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Adherence to the DASH-style Diet and the Presence of Cardiovascular Risk Factors in Adults from Tîrgu Mureș

Victoria Ancuța Rus[1,2,3], Florina Ruța[2,3], Maria Sălcudean[2,3], Monica Tarcea[2], Costela Șerban[4], Călin Avram[1], Iustinian Simion[2], Theodora Benedek[5]

[1] Department of Informatics, University of Medicine and Pharmacy, Tîrgu Mureș, Romania
[2] Department of Community Nutrition and Food Hygiene, University of Medicine and Pharmacy, Tîrgu Mureș, Romania
[3] Romanian Nutrition and Dietetics Association
[4] Department of Informatics and Biostatistics, "Victor Babeș" University of Medicine and Pharmacy, Timișoara, Romania
[5] Cardiac Critical Care Unit, Clinic of Cardiology, County Clinical Emergency Hospital, Tîrgu Mureș, Romania

CORRESPONDENCE

Florina Ruța
Str. Gheorghe Marinescu nr. 38
540139 Tîrgu Mureș, Romania
Tel: +40 746 039 863
E-mail: florinaruta24@gmail.com

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Victoria Ancuța Rus • Str. Gheorghe Marinescu nr. 38, 540139 Tîrgu Mureș, Romania. Tel: +40 265 215 551, E-mail: victoriarus91@yahoo.com

Maria Sălcudean • Str. Gheorghe Marinescu nr. 38, 540139 Tîrgu Mureș, Romania. Tel: +40 265 215 551, E-mail: maria.salcudean91@yahoo.ro

Monica Tarcea • Str. Gheorghe Marinescu nr. 38, 540139 Tîrgu Mureș, Romania. Tel: +40 265 215 551, E-mail: monaumf2001@yahoo.com

Costela Șerban • Piața Eftimie Murgu nr. 2, 300041 Timișoara, Romania. Tel: +40 256 204 400, E-mail: costela.serban@gmail.com

Călin Avram • Str. Gheorghe Marinescu nr. 38, 540139 Tîrgu Mureș, Romania. Tel: +40 265 215 551, E-mail: avram_calin@yahoo.com

Iustinian Simion • Str. Gheorghe Marinescu nr. 38, 540139 Tîrgu Mureș, Romania. Tel: +40 265 215 551, E-mail: iustinian.simion@gmail.com

Theodora Benedek • Str. Gheorghe Marinescu nr. 38, 540139 Tîrgu Mureș, Romania. Tel: +40 265 215 551, E-mail: theodora.benedek@gmail.com

ABSTRACT

Background: Adopting a healthy lifestyle, including a healthy diet, weight control, regular exercise, smoking cessation, and alcohol limitation, plays an important role in treating high blood pressure and cardiovascular and chronic diseases. **Aim:** This study aimed to investigate adherence to the DASH diet in relation to the occurrence of high blood pressure and chronic disease risk factors, in a group of people from Tîrgu Mureș. **Material and methods:** This was a cross-sectional study based on a food frequency and lifestyle questionnaire applied to a group of 2,010 people aged 15–92 years from Tîrgu Mureș. **Results:** Individuals over the age of 45 had higher DASH scores (Q4, Q5) compared to subjects younger than 40 years (Q1 and Q2, $p < 0.001$). An important percentage (19.3%) of subjects who preferred a meat-based diet (Q3) had significantly larger abdominal circumference (mean 92.2 ± 0.91 cm, $p < 0.001$). An association between pure alcohol intake (mean 5.6 ± 0.43 g) and an unhealthy diet (Q1) was observed, compared to the average 1.7 ± 19 g of alcohol consumed by subjects with a healthy diet (Q5), alcohol consumption decreasing with an increasing DASH score ($p < 0.001$). **Conclusion:** This study shows that individuals diagnosed with at least one cardiovascular risk factor had a higher adherence to the DASH diet than individuals with no cardiovascular risk factors, most likely due to the fact that diagnosed individuals had changed their eating behavior and lifestyle from the time of diagnosis, with a positive impact on treatment outcomes and quality of life.

