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Entela Puca *

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Research Article

Dietary Strategies for Weight Loss and Reducing Low Grade Inflammation: Evaluating Mediterranean Diet versus Mediterranean Diet plus Food Intolerance Elimination Diet in Obese Patients

Entela Puca [1,2]*, Edmond Puca [3], Blertina Olldashi [2,4], Ilir Akshija5, Carmelo Rizzo [6,7,8]

[1] Service of Endocrinology, American Hospital, Tirane, Albania.

[2] Westerns Balkan University, Tirane, Albania.

[3] Service of Infection Diseases, University Hospital Center, Tirane, Albania.

[4] Service of Endocrinology Hygeia Hospital, Tirane, Albania.

[5] Service of Statistics, University Hospital Center, Tirane, Albania.

[6] Scientific Director in Clinical Nutrition, Unicusano Telematic University, Rome, Italy.

[7] International Academy of Clinical Nurition Founder and President of Medical Research Center "Immunculus" Moscow, Russia.

[8] College of Medicine and Dentistry in Birmingham, Visiting Senior Lecturer in Mental Health.

***Corresponding Author:** Entela Puca, Service of Endocrinology, American Hospital, Tirane, Albania.

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Abstract

Background

Obesity is associated with chronic low-grade inflammation, which believed to play a role in causing insulin resistance. Food intolerances (FI) are also one of the probable causes of low-grade inflammation and may contribute to the onset of obesity.

The aims of this study were to evaluate the effect of Mediterranean Diet (MedDiet) modified according the FI test (MedDiet plus FI) versus only MedDiet on inflammatory markers, metabolic parameters and anthropometric data.

Material and methods: The study consisted of 20 patients with BMI over 30. FI test was done in 10 patients. The FI group was given modified MedDiet according FI results while the control group was given only MedDiet. The body composition and metabolic parameters were measured in the beginning and 8 weeks.

Results: In the MedDiet plus FI group, patients lost weight from 101.8 kg to 94.5 kg. The biochemical assessment showed a significant decrease in values of triglycerides, total-Cholesterol, HDL-cholesterol; and LDL-cholesterol. The metabolic assessment showed a significant decrease in values of insulin and HOMA- IR 37.64% vs 47.47%, respectively; in the MedDiet plus FI group vs MedDiet group alone. A significant decrease in the average value of fibrinogen and CRP in both groups was seen.

Conclusion: The result suggests that food intolerance elimination diet (FIED) gave positive changes on body composition and metabolic parameters in obese patients. Obese patients who cannot lose weight by low-calorie diet alone can do it with elimination diet according to the results of FI test.

Keywords: obesity; Mediterranean diet; low-grade inflammation; food intolerance elimination diet; inflammation

Introduction

Obesity is one of the more concerns of public health in now days. It is a complex disease associated with an increase of inflammatory biomarkers, leading to chronic low-grade inflammation (1–3). Body mass index (BMI) and waist circumference (WC) are two indicators of visceral fat

and predictors of metabolic syndromes. Individuals that are overweight (BMI>30) and obese have altered serum levels of inflammatory cytokines (1,3–5). In these obese patient's adipose tissue release many inflammatory mediators. Many studies suggest that low grade inflammation is mitigated by a healthy diet. Among other health-related behaviors, the association of obesity and inflammation is largely documented now. One of the most important diet connected with lower morbidity and mortality from chronic diseases like cardiovascular disease, diabetes, obesity, cancers, and lower all-cause mortality, is MedDiet. Greater adherence to a traditional MedDiet has good evidences on the protection of health effects [6,7].

