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Dietary Patterns Seem to Influence the Development of Perfusion Changes in Cardiac Syndrome X Patients

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A – research concept and design; **B** – collection and/or assembly of data; **C** – data analysis and interpretation; **D** – writing the article; **E** – critical revision of the article; **F** – final approval of article; **G** – other

Abstract

Background. Cardiac syndrome X (CSX) is linked with changes in the heart's micro-vasculature, without significant changes in main coronary vessels. According to ESC 2013 stable coronary artery disease criteria, CSX was replaced by Microvascular Angina (MA). While no changes in main coronary vessels are present, most patients still suffer from angina-like chest pains, which significantly diminish their quality of life. CSX is recognized among other coronary diseases and is now considered to be a form of stable angina. In most CSX patients we can visualize perfusion changes in the left ventricle.
Objectives. Since it is well known that the kind of diet can greatly influence the development of coronary disease, our aim was to evaluate the influence of diet on the myocardial perfusion in the group of patients who were diagnosed of CSX. In addition, we tried to verify whether there is any correlation between dietary patterns and perfusion changes visualized in this group of patients.
Material and Methods. Toward this goal we screened for the presence of CSX a group of 436 women who suffered from angina-like symptoms and whose routinely performed angiography revealed no changes in coronary vessels. Out of these, 55 women with CSX diagnosis, completed questionnaires regarding their nutritional patterns and underwent both myocardial perfusion studies (MPI) and exercise tests.
Results. In the studied group dietary patterns were far from normal values, with the majority of women consuming too much protein, animal fats and sugars in their daily diet, and too low amounts of complex carbohydrates and oils. We were not able to find definite correlations between diet and perfusion changes; however, women whose diet included too high fat and protein intake, seemed to have worse perfusion pattern in MPI.
Conclusions. Nutritional pattern seems to have an impact on development of myocardial perfusion changes in CSX patients (**Adv Clin Exp Med 2015, 24, 3, 453–462**).

Key words: body mass, myocardial perfusion index, nutritional value.

Cardiac syndrome X (CSX), more widely known as microvascular angina (MA), is currently counted among stable coronary syndromes. According to various sources, patients with cardiac syndrome X account for about 10–20% of all patients with symptoms of angina pectoris, a large percentage (more than 70%) of whom are peri- or postmenopausal women [1]. In more than 50% of patients with CSX, there is a characteristic persistence of chest pain more than 10–20 min after the end of exercise and poor or no response to short-acting nitrates [2]. CSX is frequently identified after exclusion of other forms of coronary disease in patients suffering from angina, with angina-like chest pains. In those patients a coronary angiography shows no changes in major coronary vessels.

According to ESC 2013 stable coronary artery disease criteria, CSX was replaced by Microvascular Angina (MA) [3]. According to those criteria, the main feature of MA should be regional myocardial ischemia.

Single photon emission computed tomography (SPECT) perfusion scintigraphy method is very useful in evaluating perfusion changes in all forms of coronary syndromes [4]. The main advantage of this method is that it enables viewing regional perfusion abnormalities, calculation of the defect's area and viability evaluation in the left ventricle; however, its value in evaluation of perfusion changes in small vessel disease is still debated. On the one hand its value in evaluation of different forms of coronary syndromes is well established, on the other in small vessel disease one can observe areas of perfusion changes which might be small enough to be outside detection range of SPECT studies, which were proved to be visualized in PET studies. There is a consensus however that in patients with normal coronary angiography results, perfusion changes observed in SPECT studies are more than likely to reflect MA changes [1].

One of the main factors affecting health is proper nutrition, both the amount of energy and the correct proportion of macronutrients, mineral elements and vitamins. A balanced diet improves physical condition, intellectual effectiveness or mental concentration. An improper diet initially causes changes in anthropometric and biochemical parameters but if sustained can lead to various diseases. High incidence of cardiovascular diseases can often be caused by improper lifestyle including diet, mainly: too high consumption of saturated fatty acids, mono- and disaccharides and salt. Low physical activity, stimulants and unhealthy life style enhance effects of an imbalanced diet [5].

The aim of current study was to assess the nutrition state and description of nutrition patterns in the group of women with CSX, as well as to visualize the perfusion changes in SPECT studies. In addition, we tried to establish whether there is a correlation between those variables.