Keywords: DASH diet, high blood pressure, cardiovascular risk factors, lifestyle

INTRODUCTION

Globally, nearly 18 million people die annually due to cardiovascular (CV) disease, diabetes and hypertension being the major predisposing factors and representing the direct result of the obesity epidemic that has been doubling since the 1980s. In 2014, a WHO report indicated that there were more than 1.9 billion overweight people in the world, and over 600 million of them were obese. According to WHO statistics, in 2008, 18.1% of the population had obesity, 40.4% had high blood pressure (HBP), and in 2012, ischemic heart disease was the main cause of death, killing 54,500 people (21.4% of all deaths), followed by myocardial infarction (MI) with 45.4 thousand people, (17.8% of deaths), and high blood pressure, with a mortality of 11.3% (28.8 thousand persons).[1]

A remarkable progress in the analysis of CV risk factors was achieved by the INTERHEART study,[2] which assessed the importance of several cardiovascular risk factors and their association with the risk of acute myocardial infarction. Of these factors, six have been found to be significant in terms of prediction, including smoking, diabetes, high blood pressure, abdominal obesity, alcohol consumption, and low consumption of fruit and vegetables. But the most important conclusion of the above study was that the simultaneous presence of more than two risk factors explains 90% of major cardiac events, and the importance of diet and nutrition accounts for 50% of disease prevention interventions.[2]

The high prevalence of HBP (60%) is a major health problem in Europe, causing approximately 25% of MIs.[3] The value of blood pressure has been shown to be positively and continuously linked to the risk of developing several CV diseases, such as coronary heart disease, MI, and stroke, which can be prevented and treated. Applying therapy for HBP to risk levels below 140/90 mmHg is associated with a reduction in CV complications.[4]

Adopting lifestyle changes, including a healthy diet, weight control, regular exercise, smoking cessation, and alcohol limitation, plays an important role in treating HBP.[5–10] The DASH diet is a lifestyle approach to a healthy and balanced nutrition, developed by the National Heart Lung and Blood Institute and promoted by the American Heart Association, being recognized as a set of nutritional recommendations that was designed to help, treat, and prevent HBP.[8–10] This diet recommends focusing on a lower intake of saturated fat and cholesterol to help reduce blood pressure, and promotes an increased consumption of low fat and a balanced consumption of whole grains, fish, poultry, seafood, and oilseeds.[5]

Therefore, it is important to assess possible associations between a DASH-style diet adherence score and chronic disease risk factors. From our knowledge, no such study has been carried out in Romania, and we proposed to investigate the adherence of the population of Tîrgu Mureș to the DASH diet in the context of the presence of cardiovascular and chronic disease factors, in order to improve compliance with the cardiovascular treatment.

MATERIALS AND METHODS

Patient setting and population

This is a cross-sectional study based on a food frequency and lifestyle questionnaire applied to a group of 2,010 people aged 15–92 years from Tîrgu Mureș. The sampling was based on the systematic method (sampling step k = 5) by applying the initial cluster type in all districts of Tîrgu Mureș. Subsequently, a systematic sampling was applied, where starting from a main street, the fifth apartment building of the block or private house was chosen. For apartment buildings with 4 to 10 stories, one person from every third apartment was questioned. Data collection took place between May 2017 and July 2017, the time of the year when fruit and vegetable consumption is increased.

The interviews were conducted face to face, at the respondents' households, by trained interviewers, and had an average duration of 15 minutes, the subjects being informed of the purpose of the study, as well as the anonymity and confidentiality of their answers.

Dietary assessment

The questionnaire consisted of 106 questions related to anthropometric indicators, demographics, smoking status, lifestyle behavior, one-week food consumption estimation, and diagnosed chronic disease (ischemic cardiomyopathy, HBP, diabetes mellitus). Respondents were asked to refer to the frequency of a standard portion of a single serving over a week with 7 variants ranging from "not at all, or less than once/month" to a frequency of "2–3 times/day". Total energy and nutrient intake was calculated by summing up energy and nutrients from all foods. We calculated the DASH score based on food and nutrients from the DASH diet,[8,11] focusing on 8 food groups: high intake of fruits, vegetables, nuts and legumes, whole grains, low-fat dairy products, and low intake of sodium, red and processed meats, and sweetened beverages.[11,12] For each component of the questionnaire, we calculated the number of servings per day. Then, the obtained values were divided into five quintiles, and the average values of servings per each of the five quintiles are presented in a table. Quintiles values were turned into scores, using the following criteria: for fruits, vegetables, nuts and legumes, whole grains and low-fat dairy servings – Q1 = 1 point, Q2 = 2 points, Q3 = 3 points, Q4 = 4 points, Q5 = 5 points; for sodium, red and processed meats, and sweetened beverages servings – Q1 = 5 points, Q2 = 4 points, Q3 = 3 points, Q4 = 4 points, Q5 = 1 point (Table 1). We then summed up the component scores to obtain an overall DASH score ranging from 10 to 40. For the consumption of healthy food groups, a higher score reflected a higher consumption of those food groups. These groups were rated on a scale of 1–5; participants in quintile 5 had the highest consumption and were scored 5. Less healthy food groups, where a lower consumption is recommended, were scored using a reverse scale. Participants from quintile 1 reported the lowest consumption and scored 5. Participants from quintile 5 had the highest DASH score and a good-quality diet (Table 1).