The Mediterranean diet (MedDiet) is one of the most studied and used diet since 1960 by Ancel. It is based on the traditional foods that people used to eat in countries of the Mediterranean Sea region [8,9]. The MedDiet encourages plant-based foods and healthy fat and moderation consumption of red wine, by a high intake of plant foods (fruits, vegetables, breads and other cereals, potatoes, beans, nuts and seeds); minimally processed, seasonally fresh and locally grown foods; fresh fruits as typical dessert, with sweets containing sugars or honey a few times per week; a high intake of olive oil (especially virgin and extra-virgin olive oil) used as the principal source of fat; a moderate intake of dairy products (mostly as cheese and yoghurt); zero to four eggs a week; fish and poultry consumed in low to moderate amounts; red meat consumed in low amounts; and wine in moderation, consumed with meals (10–14). Following this pattern may help stabilize blood glucose levels and protect against type 2 Diabetes Mellitus. The MedDiet has also been shown to decrease insulin resistance, evidence from observational and intervention studies. Numerous studies have now shown that the Mediterranean diet can promote weight loss and help prevent heart attacks, strokes, type 2 Diabetes, and premature death (10,13,15-18).

Food intolerance is a reaction against food, but not immunological manner, and may be confused with real food allergies. According to the WHO, half of the world population has food intolerance (FI), and is associated with chronic systemic inflammation. The FIED is often helpful in discovering and eliminating foods associated with symptoms that may interfere with weight loss. Foods are commonly reintroduced after elimination to further assess individual sensitivity and tolerability (19-21). In the recent years has been concluded that obesity is an inflammatory disease and weight loss programs through different model of diets has been shown to decrease the inflammation (1,4,13,22).

Medical evidence is the keystone to sustaining and protecting the MedDiet and its beneficial clinical implications. Considering the value of the MedDiet in improving symptoms in patients with chronic diseases, we aimed to assess the immunomodulatory effect of the MedDiet combined with the FI in managing of inflammatory tests.

The aim of this study was to analyse the correlation between low grade marker of inflammation/cytotoxic such as C-Reactive Protein (CRP) and fibrinogen with metabolic profile: fasting glycemia, fasting insulin, Insulin Resistance (HOMA-IR), lipid profile, liver enzyme (ALT, AST, total bilirubin), in patient received only MedDiet and patient received MedDiet modified according the food intolerance test. All participants were with BMI>30kg/m^2.

Material and Methods

We enrolled 20 patients diagnosed with obesity (BMI >30kg/m^2). Inclusion criteria were: Individuals over 18 years old BMI >30kg/m^2

For all of them, we calculated: BMI and WC (waist circumference), measured metabolic parameters and inflammatory marker. FI test were done in 10 of the 20 patients. We used stratified randomization, because we wanted that each group would have equal distribution of age, gender, BMI or other variables and divided them in two groups. The patients in the first group were given MedDiet. The patients in the second group were given MedDiet modified according the food intolerance test (MedDiet plus FI). The patients were monitored one month later for compliance with diet through self-recorded in a paper where the patients wrote all food diaries. The demographic data, calculated BMI, WC, venous blood collection, were measured before and at the end of the study, 8 weeks later. Physical activity during the study period was not promoted.

Mediterranean pattern consisted: ingestion of monounsaturated fats such as olive oil for cooking and dressing salad. Consumption of fresh fruit (4-6 servings/day), vegetables (2-3 servings/day), nuts (4-6 servings/week); legumes; moderate consumption of whole grains, moderate to high consumption of fish; fish meat instead of red meat or processed meat; Low to moderate consumption of dairy products (1-2 servings/day); moderate consumption of alcohol and only in form of red wine. It was recommended that during the period of the study the food to be consumed at home to be sure that they consume their accurate food cooked at home (7-12).

Exclusion criteria were:

- Patients with type 2 Diabetes mellitus in treatment with oral antidiabetic like Metformin.
- Fasting glycemia >126 mg/dL.
- Use of weight-loss medications.
- Patients that were in treatment with medication that influence inflammatory testes like steroid and non-steroid anti-inflammatory drugs.
- Patients shouldn't have done any gastric surgical interventions or stomach rings or gastric balloons.
- Subjects with a current acute illness were also excluded from the study. Anthropometric variables: weight and WC were measured twice and we use the average value for every variable. We asked if they consume alcohol or other substances and if they had other co-morbidities.