Material and Methods

Initially, screening for the presence of CSZ was performed among 436 women, patients of the Cardiology Clinic, John Paul II Specialist Hospital and the Department of Cardiac and Vascular Diseases, Jagiellonian University Medical College in Kraków.

All women participating in the study after risk factor evaluation for coronary artery disease as well as medical evaluation were included into the "intermediate risk" category and were scheduled for myocardial perfusion stress/rest scintigraphy, according to ECS guidelines.

Tests using radioisotopes were performed in accordance with a two-day protocol [4].

On the first day a stress test was performed which included exercise on a treadmill consistent with guidelines [5]. For all patients a radioisotope tracer was administered at peak stress, and exercise was continued for 1 to 2 min in order to obtain the best distribution of the perfusion imaging tracer during the exercise. On the second day, tests were performed at rest.

In both the stress and resting tests, data acquisition was carried out in the 40–60 min following tracer injection using a dual-head gamma camera, E. Cam, by Siemens Medical Systems, Inc., with a matrix of 64 × 64. Radionuclide scintigraphy was performed using the gated method (GSPECT) with a preparation of technetium-99 combined with MIBI administered intravenously with an activity of 18–25 mCi (700–925 MBq). Data acquisition was set at 25 s for each of the 32 projections in a single cardiac cycle. The heads moved in a rotary fashion around the patient, from a 45° right anterior oblique (RAO45) position for head no. 1 to a 45° right posterior oblique (RPO45) position for head no. 2. Corridor 4DM reconstruction software supplied by Siemens was used to process the acquired raw data.

As the data was acquired, image reconstruction was performed, enabling images of the three sections of the left ventricle to be obtained, i.e. along the horizontal long axis (HLA), vertical long axis (VLA) and short axis (SA). Cross-section cardiac images, divided into 17 segments, were evaluated using the semi-quantitative method. This division of the left ventricular myocardium into 17 segments was used for perfusion assessment in each segment, along with a summary analysis of perfusion in segments corresponding to the areas of main coronary vasculature, i.e. the left anterior artery (LAD – segments 1, 2, 7, 8, 13, 14, and 17), circumflex artery (LCX -segments 5, 6, 11, 12, and 16) and right coronary artery (RCA – segments 3, 4, 9, 10, and 15).

For the purposes of this study, the extent of the tracer uptake in the individual segments was assessed on the Visual Score 5-point scale, where the degree of tracer accumulation corresponded to the following points:

0 – standard image of the heart muscle (normal perfusion),

1 – slight impairment of tracer accumulation or non-uniformly marked heart muscle (50–70% preserved perfusion) (equivocal),

2 – significantly reduced non-uniform collection of 99m Tc-MIBI (30–50% preserved perfusion) (mild perfusion change),

3 – heart area only 'marked' (10–30% preserved perfusion) (severe perfusion deficit),

4 – 'cold' scintigraphy image – complete absence of accumulation of Tc-99m-MIBI (0–10% preserved perfusion) (no tracer uptake).

From 436 participants after evaluation of SPECT tests in 169 women (38.76%) perfusion abnormalities were observed both at stress and at rest, while in 76 women (17.44%) only at stress evaluations. Within this group of patients with perfusion abnormalities, in 158 individuals coronary angiography or angio-CT scan have not confirmed the presence of vascular changes in main coronary vessels thus making subjects possible to be recognized of MA. Patients were then referred to adenosine stress echocardiography according to ESC criteria to diagnose Microvascular Angina [3] which confirmed the presence of the disorder in a total of 87 of the subjects. Out of that total only 55 women took part in subsequent steps of the study.

In this group basic anthropometric measurements and assessment of nutritional status were performed:

a) qualitative/quantitative assessment – 24-h dietary recall,

b) qualitative diet scoring (Healthy Diet Index).

Basic Anthropometric Measurement and Assessment of Nutritional Status

Women taking part in this study were measured to assess and classify their nutrition status according to WHO guidelines:

a) body weight measurement (rounded to the nearest 100 g),

b) body height measurement (accurate within 1 cm, in accordance with the principles of anthropometric testing).

On the basis of the body weight and height measurements, BMI (BMI = body weight [kg]/ /(body height [m])^2) was calculated according to the WHO criteria.

