796.2 [211.6 ± 105.3]
	median	3098.6 [205.6]	3120.4 [208.4]

Table 3 (Continuation). Daily intake of minerals and vitamins

parameter		urban (n=154)	rural (n=152)
K (mg) [%AI]	Mean ±SD	3675.0 ± 1897.4 [78.2 ± 32.3]	3213.3 ± 1912.3 [68.6±35.6]
	median	3605.3 [76.7]	3189.4 [67.9]
Ca (mg) [%AI]	Mean ±SD	690.3±312.5 [61.2±31.2]	635.4 ± 449.1 [55.3±28.4]
	median	675.4 [58.3]	618.6 [53.8]
Mg (mg) [%RDA]	Mean ±SD	305.5 ±112.5 [81.5 ± 34.2]	269.6 ±89.9 [73.5 ± 25.4]
	median	298.6 [80.7][b]	261.6 [70.7][a]
Fe (mg) [%RDA]	Mean ±SD	12.3 ± 5.20 [82.5±33.2]	12.7 ± 4.91 [84.6±32.8]
	median	12.1 [80.8]	12.3 [82.1]
Zn (mg) [%RDA]	Mean ±SD	11.9 ±4.32 [125.4±45.3]	12.2 ± 5.23 [128.4±55.3]
	median	10.9 [115.4]	11.8 [124.3]
Cu (mg) [%RDA]	Mean ±SD	1.59±0.98 [176.7±108.3]	1.24 ± 0.87 [137.5±96.4
	median	1.58 [176.0]	1.20 [133.3]

AI – adequate intake [13].

Vitamin A supply was significantly higher in the urban dwellers group than the village rural group, exceeding the recommended level.

Vitamin C supply was lower in the rural inhabitants group, however, it was insufficient in both groups.

Analysis of the results demonstrated an excess in sodium and a deficiency in potassium, calcium, iron and magnesium in the subjects' daily food rations. Magnesium supply was significantly lower in the group of urban dwellers. The supply of copper and zinc exceeded the current norms.

DISCUSSION

The results obtained in the presented study indicate a significant correlation between the prevalence of obesity and hypertension, both in the rural and urban environments. Demonstrated relationships confirm numerous earlier reports showing an increase of hypertension prevalence in overweight patients [14, 15].

Frequent coexistence of overweight and obesity in patients with hypertension is also reported by other authors. A 12-year observation of a population of adults participating in the Pol-MONICA Warsaw study, conducted from 1984 – 1992, revealed that about 80% of hypertensive patients (76.8% of men and 81.8% of women) were overweight or obese [16]. The presented study shows an even greater percentage (93%). In Indian studies, a high BMI was also positively correlated with the development of hypertension; however, both obesity and hypertension were more often diagnosed in patients living in urban rather than rural areas in this region of the world [17]. A relationship between obesity, large waist circumference and hypertension development was also indicated in rural areas of South Korea [18]. The rural residents of Peru, however, had higher levels of physical activity and lower body mass than urban residents [19]. On the other hand, a higher percentage of hypertensive patients was reported in rural areas of Turkey, with the main risk factors including obesity, sedentary lifestyle, and high fat and red meat consumption [20].

Studies conducted in Spain reported a higher percentage of overweight and obesity in rural areas, and indicated its correlation with hypertension development [21]. The constant trend of increasing body mass of people living in rural areas compared to those living in the cities results from different lifestyles, including eating habits, which was confirmed by this study. Subjects inhabiting rural areas had a higher fat, cholesterol supply, and a lower fibre supply in their daily food rations compared to city residents.

Numerous studies have shown that a high supply of saturated fatty acids (over 10% of food energy) and cholesterol (over 300mg/day) promote an elevated levels of total cholesterol, LDL and VLDL, increased blood coagulation, endothelial dysfunction, hypertension and arhythmias [22].

According to nutritional recommendations, the diet of healthy adults should provide 30% of energy from fat and 300mg of cholesterol. Regarding hypertensive patients participating in the study, considering the coexisting high body mass, it is advisable to limit the supply of fat in the diet. It is suggested that the diet of obese people should provide no more than 25% of energy from fats [23].

The presented research shows a nearly double the recommended methionine supply in DFR of both groups, exceeding 20mg/kg of b.m./day. The recommended supply for adults is considered to be 12.1mg/kg of b.m./day. As a homocysteine precursor, this amino acid plays an important role in the pathogenesis of atherosclerosis [24].

During this study, another amino acid important in the development of cardiovascular diseases was evaluated – arginine. This particular nutrient was closely studied because it is considered to be an essential substrate in the endothelial production of nitric oxide (NO) – a blood pressure regulating factor. The study shows that the daily food rations in both groups contained a similar amount of arginine.

The average supply of arginine – a conditionally essential amino acid – in the studied DFRs was 3g. This result is lower than in studies in Finland (about 5g) [25], Holland (about 4g) [26] and the USA (about 5g) [27].

Presented study also shows a low supply of antioxidant vitamins E and C in both studied groups. Similarly, other studies conducted in Poland confirm an unsatisfactory level of these vitamins, which perform a vital role in the prophylaxis of civilization diseases. The percentage of the supply of the vitamin for adults, calculated during this study, is comparable to earlier research conducted in the Greater Poland region. It differs 'in minus', however, in case of vitamin and C from the daily food rations consumed in other Polish regions [28, 29].

Worldwide reports also show a deficiency in the above-mentioned vitamin supply in the consumed food rations in other countries [30, 31]. One of the studies concerned adult citizens of the USA whose vitamin C supply was 20-30% lower than recommended (60mg/day) [31]. The studies assessing eating habits of the Chinese population reported a low supply of antioxidant vitamins in regions with a high prevalence of hypertension [32].

Numerous studies concerning patients, particularly those with cardiovascular diseases, reported a lower antioxidant system activity, requiring a greater supply of essential antioxidants, mainly vitamin C, E and β-carotene [33]. Other reports indicate that an increased supply of the above-mentioned nutrients from fruits and vegetables and/or pharmacological supplements lowered blood pressure, inhibited lipid peroxidation process and endothelial dysfunction [34, 35].

Authors of numerous studies emphasize that a high level of sodium consumption can lead to increased blood pressure (in sodium-sensitive patients) and many metabolic disorders, such as: lower NO synthase activity and lower insulin sensitivity [36, 37].

It should be noted that in comparison to the results obtained in other countries concerning mineral nutrients consumption, the diet of the studied hypertensive subjects mostly provided lower amounts of calcium and magnesium but with greater amounts of sodium, potassium and iron. The copper and zinc supply was comparable. Similar results to the ones presented in this study can be found in Chinese and American reports, which confirm that people with hypertension consume more sodium than those with normal blood pressure [38, 39].

Research conducted in Portugal indicates a reverse relationship between the intake of potassium, fruits, vegetables and leguminous plants, and blood pressure level [40].

The results obtained in the presented study confirm earlier observations in the USA, which showed that the main factor for hypertension development among rural residents is the insufficient intake of fruits, vegetables, potassium, calcium and magnesium [41]. Recent studies conducted on women from rural areas also indicate a low supply of vitamin C, calcium and fibre, as well as its relationship with the development of cardiovascular diseases [42].

CONCLUSIONS

The presented study shows inappropriate nutritional habits in subjects with hypertension, often related to coexisting overweight and obesity. Rural residents, compared to urban residents, have a higher body mass and fat content in the organism, which is associated with a markedly higher supply of fat and cholesterol and lower supply of fibre, antioxidant vitamins and magnesium. Proper health education is important in hypertension patients, especially those in rural areas.

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