Laboratory examination

For all individuals blood was obtained from an antecubital vein from 8 to 10 a.m. after 8-12h of fasting. First in the beginning of the study and the second time eight weeks later from the first evaluation. Blood was centrifuged and the serum was sent for analyses at the central laboratory. Biochemical markers (blood glucose levels, serum insulin concentrations, C-reactive protein, fibrinogen, liver enzyme, lipid profile) were measured. Hypercholesterolemia was defined as total serum cholesterol levels greater than 200 mg/dl or the use of lipid lowering agents. Insulin resistance was assessed by the approach involving calculation of a homeostasis model assessment (HOMA). Fasting plasma glucose (mmol/l) × fasting plasma Insulin (μU/ml) / 22.5.

CRP was measured by an ultrasensitive competitive immunoassay was considered positive >0.5mg/dL.

Fibrinogen was measured in citrated plasma with a modified clot-rate assay was considered positive > 400 mg/dl.

All lipids (triglycerides, cholesterol, LDL and HDL) was analyzed using photometry with Cobas 8000 (Roche).

Variables	Reference interval
Glucose	70-110 mg/dl
Fasting Insulin	2.6-24.9 uU/mL
HOMA-IR	<2 normal 2-2.5 borderline high >2.5 high
Fibrinogen	200-400 mg/dl
CRP	0-0.5 mg/dl
Total-Cholesterol	0-200 mg/dl
LDL-Cholesterol	0-100 mg/dl
HDL-Cholesterol	>65 mg/dl
Triglyceride	0-200 mg/dl

Table 1: Reference interval according ALNET (Albanian Laboratory Network at American Hospital).

We used the CYTOTEST® to detect foods that the patients were intolerant. The principle of the test is modification of leukocytes caused by the reaction antigen-antibody. There are four degree of reaction first degree of reaction - Stacking of red blood cells, normal - Normochromic red blood cells - Leukocytes do not have assumed any structural deformation - The membrane of leukocytes is well preserved, second degree of reaction - Swollen leukocytes - Stacking of red blood cells, normal - Normochromic red blood cells - Vacuolated leukocytes with a slight alteration of the membrane, third degree of reaction - Vacuolated leukocytes - Not stacking of red blood cells - Red blood cells tend to hypochromia - Vacuolated leukocytes with a partial rupture of the membrane followed by a loss of cytoplasmic granules, fourth degree of reaction - Leukocytes in disintegration - Stacking of red blood cells increasingly less evident - The red blood cells are hypochromic - Leukocytes are disintegrating with a total rupture of the membrane. According the grade result we recommended abstinence period. After the test result the reaction of the participants were identified for each food. The food that showed reaction was eliminated from the diet for 8 weeks.

Statistical Method

The Windows SPSS 17.0 Statistics Package Program was used for statistical analysis of study data. Pearson correlation test and binary linear regression were used for evaluation of data. The P value calculated in the analyses $p < 0.05$ was considered statistically significant.

Results

In this study were included 20 patients. Female were 14 (75%) and male 6 (25%). Mean age was 42.4 years' old, SD±13.1 years. Minimum and maximum ages were 18 and 66 years old respectively. The groups were homogeneous for all variables (P> 0.05) and they have similar baseline demographic, anthropometric, metabolic, and inflammatory characteristics.

Variables	MedDiet (nr=10)	MedDiet plus FI (nr=10)	P Sig. (2-tailed)	Mean Difference	Mean Difference (%)
Age (years	42±11.4	42.8±15.3	0.896	-0.80	-1.9
Weight (kg)	101.3±12.2	101.8±11.7	0.932	-0.46	-0.5
Height (cm)	164.5±8.4	163.5±7.9	0.839	0.75	0.5
BMI	37.5±4.1	38.1±4.7	0.784	-0.55	-1.5
WC (cm)	106.3±8.3	105.9±11.7	0.931	0.40	0.4
ALT (<35 U/L)	28.6±11.7	48.6±36.1	0.114	-19.96	-69.8
AST (<43 U/L)	23.2±5.9	35.5±20.1	0.080	-12.31	-53.1
Glucose (74-106 mg/dL)	100.5±6.8	102.0±10.4	0.705	-1.52	-1.5
Insulin (2.6-24.9 mIU/L)	24.3±9.7	23.1±8.3	0.762	1.24	5.1
HOMA-IR	6.0±2.4	5.7±1.8	0.772	0.28	4.7
CRP (< 0.5 mg/dL)	0.6±0.2	0.7±0.4	0.598	-0.07	-10.7
Fibrinogen (200-400 mg/dL)	403.1±42.0	405.5±55.5	0.914	-2.40	-0.6
T-Chol (0-200 mg/dL)	239.2±39.8	239.2±39.8	0.393	-15.33	-6.8
LDL-Chol (0-100 mg/dL)	170.7±44.3	174.2±58.1	0.880	-3.54	-2.1
HDL-Chol (>50 mg/dL)	46.8±10.0	47.1±12.8	0.946	-0.35	-0.7
TG (0-150 mg/dL)	223.1±77.5	248.8±87.8	0.496	-25.70	-11.5