Nutritional Assessment

Qualitative/Quantitative Assessment – 24-h Dietary Recall

A 24-h dietary recall was carried out for each participant three times (two working days and one feast day) by a trained dietician. For an accurate assessment of food items the photographic Album of Food Products and Dishes published by National Institute of Food and Nutrition in Warsaw was used. The data gathered in recalls was analysed by dietetic program DietaPro (program based on the database of National Institute of Food and Nutrition 2005, subsequently expanded by Department of Hygiene and Dietetics, Jagiellonian University, Medical College, and corrected for losses due to culinary processes). Quantitative analyses included: overall amount of energy for each diet and concentrations of 80 other food components (macronutrients, mineral elements and vitamins). The results obtained were compared to norms published by National Institute of Food and Nutrition as well as guidelines of Polish Forum of Cardiovascular Diseases Prophylaxis [6, 7].

Qualitative Diet Scoring

Quick methods of qualitative diet assessment are based on scoring points for properly composed menu. Healthy Diet Indicator, developed and validated by Huijbregts et al. [8] estimates the adherence of a menu to dietary guidelines developed by WHO. Interpretation was based on methodology published by Gibson [9].

Statistical Analysis

All statistical calculations were performed with the usage of STATISTICA™ 10.0.

Results

We studied 55 patients, aged 49 to 69 years. The mean age was 57.25 ± 5.43 years. Height of patients ranged from 1.54 to 1.71 m (mean 1.63 ± 0.05). The mean BMI was 27.53 ± 2.87 kg/m^2 and values ranged from 21.94 to 34.6 kg/m^2. Ten subjects (18.2%) were characterized by normal BMI, in case of 34 subjects (61.8%) BMI was within overweight category, while the remaining 11 subjects (20%) were found to be obese.

Diet Patterns in the Study Group

Quantitative and Qualitative Diet Evaluation

In the population of studied women, a very high proportion of total fat (33.4%), and proteins (16.7%) in their diet was observed, though their respective intakes should not exceed 30% and 15% of the energy demand. The study group was characterised by a low proportion of carbohydrates in their diet (48.6%) as compared to the recommended values (over 55%), while the percentage of simple sugars (mono- and disaccharides) constituted 30% of all carbohydrates (recommended level – < 10%).

An abnormal distribution of individual types of fats was also observed:

– the average proportion of saturated fats in analysed diets was 42% which, taking into account the recommendations of the Polish Forum for Prevention of Cardiovascular Disease, exceeds 6 times the suggested value of 7% for those with increased cardiovascular risk. Detailed description of the distribution of saturated fatty acids are shown in Fig. 1.

The average proportion of mono-unsaturated fatty acids in the diet was 39% while according to the recommendations it should not exceed 20%. Detailed characteristics of mono-unsaturated fatty acids is shown in Fig. 2.

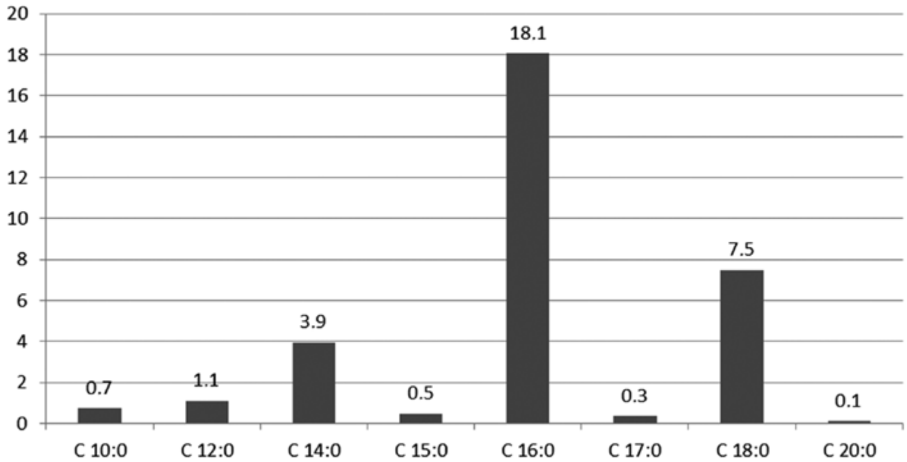

Fig. 1. Distribution of selected fatty acids (g) in the total supply of SFA (saturated fatty acids). In total – 32.2 g

