THE IMPORTANCE OF ASSESSING THE RATIO BETWEEN THE ATHEROGENIC INDEX OF FOOD AND THE ATHEROGENIC INDEX OF PLASMA IN DYSLIPIDEMIA IN ORDER TO SET UP A DIET PLAN

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Abstract

Assessing the metabolic benefits of a rational diet, recommended in cardiometabolic pathologies, implies the knowledge of all the aspects regarding the nutritional quality of foods that can lead to the improvement of the metabolic processes that are involved in this pathology. Thus, an improper correlation of the nutritional quality parameters of food with the metabolic process incriminated in this pathology can lead to an increase of the pathological status.

This study determines the nutritional quality parameters of the foods prescribed in the nutrition plan and quantifies the metabolic and nutritional benefits on the cardiometabolic pathologies. The results of the nutritional analysis and of the analysis of the impact of food quality on the paraclinical markers that are specific to these pathologies revealed a significant improvement of the paraclinical parameters and of the quality of life of the patients with cardiometabolic pathologies. These results highlighted the importance of rational nutrition plans based on scientific data correlated with the pathological status.

This study aimed to complete the existing information on the nutritional importance of the lipid quality indices of foods on dyslipidemias and associated pathologies. The atherogenic index, the $\omega_6 : \omega_3$ ratio, the percentage of saturated fatty acids, the trans fatty acids and the cholesterol level are among the most important indices.

Key words: healthy diet, metabolic benefit, dyslipidemia, atherosclerosis

INTRODUCTION

Atherosclerotic dyslipidemias have truly become a global epidemic, being responsible for the death of 25 million people worldwide by the year 2020 (Murray and Lopez, 1996).

According to the American Heart Association (AHA), by 2030, the prevalence of cardiometabolic diseases is expected to increase by 9.9% (Heidenreich et al., 2011). Mozaffarian, 2016 considers cardiometabolic diseases as diet-related diseases, including coronary heart disease, stroke, type 2 diabetes and obesity. Thus, diet represents a prime factor in current studies. Lifestyle, including nutrition, plays an important role in the

aetiology of the cardiovascular disease (CVD) preceded by cardiometabolic pathologies (Sigal et al., 2013).

Prabhu et al., 2013 consider that atherosclerosis is a disease that progresses rapidly and its approach based on the use of food constituents can be a challenge for those who want to study this subject. The quality and the types of foods consumed have a great influence on the various metabolic pathways that imply complex nutritional interventions at an individual, social, cultural, community, agricultural, industrial, governmental and global level. These interventions are based on strong and effective evidence that lead to the development of several strategies of improving health systems and policies, and, last but not least, to the setting up of several individual strategies (Mozaffarian et al., 2012, Afshin et al., 2014 quoted by Mozaffarian, 2016).

In order to modify the LDL-C / HDL-C balance, it is necessary to reduce the ratio of ω_6 and ω_3 fatty acids present in the foods that are recommended in dyslipidaemias. A higher consumption of ω_3 fatty acids reduces the biosynthesis of ω_6 and arachidonic acid which in a high ratio of ω_6 and ω_3 have a pro-inflammatory effect because the C 22: 6 - ω_3 and C 20: 5 - ω_3 fatty acids antagonize the overproduction of eicosanoids derived from ω_6 fatty acids - arachidonic acid, which is the component of the inner membrane of the blood vessels, of the intima on which the cholesterol is deposited, forming atheromatous plaques. The recommended ω_6:ω_3 ratio that improves the LDL-C / HDL-C balance is 2:1.

The quality of foods with impact on reducing atherosclerotic risks, based on the atherogenic index of food correlated with the atherogenic index of plasma, is of significant importance in establishing dietary plans specific to these pathologies.

MATERIAL AND METHOD

The selected methods of analysis highlight as accurately as possible the metabolic benefits of diet on the reduction in the pathological status of atherosclerotic dyslipidemic diseases.

The clinical method of analysis that included nutritional anamnesis and objective examination was applied for a judicious clinical evaluation of patients' nutritional and dyslipidemic pathological status revealed by paraclinical analyses specific to dyslipidemias and associated pathologies. This method involves the analysis of the studied pathological events, correlation of the cases and medical supervision.

The nutritional method of analysis assessed the nutritional intake in order to collect information on the amount and type of ingested foods,

nutrition and energy balance based on the composition of the food ingested over a day. These assessments were completed by the calculation of the atherogenic index of food and by the ω_6 **:** ω_3 ratio. The atherogenic index of food was calculated by using the following formula: IA = (12: 0 + 4 x 14: 0 + 16: 0) / (Σ MUFA + Σ PUFA) (after Ulbricht and Southgate, 1991).