Anthropometric measurements

Body mass index (BMI, calculated as kg/m^2) was derived from weight and height measured with a calibrated scale and a Kawe measure. Study subjects were included in the BMI classification as follows: underweight (BMI ≤18.49 kg/m^2), normal weight (BMI = 18.50–24.99 kg/m^2), overweight (BMI = 25.00–29.99 kg/m^2), or obese (BMI ≥30.00 kg/m^2). Waist circumference was measured using a Kawe measuring tape, and central obesity was defined as having a waist circumference ≥94 cm for men and ≥80 cm for women.[13]

Blood pressure was determined using a Beurer BM 85 digital blood pressure monitor, the subject being seated, and the right arm positioned at the heart level. Participants with a systolic pressure value ≥140 mmHg and a diastolic pressure ≥90 mmHg were classified as hypertensive subjects.[4,8]

Statistical analysis

The data was collected in an Excel database, and the statistical analysis was performed using the IBM SPSS program (Statistical Package for Social Sciences), Version 22.0 for Windows. The level of significance was considered 5%, and for comparisons of ordinal variables the Mann-Whitney and Kruskal-Wallis tests were applied. Chi-squared tests were used in tables with nominal/ordinal variables. A principal component analysis (PCA) was conducted on 49 items with orthogonal rotation (varimax). The Keiser-Meyer-Olkin measure verified the sampling adequacy for analysis, KMO = 0.77, which are above Keiser's criteria (>0.5). Bartlett's test of sfericity $\chi 2(1176)=14716.6$, $p <0.001$, indicated that the correlation between items was sufficiently large for PCA. An initial analysis was run to obtain eigenvalues for each component in the data. Fifteen components had eigenvalues over Keiser's criterion of 1 and in combination explained 53.7% of the variance. After inspecting the screen plot we decided to keep five components, which in combination would explain 21.5% of the variance (Table 2).

Table 2 shows factor loadings after rotation. The items that cluster on the same components suggest that component 1 represents a Mediterranean-like pattern, component 2 represents a pattern of consumption of meat and alcohol, component 3 represents a diet without meat, and component 4 includes fast-food eaters. Pattern 5 includes individuals who eat dairy.

The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2013. This study was approved by the Scientific Ethics Committee Board at the University of Medicine and Pharmacy of Tîrgu Mureş.

TABLE 1. Dietary food group intakes according to quintiles of Dietary Approaches to Stop High Blood Pressure related to the DASH diet score

Components of DASH score a,b	Quintiles DASH score				
	Q1 (n = 432)	Q2 (n = 450)	Q3 (n = 390)	Q4 (n = 391)	Q5 (n = 347)
Fruits[a] (servings/day)	0.5746	0.7950	1.0358	1.2220	1.8153
Vegetables[a] (servings/day)	0.8118	1.1540	1.4017	1.6436	2.4588
Nuts and legumes[a] (servings/day)	0.3778	0.4724	0.5780	0.7247	1.1140
Whole grains[a] (servings/day)	0.6486	1.4518	2.2074	2.5903	3.3104
Low-fat dairy[a] (servings/day)	0.1060	0.1862	0.2704	0.3581	0.4926
Sodium[b] (mg/day)	3,681.09	2,868.23	2,593.77	2,225.04	1,746.56
Red and processed meat[b] (servings/day)	1.3036	0.9283	0.7653	0.5367	0.2753
Sweetened beverages[b] (servings/day)	0.5915	0.2718	0.1362	0.0701	0.0262

a. Scoring criteria: for fruits, vegetables, nuts and legumes, whole grains and low-fat dairy servings – Q1 = 1 point, Q2 = 2 points, Q3 = 3 points, Q4 = 4 points, Q5 = 5 points; for sodium, red and processed meats and sweetened beverages servings – Q1 = 5 points, Q2 = 4 points, Q3 = 3 points, Q4 = 4 points, Q5 = 1 point
b. Higher quintiles represent higher intake; however, in constructing the DASH score, high intake and high quintiles received lower scores.