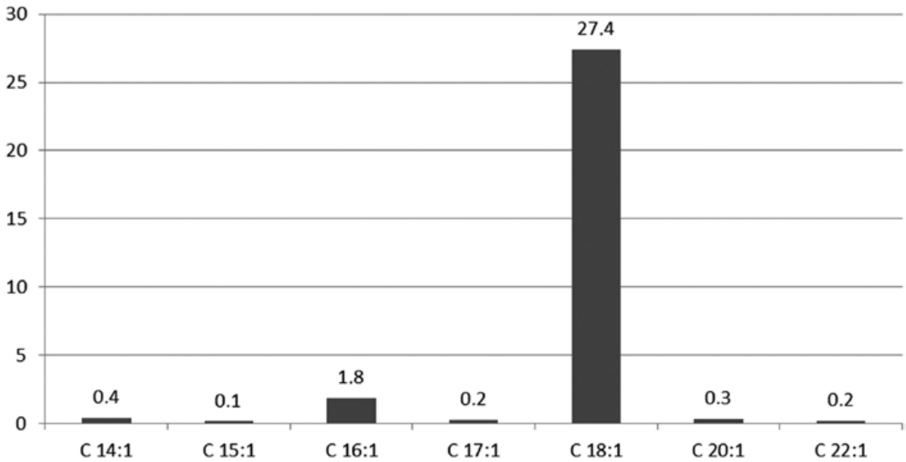

Fig. 2. Distribution of individual fatty acids in the total supply of MUFA (mono-unsaturated fatty acids). In total – 30.4 g

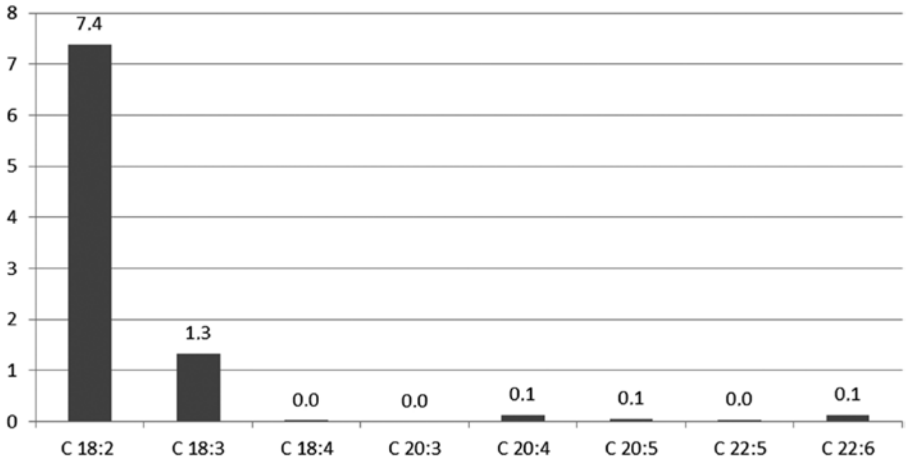

Fig. 3. Distribution of individual fatty acids in the total supply of PUFAs (poly-unsaturated fatty acids). In total – 9.0 g

The average proportion of poly-unsaturated fats in the analyzed diets slightly exceeded recommended values, around 11.5% of the recommended range of 6-10%. Detailed description of the distribution of poly-unsaturated fatty acids are shown in Fig. 3.

In the studied group the recommended proportions of the saturated fatty acids to poly- and mono-unsaturated fatty acids (which according to recommendations should be 0.7 : 0.8 : 1.5) were not maintained. Total cholesterol levels in diet also exceeded the recommended intake of 300 mg daily (345 g average in studied group), which is even lower (200 mg daily) in case of increased serum total cholesterol value.

Qualitative Diet Scoring

24-hour dietary recalls were analyzed in terms of the scoring method of Healthy Diet Index (HDI). The more points earned by individual patients, the better the Healthy Diet Index assessment. The average score of the patients was 3.9 out of 9 possible points. The max score reached in the study group was 5 points. Detailed results for individual scoring categories are presented graphically in Fig. 4.