The methods of assessing the inputs of the main nutrients that are present in the foods of a nutrition plan are represented by *food surveys* that can provide information on the nutritional consumption of an individual or of a group. We must say from the very beginning that there is no method that allows an accurate assessment of food intake, but these methods are essential in determining food disorders and need to be completed by paraclinical analyses in order to set up a real nutritional plan with beneficial effects of risk reduction.

The paraclinical methods were meant to:

1. Assess the laboratory analysis report specific to dyslipidemiant pathologies at the beginning of the study and after 6 weeks of hygienic-dietetic regime provided in each patient's individualized nutrition plan.

The assessed paraclinical indicators were:

1. Total cholesterol and fractions of cholesterol - LDL and HDL
2. Triglycerides

RESULTS AND DISCUSSION

From the study regarding the evolution of the paraclinical parameters measured in comparison with the reference values before the establishment of the dietary plan (table 1) it is noted that 7 out of 10 patients have total cholesterol increased in large limits, with 5 to 25% compared to the reference interval for this marker.

Table 1

Distribution of measured paraclinical parameters comparative with the reference values at the beginning of the study

No	Surname, First name	Age	Sex	TC	Reference value TC max.	HDL-c	Reference value HDL-c min.	LDL-c	Reference value LDL-c max.	TG	Reference value TG max.
1	BR	48	M	192	200	49	40	138	100	62	150
2	BF	44	F	196	200	56	40	131	100	139	150
3	SM	66	F	180	200	72	40	90	100	102	150
4	DVL	56	M	268	200	51	40	189	100	280	150
5	DAI	46	M	220	200	46	40	123	100	136	150
6	BV	66	F	203	200	51	40	161	100	78	150
7	GS	44	M	258	200	48	40	234	100	157	150
8	VA	52	M	212	200	46	40	148	100	132	150
9	JD	41	M	214	200	40	40	126	100	151	150
10	DIL	49	M	225	200	48	40	145	100	164	150

Note: TC - total cholesterol; HDL-c - high density lipoprotein; LDL-c - low density lipoproteins; TG - triglyceride.

LDL-c values were increased in 9 of 10 patients and HDL-c values were also modified, being only in 40% of cases above 50 mg / dL. In 60% of cases HDL-c recorded values between 40 -48 mg / dL, indicating an increased CVD risk (Table 1).

These values correlated with the quality parameters of the diet, especially with the dietary lipid profile, have shown that the food plan must be drawn up in such a way as to respect the principles of rational nutrition. These principles are aimed at respecting the ratio of saturated and unsaturated fat content, correcting the ω6 / ω3 ratio, determining AtI of foods and reducing food cholesterol intake.

After review Atherogenic index (table 2) obtained by reporting HDL-c with cardioprotective effect at CT, it was observed that 30% of the total subjects analyzed had an AtIP below 0.20.

Table 2

Plasma atherogenic index (AtIP) at the beginning of the study

No	**Surname, First name**	**Age**	**Sex**	**TC**	**HDL-c**	A_tIP = HDL-c/TC	**Reference value** A_tIP
1	BR	48	M	192	49	0,25	0,30
2	BF	44	F	196	56	0,29	
3	SM	66	F	180	72	0,40	
4	DVL	56	M	268	51	0,19	
5	DAI	46	M	220	46	0,21	
6	BV	66	F	203	51	0,25	
7	GS	44	M	258	48	0,19	
8	VA	52	M	212	46	0,22	
9	JD	41	M	214	40	0,19	
10	DIL	49	M	192	48	0,25	

Note: TC - total cholesterol; AtIP - atherogenic plasma index; HDL-c - high density lipoprotein

AtIP values below 0.20 indicate an increased atherosclerotic risk. The higher this index, the lower the risk of cardiovascular disease (CVD), the risk of atherosclerosis and hemorrhagic or ischemic events (myocardial infarction, stroke).

The atherogenic index in this study indicates that 80% of the cases present an atherogenic risk, with a close connection with the positive diagnosis of cardiometabolic pathologies. This result entails the urgent need to identify eating defects and modify eating habits in order to obtain important metabolic benefits, with the purpose of reducing the overall risk of the patient.