TABLE 2. Diet patterns in relationship with DASH quintiles analysis – factor loadings after rotation

Food groups from the menu	Diet patterns				
	1	2	3	4	5
	Mediteranean-like	Diet with meat and alcohol	Diet without meat	Fast-food diet	Diary diet
Fresh vegetables	0.793				
Fresh green leaves vegetables	0.665				
Fresh fruits	0.653	–0.159	0.159		
Cooked food	0.529				
Home-made wine		0.745			
Spirits/liquor/brandy		0.718			
Beer		0.683		0.245	
Commerce wine		0.539		0.215	
Nuts/peanuts	0.247		0.721		
Seeds			0.688	0.212	
Dried fruits			0.501		
Soy beans and soy products			0.443		
Flakes/cereal/muesli		–0.168	0.356		
Sweet juices				0.641	
Energy drinks	–0.201			0.635	
Chips/fries				0.564	
Pizza	–0.188			0.430	
Salt cheese					0.660
Fermented salt cheese					0.643
Fresh cheese					0.532
Melted cheese					0.516
Fermented cheese					0.447
buttermilk/yogurt/kefir					0.378
Meat products – salami,bacon					
Meat products – ham					
Canned food products					
Mayonnaise	–0.180				
Fried meat products				0.332	
Pickles	0.276				
Pork meat		0.225		0.200	
Juice 25–50%				0.268	
Juice 100%			0.183		
Pre-cooked food products	–0.236			0.171	
Concentrated sweets					
Sweet dough					
Rice	0.159				
Mushrooms				–0.178	0.172
Pasta					
Beans/peas/lentils/chickpeas	0.156		0.243		
Fish					0.152
Beef					
Chicken	0.215		–0.326	0.267	
Mineral water					
Plain water			0.173		
Tap water					
Whole milk					
Eggs	0.242		–0.156		
Caffee					
Black/green tea			0.205		

TABLE 3. Distribution of demographic characteristics and risk factors of our sample in relationship with quintiles of DASH score range

Demographics/Parameters		Quintiles DASH score range					
		Q1 10–18	Q2 19–22	Q3 23–25	Q4 26–29	Q5 30–40	P for trend
		n = 432	n = 450	n = 390	n = 391	n = 347	
Age (mean ± SEM)		38.9 ± 0.77	43.9 ± 0.75	47.0 ± 0.85	46.1 ± 0.82	45.6 ± 0.82	<0.001
BMI (mean ± SEM)		25.1 ± 0.21	25.6 ± 0.22	26.3 ± 0.25	26.2 ± 0.26	25.4 ± 0.26	0.068
Abdominal circumference (mean ± SEM)		88.6 ± 0.83	89.2 ± 0.88	92.2 ± 0.91	90.5 ± 0.96	86.2 ± 0.90	0.321
Systolic blood pressure (mean ± SEM)		124.8 ± 1.17	126.6 ± 1.19	128.8 ± 1.13	127.4 ± 1.18	123.0 ± 0.99	0.562
Diastolic blood pressure (mean ± SEM)		79.3 ± 0.71	81.4 ± 2.64	79.8 ± 0.74	79.1 ± 0.73	76.5 ± 0.59	0.094
Raw alcohol (mean ± SEM)		5.6 ± 0.43	3.9 ± 0.39	3.8 ± 0.41	2.8 ± 0.33	1.7 ± 0.19	<0.001
Total energy intake, kcal		2001.7 ± 29.12	1755.6 ± 29.55	1739.1 ± 34.95	1676.3 ± 33.73	1741.9 ± 30.96	<0.001
Gender, male (%)		53.5%	36.4%	37.9%	30.4%	24.5%	<0.001
Education level	less than 8 classes	8.1%	5.8%	5.9%	2.8%	2.6%	<0.001
	secondary school	21.3%	18.0%	20.3%	22.8%	10.4%	
	high school studies	30.6%	32.9%	33.6%	28.1%	24.8%	
	post-graduate studies	8.3%	14.7%	11.3%	14.1%	17.3%	
	university studies	31.7%	28.7%	29.0%	32.2%	45.0%	
Marital status	married	49.5%	58.0%	63.8%	59.8%	59.7%	<0.001
	divorced	6.0%	7.1%	6.7%	8.7%	9.2%	
	single/ concubinage	39.1%	26.2%	20.0%	21.7%	22.2%	
	widower	5.3%	8.7%	9.5%	9.7%	8.9%	
History of...	ischemic heart disease	4.4%	6.4%	9.2%	10.2%	5.8%	0.006
	obesity	5.8%	7.6%	11.0%	10.2%	5.8%	0.013
	diabetes mellitus	4.6%	4.4%	7.7%	9.7%	6.6%	0.010
	cancer	0.7%	0.9%	0.5%	1.0%	2.3%	0.135
	high blood pressure	13.7%	19.8%	24.9%	23.8%	19.3%	<0.001
	gastric pathology	5.1%	3.6%	4.6%	4.3%	2.9%	0.553
	osteoporosis	2.5%	4.9%	4.6%	4.1%	3.7%	0.438
	chronic hepatitis	1.4%	1.3%	2.6%	1.3%	0.9%	0.379
	neurological diseases	1.6%	0.9%	1.0%	2.3%	0.6%	0.225
Smoking status	non-smoker	38.7%	46.4%	50.0%	54.7%	56.5%	<0.001
	ex-smoker	18.1%	19.8%	23.1%	22.3%	24.8%	
	active smoker	43.3%	33.8%	26.9%	23.0%	18.7%	