HDI results obtained from the analysis of 24-h dietary recalls consistently show far too high supply of saturated fatty acids and abnormal supply of poly-unsaturated fatty acids.

Myocardial Perfusion Scintigraphy at Rest and Stress

In the studied group both rest and stress myocardial perfusion scintigraphy tests were performed.

Both at rest and at stress tests perfusion defects were detected in vascularization areas of the 3 main coronary arteries thus conforming MA occurrence in those patients. Most pronounced changes in both tests occurred in the area reflecting circumflex artery vasculature. What is important, we noticed better average of point values in the range of vasculature of all 3 major coronary arteries, which indicates the presence of transient perfusion defects.

The Summed Difference Score (SDS) between rest and stress values of the left ventricle perfusion was 3.13 ± 1.64 in the studied group and was located in the values corresponding to the presence of intermediate risk. It should be reminded that the absence of significant coronary lesions was earlier confirmed in all patients in the study through angiography or tomography of coronary arteries.

The Correlation Between the Perfusion of the Left Ventricle at Rest and at Stress Study, and Dietary Patterns in the Group of Studied Women

The obtained values of Pearson correlation coefficient R between the values of point-reflecting myocardial perfusion of the left ventricle and the energy content of the diet were shown in the Table 1.

A linear relationship has been demonstrated between increasing the amount of calories in the diet and the occurrence of more severe perfusion defects, both in resting conditions and post-workout. A similar relationship was found for the increase in the percentage of protein in the diet, and to a lesser extent, carbohydrates and fats.

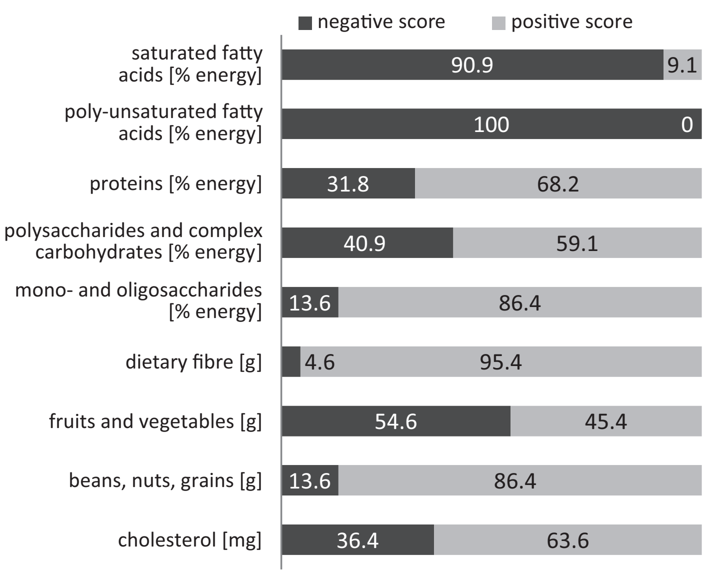

Fig. 4. Healthy Diet Index scores, values shown as a percentage

Table 1. The values of Pearson's correlation coefficient R between the values of point-reflecting myocardial perfusion of the left ventricle and the energy content of the diet

	LAD	Cx	RCA	Total
	stress MPI			
The average amount of energy in the diet (kcal)	–0.43*	–0.44*	–0.17	–0.29
The amount of energy derived from protein (kcal)	–0.47*	–0.48*	–0.18	–0.39
The amount of energy derived from fats (kcal)	–0.33	–0.34	–0.26	–0.29
The amount of energy derived from carbohydrates (kcal)	–0.36	–0.36	–0.26	–0.31
	rest MPI			
The average amount of energy in the diet (kcal)	–0.24	–0.45*	–0.29	–0.37
The amount of energy derived from protein (kcal)	–0.27	–0.41	–0.19	–0.29
The amount of energy derived from fats (kcal)	–0.16	–0.39	–0.28	–0.27
The amount of energy derived from carbohydrates (kcal)	–0.25	–0.41	–0.25	–0.29

* significant values at $p < 0.05$, LAD – left anterior descending artery region, Cx – circumflex coronary artery region, RCA – right coronary artery region.

Discussion

In its classic form the cardiac syndrome X (CSX) or microvascular angina (MA) – as in other forms of coronary heart disease – manifests itself with chest pain that can occur both in effort and in the state of nervous tension, usually easing off at rest.