Following the analysis of the ratio ω6 / ω3 of foods consumed during a day, for a period of 10 days before the establishment of the nutrition plans, it was observed that it had significantly higher average values compared to the cardioprotective reference values (ideal 2, maximum 4). (figure 1).

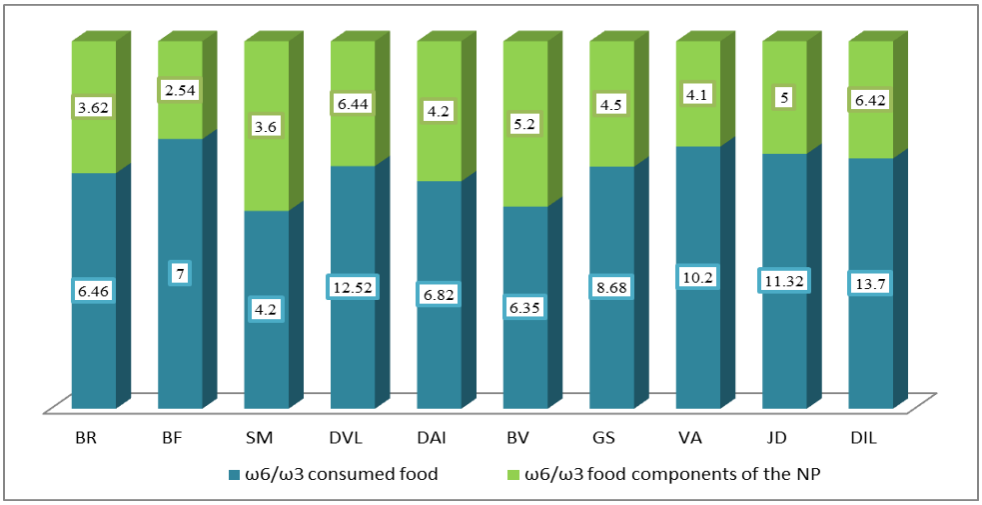

Fig. 1. The ratio ω6 / ω3 of foods consumed before the establishment of PN compared to the ratio ω6 / ω3 of foods recommended by PN

The ω6 / ω3 ratio of foods consumed during a day, recommended by individual PN (nutrition plans), had on average values between 2.54 and 6.42 over the entire study period. These values were influenced by the psychosocial, family and cultural factors (figure 1).

A_tI of foods recommended in PN had average individual values between 0.34 and 0.41 compared to A_tI of foods consumed before the establishment of PN, where the values of this index ranged from 0.19 to 0.29 (Figure 2).

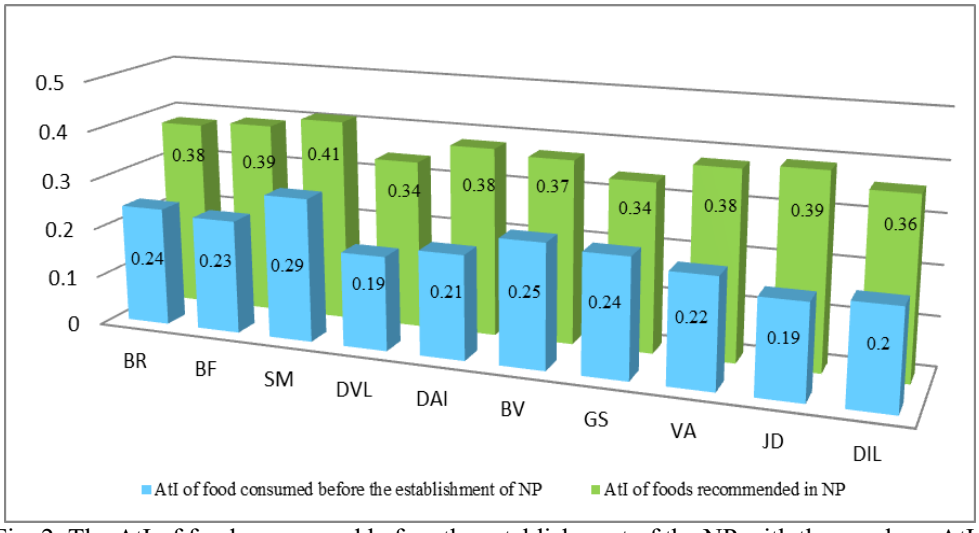

Fig. 2. The AtI of foods consumed before the establishment of the NP with the purchase AtI of the recommended foods for NP

The AtI of foods with a minimum risk of inducing atherosclerosis is recommended to be as high as possible, being considered optimal at the value of 0.38, a value similar to that of the Eskimo diet specific ingredients.