RESULTS

In the studied group, 62.8% (n = 1,263) of respondents were female, and the average age of the whole sample was 44.14 ± 7.2 years (between 15 and 92 years). Almost one third of subjects have completed university studies (32.9%), followed by 30.2% who have just completed high school.

The social-demographic characteristics of the studied group in correspondence with the DASH score quintiles are presented in Table 3. A share of 8.1% of the total respondents showed obesity, and 18.6% were overweight, the mean BMI being 25.7 kg/m^2 (min = 16.33 kg/m^2, max = 54.69 kg/m^2), abdominal circumference was characterized by an average of 89.4 cm in both sexes (36.5% had an abdominal circumference above the limit), and mean blood pressure was 126/79 mmHg (Table 2), 20.1% of the respondents having HBP.

The study group consisted of 58.3% healthy people and 41.7% people who reported chronic illnesses, among the most common being HBP (20.1%), ischemic heart disease (7.2%), and diabetes mellitus (6.5%).

Individuals over the age of 45 had higher DASH scores (Q4, Q5) than subjects under 40 years, which had Q1 and Q2, p <0.001. An important share (19.3%) of subjects who preferred a meat-based diet (Q3) had a significantly elevated abdominal circumference (mean = 92.2 ± 0.91 cm, p <0.001).

An association between alcohol intake (mean = 5.6 ± 0.43 g) and an unhealthy diet (corresponding to DASH score = 10–18) was recorded; compared to the average 1.7 ± 0.19 g of alcohol consumed by subjects with a healthy diet (DASH score = 30–40), alcohol consumption decreased with an increasing DASH score, p <0.001. The

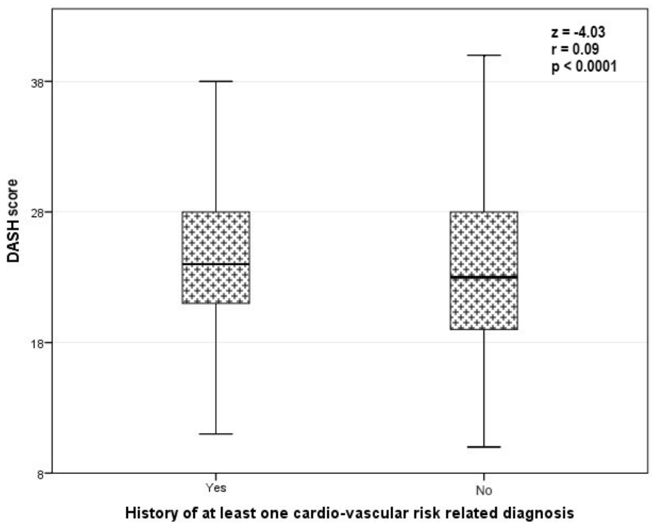

FIGURE 1. Adherence to the DASH diet style, individuals with cardiovascular risk vs. healthy individuals

highest caloric intake (2,001.7 ± 29.32 kcal) was found in 53.5% of male respondents with an unhealthy diet (Q1), which also explained the increased BMI (overweight and obesity).