It should be emphasized that what distinguishes CSX from other forms of coronary heart disease is the lack of changes in main coronary vessels. It is now believed that the risk factors for CSX or MA and other forms of ischemic heart disease will be identical. One includes both non-modifiable factors (genetics, age, gender) and modifiable ones (lifestyle, diet, exercise). CSX diagnosis may be associated with an increased risk of coronary events and its symptoms and can cause significant impairment of quality of life of the patient and provide a significant financial burden by virtue of the diagnosis and (often ineffective) treatment [10, 11]. The WISE (Women's Ischemia Syndrome Evaluation) study results showed that in patients with cardiac syndrome X and coronary microcirculation disorders disclosed annual risk exists at the level of 2.5% of such episodes like sudden cardiac death, myocardial infarction, stroke, or congestive heart failure [12, 13].

Non-pharmacological intervention consists mainly of changes in lifestyle, diet and increased physical activity that improves metabolism (e.g. aerobic physical activities improve physical effectiveness). In patients who enhanced their physical activity, a metabolic improvement in cardiac muscle was observed. Changes in diet together with enhanced physical activity in many described studies caused a noticeable clinical improvement and partial elimination of CSX patients' indisposition [14–16]. As revealed in our material, both quantitative and qualitative analyses of studied subjects' diets revealed errors that were connected with improper nutrition state. Among most important issues, analysis of diet composition showed high intake of fats and proteins and low intake of complex carbohydrates at the same time.

Diet modification remains one of the most important non-pharmacological interventions, especially the diversity of food products and overall amount of calories that will fulfill the patient's needs. According to guidelines, fat intake should be kept below 30% of energy needs, with saturated fats below 10% of energy needs, but in the case of patients with increased cardiovascular risk it should be kept even lower – below 7%. Trans isomers of unsaturated fatty acids should be reduced to less than 1% of energy needs, while poly-unsaturated fats should be found in the range below 10% and above 6% of energy needs and the ratio of n-6 to n-3 should be less than 4 : 1. Mono-unsaturated fatty acids should not exceed 20% of energy needs. Guidelines highlight that protein uptake should be around 15% of energy needs and carbohydrates below 55%. Reduction of fatty acids intake and modifications in type of chosen fats remain the standard advice for preventing cardiac disease. Poly-unsaturated fats are key points because their presence, according to published data, is linked with beneficial influence on overall cholesterol to HDL cholesterol ratio comparing to other macronutrients [17].

Moreover, the intake of this type of fats increases sensitivity to insulin that has a positive impact on patients with BMI over 25 and/or glucose intolerance [18]. Even though positive aspects of poly-unsaturated fats are well documented, this kind of fatty acids cannot constitute the substitution for saturated fatty acids (the percentage of which usually should be reduced). There is some data indicating that a higher intake of n-6 poly-unsaturated fatty acids was correlated with an increase in heart incidents, that is why intake of poly-unsaturated acids, which in typical diet is connected with absorption of n-6 fatty acids, should be set in range between 6–10% of energy needs [19]. On the other hand, the intake of long-chain fatty acids, that belong to n-3 family fats, correlated in randomized cohort studies with lower number of cardiac incidents [20].

In the presented group of women with CSX the intake of long-chain fatty acids (20 or 22 carbon atoms) that are typically found in fish meat and belong to n-3 fatty acids was marginal. Long chain fatty acids that construct cell membrane are crucial for its integrity. Those fats undergo changes into site active substances that belong to prostanoids (prostaglandins and prostacyclins), thromboxanes and leucotrienes. Prostanoids originate from arachidonic acid (20 : 4, n-6) that can be taken in with fish fats and fish oils. The most abundant was linoleic acid (C18 : 2), which indicates a high intake of plant oils that are perfect sources of n-6 fatty acids. The intake of unsaturated fatty acids was unexpectedly high in the examined female group in comparison to other Polish studies done among women in a comparable age. On the other hand, the predominance of n-6 fats over n-3 fats, found in the presented study, was described many times as one of the most typical forms of dietary errors [21, 22].