Table 3

AtIP distribution correlated with food AtI after a 3 months of nutritional treatment

No.	Surname, First name	Age	Sex	A_tI food = (12:0 + 4 x 14:0 + 16:0) /(Σ MUFA + Σ PUFA)			A_tIP = HDL-c/TC		
				At the beginning of the study	Reported to NP	%	At the beginning of the study	After a 3 months of diet	%
1	BR	48	M	0.24	0.38	+58.33	0,25	0.30	+20.00
2	BF	44	F	0.23	0.39	+69.56	0,29	0.31	+6.89
3	SM	66	F	0.29	0.41	+41.37	0,40	0.42	+5.00
4	DVL	56	M	0.19	0.34	+78.94	0,19	0.23	+21.05
5	DAI	46	M	0.21	0.38	+80.95	0,21	0.28	+33.33
6	BV	66	F	0.25	0.37	+48.00	0,25	0.32	+28.00
7	GS	44	M	0.24	0.34	+41.66	0,19	0.23	+21.05
8	VA	52	M	0.22	0.38	+72.72	0,22	0.29	+31.81
9	JD	41	M	0.19	0.39	+105.26	0,19	0.27	+42.10
10	DIL	49	M	0.20	0.36	+80	0,25	0.28	+12.00

Note: NP - nutritional plan; AtI feed - food atherogenic index; AtIP - atherogenic plasma index; TC - total cholesterol; HDL-c - high-density lipoprotein

In Table 3, the data resulting from the food AtI determinations correlated with the AtIP led to the observation that these parameters are closely related. Thus, it can be observed that a low food AtI can lead to an atIP with high cardiovascular risk. The more food AtI is maintained at recommended values of 0.39 the more AtIP will have cardioprotective reference values.

Table 4

Distribution of paraclinic markers after 3 months of nutritional treatment

No.	Surname, First name	Age	Sex	CT		HDL-C		LDL-C		A_tIP = HDL-c/TC	
				mg/dL	%	mg/dL	%	mg/dL	%		%
1	BR	48	M	184	-4.16	56	+14.28	128	-7.24	0.30	+20.00
2	BF	44	F	187	-4.59	58	+3.57	129	-1.52	0.31	+6.89
3	SM	66	F	175	-2.78	73	+1.38	89	-1.11	0.42	+5.00
4	DVL	56	M	249	-7.08	57	+11.76	168	-11.11	0.23	+21.05
5	DAI	46	M	186	-15.45	53	+15.21	102	-17.07	0.28	+33.33
6	BV	66	F	182	-10.34	58	+13.72	138	-14.28	0.32	+28.00
7	GS	44	M	237	-8.13	55	+14.58	187	-20.08	0.23	+21.05
8	VA	52	M	191	-9.90	56	+21.73	120	-18.91	0.29	+31.81
9	JD	41	M	183	-14.48	49	+22.5	102	-19,04	0.27	+42.10
10	DIL	49	M	198	-12.00	56	+16.66	116	-20.00	0.28	+12.00

Note: CT - total cholesterol; AtIP - atherogenic plasma index; HDL-c - high density lipoprotein, LDL-c low density lipoprotein

After a period of 3 months of nutritional treatment, the paraclinical markers specific for the dyslipidemic and associated atrosclerotic pathologies had significantly improved values in about 80% of cases.

CONCLUSIONS

1. The analysis of the results obtained revealed that atherogenic dyslipidemias have a favorable evolution correlated with poor nutrition in saturated fats and trans fats but rich in unsaturated fats, especially polyunsaturated fats of type ω3, ω6.
2. The quality parameters of the lipid profile of the foods that can be correlated with the paraclinical markers incriminated in the dyslipidemias pathologies are first line factors in the evolution and prognosis of atherogenic dyslipidemias. Thus, these food quality parameters correlated with the drug treatment prescribed by the cardiologist, significantly reduce the risk of atherogenic recurrence**.**
3. The nutritional plans established in close correlation with both the food quality parameters and the pathophysiology of the disease lead to significant results regarding improving the quality of life of the patients.
4. By correlating the paraclinical parameters with the nutritional value of the foods prescribed in the nutrition plan after a period of 12 weeks of diet, a significant improvement of these parameters was observed, which again emphasizes the importance of establishing nutritional PNs closely related to the medical diagnosis and metabolic process.

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