From respondents who follow a balanced dietary intake (Q5), 45% (p <0.001) declared that they have higher education levels, and 59.7% are married custodians (p <0.001). However, 63.8% of married people and 39.1% of unmarried or cohabiting relatives followed a less healthy diet (Q3). Of the non-smoker sample, 56.5% respected a balanced diet (Q5), p <0.001, compared to smokers, of which 43.3% associated a processed food menu (Q1).

Each diet pattern was statistically associated with lifestyle and demographic risk factors when comparing data between Q5 and Q1 (Table 3).

A total of 61.9% of subjects who scored an elevated DASH score (Q5) in the Mediterranean pattern were women over the age of 47 who consume >2,000 kcal/day, with a DASH score of 26.2, as well as a high intake of healthy foods, vegetables, and legumes.

Patients diagnosed with at least one CV risk-related diagnosis had a higher median of DASH score, U = 363196, z = −4.03, p <0.001, r = 0.09, with a very small effect size (Figure 1), compared with healthy subjects.

DISCUSSIONS

Studies have shown that there is a link between increased chronic consumption of sodium and the occurrence of high blood pressure.[3] In Europe, about 70–75% of the total salt consumed is hidden in processed food or other food products that are not under consumer control, and the remaining 25–30% is added to meals at the table.[3,14,15] While overconsumption of salt is undoubtedly a worldwide problem, there is a growing concern in the European region, where a typical diet consists of high consumption of preserved meat, bread and cheese, high-salt foods, sugar, lipids, saturated fat, and cholesterol.[3,16] Research has found that limiting salt intake to less than 5 g/day (2,000 mg of sodium, one teaspoon of salt) is associated with a 17% reduction in the long-term risk of developing a CV disease.[3,17]

The DASH diet recommends a lower intake of sodium, sugars, and fats, as well as a lower intake of saturated fat and cholesterol to help reduce blood pressure. This diet also promotes a high consumption of vegetables, fruits, and low-fat diaries, as well as a balanced intake of whole grains, cereals, fish, and legumes.[18–21]

According to similar studies, adherence to the DASH diet has been shown to reduce the risk of developing coronary artery disease due to limited consumption of salt and saturated fats, which prevents HBP.[11,22,23]

For the analyzed population from Tîrgu Mureș, the profile of the top quintiles of DASH (Q4 and Q5) was as follows: older people, who consume less alcohol, have lower or normal caloric intake, are predominantly women, graduated university, are married, non-smokers, with a significantly higher prevalence than those in the lower quintiles. Subjects from Q3 have significantly higher values for BMI, abdominal circumference, and chronic disease history than those in the extreme quintiles.

Adherence to the DASH diet has been statistically associated with the presence of chronic diseases, except for cancer. Consumption of a DASH dietary pattern was not significantly associated with the BMI or abdominal circumference. The HBP cases were associated with the consumption of lower-than-healthy food products (Q3) in a proportion of 24.9%, and with a healthy lifestyle (Q5) in a share of 19.3%, compared to subjects who have an increased intake of processed foods (Q1), of which only 13.7% had HBP.

In this study, increased adherence to the DASH diet was associated with age over 45 years (p <0.001), a BMI >25 kg/m^2 (p <0.001), a lower frequency of males (p <0.001), married and non-smokers subjects (p <0.001), although other studies have shown that CV diseases are more prevalent among males.[24]

Lifestyle changes by community interventions that are focused on reducing the risk of CV diseases among the population of Tîrgu Mureș will have more effective outcomes with personalized therapy for the following risk profile: young men, smokers, and unmarried subjects, because in these individuals we identified a low adherence to the DASH diet.

Nutritional interventions should be applied in young subjects, at school (as a primary preventive measure), but also in patients with the above-mentioned profile and registered cardiovascular risk factors (even if there is no clear diagnosis) and in patients who already have a diagnosed cardiovascular disease, in order to improve their health status.

CONCLUSIONS

This research showed that individuals diagnosed with at least one cardiovascular risk factor had a higher adherence to the DASH diet, compared to individuals with no cardiovascular risk factors, most likely because diagnosed patients have changed their eating behavior and lifestyle from the time of diagnosis, with a positive impact on treatment outcomes and quality of life. Prospective cohort studies are required to confirm these findings.

CONFLICT OF INTEREST

Nothing to declare.

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