Apart from the restrictions connected with poly-unsaturated fats, the lowering of saturated fats intake is strongly advised in the prevention of cardiac diseases. According to the literature, the substitution of 1% of energy from saturated fats with poly-unsaturated fats resulted in 2–3% reduction of cardiovascular incidents [20, 23]. On the other hand, similar substitution of saturated fats with carbohydrates or mono-unsaturated fats gave ambiguous results. On such a basis, the reduction of the saturated fats intake (to max 10% of energy) through substitution with poly-unsaturated fats remains one of the most valuable diet modifications aimed at preventing cardiovascular disease. One of the newest meta-analyses, published by Hooper [24], indicates that a reduction in fat consumption and the control the fat type lowered the number of heart incidents by 14% in men. Different fatty acids have different biological effects on cell metabolism. It was described that saturated fatty acids – mainly C14 : 0, C12 : 0 and C16 : 0 – correlated with increased LDL-C and HDL-C while slightly longer, stearinic fatty acid C18 : 0, was described as having a neutral impact on cholesterol levels [25]. It should be stressed that analyses of individual fatty acids' influence on cardiovascular disease is not an easy task and not many articles in this field were published. In the diets of women with CSX among saturated fatty acids the C16 : 0, C18 : 0 and C14 : 0 were found in significant amounts. In publications there are some reports about the protective influence of short chain fatty acids and mid-length chain fatty acids, but in the diets of women analyzed here those fats were poorly represented and can be neglected.

In a study designed by Jakobsen to lower the risk of cardiovascular disease saturated fats were partially substituted by mono-unsaturated fatty acids; nevertheless, the expected positive result did not occur. Those findings led to the conclusion that mono-unsaturated fatty acids together with saturated ones were described as factors that may increase mortality caused by cardiovascular disease [26]. In the analyzed group the main mono-unsaturated fatty acid was the oleic acid which according to literature lowers the LDL cholesterol, overall cholesterol and triglycerides in blood [27].

Cholesterol intake among women with CSX exceeded the norm (< 300 mg) by about 15%. The newest data confirms a correlation between cholesterol intake and lipids blood concentration that increases the risk of cardiovascular disease but this correlation appears to be weaker than described previously. Some data indicates that for 2/3 of the healthy population with increased cholesterol, consumption did not have a significant impact on cholesterol concentration in the blood. However, for the remaining one third it is connected with higher levels of LDL and HDL cholesterol. This data indicates that for people with already developed cardiovascular problems it is crucial to monitor cholesterol levels in the diet [28]. According to European guidelines for prevention of cardiovascular diseases in clinical practice for 2012, not only the types of fatty acids are important, but also the proportions of saturated fatty acids to poly-unsaturated fatty acids to mono-unsaturated fatty acids and in the presented study they were not correct and equaled 3.7 : 1 : 3.4. The intake of mono-unsaturated and poly-unsaturated fats favors a lowering of triglycerides and LDL concentration in the blood. Usually a lower intake of saturated fats is connected with a lower intake of cholesterol, that is why separate norms for cholesterol are usually not created, but it is advisable to keep cholesterol consumption below 300 mg per day. In the presented group the average daily consumption of cholesterol was 345 mg.

Apart from the fats and proteins, carbohydrates were consumed in too low amounts. Deeper analysis revealed that low intake was mainly caused by low uptake of complex carbohydrates, whereas disaccharides (sucrose and lactose) reached over 30% of overall energy intake, though they should be kept at levels below 10%. Carbohydrates are the main substrate for satisfying an organism's energy needs. Plants are the natural source of carbohydrates. Appropriate concentration of carbohydrates is necessary for efficient oxidation of fats and protects amino-acids against unnecessary utilization. Compound sugars contain food fiber that makes absorption of starch and simple sugars slower, lowers glycaemic index value and enhances insulin sensitivity. That is why this fraction of carbohydrates can serve as a non-pharmacological factor in obesity, overweight and cardiovascular disease treatment. According to guidelines food fiber should be consumed in amount between 30-45 g per day. In the presented study women ate food fiber in very low amounts – on average 16.7 g per day. In the intestine food fiber influences the absorption of fats and bile acids' conversion that affects sterol metabolism and can influence the absorption of mineral elements and vitamins. Moreover, the food fiber intake influence on digestion and absorption of carbohydrates and fats slows down the degenerative changes characteristic in adult and old age.

In the primary and secondary prevention of cardiovascular disease not only the size of food rations but also the frequency of food consumption play an important role. One of the most important suggestions is the regular consumption of fruits, vegetables and fish. Fruits and vegetables are valuable sources of antioxidant vitamins and flavonoids and the recommended intake is at min 400 g per day. Dauchet et al. [29], state that an additional portion (about 80 g) eaten every day can lower cardiovascular risk by 4% (RR 0.96; 95% CI 0.93–0.99). A meta-analysis of 7 cohort studies revealed a reduction of the risk of cerebrovascular accidents by 5% with each additional portion of fruits and vegetables.

There can be different patterns of perfusion changes observed in CSX patients, which is a result of differences and multi-factor aetiology and not entirely understood background of the diseases. However, it is important to mention that poor correlation between the decrease in perfusion in scintigraphic examination and too high energetic value of consumed diet and too high intake of proteins were found in presented study. The correlation of perfusion and simple sugars intake or animal fats consumption was even lower, below statistical significance. Such result is surprising, as the risk of cardiovascular disease is increased by high consumption of fats (quality and quantity) and simple sugars (quantity) as well. The relationship between increased risk of cardiovascular disease or other diseases based on cardiovascular impairments and simple sugars, high glycaemic index and glycaemic load was studied extensively and is well documented. In the studied group only 5% of diets adhered to recommended values for simple sugars (< 10% of total energy) [30, 31]. A high protein diet is connected with reduced risk of cardiovascular disease indirectly by lowering the body mass among people with overweight and obesity, but long-term studies do not confirm positive impact on cardiovascular disease risk [32], that is why usage of high protein diet as an effective non-pharmacological long-term therapy is still unclear. From year to year there are new published findings focusing on long-term consumption of high protein – low carbohydrate diet (without quality control: polysaccharides/simple sugars; animal/plant proteins) and increased risk of cardiovascular diseases and even some conclusions indicate correlation with increased risk of cardiovascular incidents [33]. Though the presented study shows a correlation between improved heart muscle perfusion and higher protein intake in women's diet, this effect can be explained by reduction in body weight. Moreovere these data indicates that both quality and quantity must be taken into account in those patients.

Macro- and micro-elements are food components that are important in the context of the effect on CVD. It has been shown that a higher potassium intake lowers blood pressure by modifying the risk of coronary heart disease of which CSX is one of the forms. Many studies have confirmed that a reduction in salt intake has a positive effect on the body functional status; the daily intake should not exceed 6 g of salt (i.e. 2.4 g per day of sodium), and in people with hypertension 5 g salt a day (i.e. < 2 g sodium per day).

The policy of reduced salt intake in the general population, adopted in the 1970s in Finland, resulting in 30 years of collaboration with the nutrition industry (production of food products with reduced sodium content) coupled with a simultaneous increase of public awareness has resulted in a reduction in systolic and diastolic blood pressure, a reduction of 75–80% in the incidence of strokes, a reduction in mortality due to cardiovascular disease and an increase in survival.

In this paper we presented only the overall results, and individual assessment of quantitative, and a qualitative feeding method was used to develop dietary recommendations for each of the studied women. Women participating in the study were given detailed instructions on modifying their eating habits and how to properly balance their diet in order to properly conduct nutritional support and pharmacological therapy to improve outcomes in cardiac interventions. Further cardiac interventions in this group consisted of a 3-month period cardiac rehabilitation. In light of the above mentioned studies and clinical observations it can be concluded that the modification of diet will help to keep the results of cardiac interventions in terms of the long-term.

To sum up, the subsequent general conclusions can be stated. The women in analyzed group made mistakes in their diets, in terms of both quality and quantity. Each woman was given individual counseling, leading to an optimization of their dietary patterns, which should improve their long-term effects on cardiac health. The control of dietary patterns in patients with ischemic heart disease (including CSX) should not be confined only to the control of the content of saturated fats and simple sugars and total calories in the diet, but should also include other nutrients, which may also have an impact on the number of changes and symptoms of CSX. It seems that research on the effects of protein-rich diet and its possible impact on the incidence of all forms of ischemic heart disease should be continued, as the role of this factor in the pathogenesis of this group of diseases may be underestimated.

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