Table 2. Baseline demographic, anthropometric, metabolic, and inflammatory characteristics between two groups. Date is presented as mean and SD.

Abbreviations: BMI, body mass index; WC, waist circumference; Homa-IR, Homeostasis model assessment-Insulin Resistant; HDL, high-density lipoprotein, LDL, low-density lipoprotein; CRP, C-reactive protein.

Participants generally displayed high levels of CRP. CRP as it's shown on table 3. was elevated in 15 participants (75%) from them 9 were female and 6 males. Eight patients were from the group with only MedDiet and 7 from the group with MedDiet plus FI. Fibrinogen was elevated in 5 patients (25%), 3 female and 2 males and 4 of them were in MedDiet and 1 was on MedDiet plus FI group respectively see table 3.

CRP	Male	Female	Sum
Med diet	3	5	8
Med diet plus FI	3	4	7
Fibrinogen			
DM	2	2	4
DM plus FI	0	1	1

Table 3. Distribution of cases with elevated CRP level and fibrinogen according to gender.

HOMA-IR was elevated in all 20 participants.

When we use Linear logistic regression, fibrinogen showed a stronger association with BMI (5.4%, p=0.005 and with WC (r=3.4% p=0.001), wheras HOMA-IR showed a stronger association with BMI (3.6%, p=0.041) see table nr 4.

Dependent Variable	Independent Variable	R2 (%)	P
HOMA-IR	BMI	3.6	0.041
HOMA-IR	WC (cm)	0.1	0.329
CRP (mg/dL)	BMI	7.0	0.969
CRP (mg/dL)	WC (cm)	5.1	0.990
Fibrinogen (g/L)	BMI	5.4	0.005
Fibrinogen (g/L)	WC (cm)	3.4	0.001

Table 4. Linear logistic regression between different variables.

.95% confidence intervals as a measure of the precision of their estimates, as well as the coefficient of determination (R^2). HOMA-IR: Homeostasis Model Assessment of Insulin Resistance BMI body mass index R2 (%).

Measurement	Period	Mean	Std. Deviation	Mean Difference	Mean Diffe (%)	P value
Weight (kg)	Beginning	101.6	11.6	5.58	5.5	0.129
	After 8 weeks	96.0	11.1			
BMI	Beginning	37.8	4.3	2.03	5.4	0.142
	After 8 weeks	35.8	4.2			
WC (cm)	Beginning	106.1	9.8	4.30	4.1	0.139
	After 8 weeks	101.8	8.1			
ALT (U/L)	Beginning	38.6	28.1	12.17	31.5	0.074
	After 8 weeks	26.4	9.5			
AST (U/L)	Beginning	29.3	15.7	4.46	15.2	0.264
	After 8 weeks	24.9	7.6			
Glucose (mg/dL)	Beginning	101.2	8.6	4.28	4.2	0.097
	After 8 weeks	96.9	7.2			
INSULINEMI (mIU/L)	Beginning	23.7	8.8	7.60	32.1	0.003
	After 8 weeks	16.1	5.7			
HOMA-IR	Beginning	5.9	2.1	2.24	38.1	0.000
	After 8 weeks	3.6	1.3			
CRP (mg/dL)	Beginning	0.7	0.3	0.30	44.1	0.000
	After 8 weeks	0.4	0.1			
Fibrinogen (g/L)	Beginning	404.3	47.9	50.75	12.6	0.001
	After 8 weeks	353.6	36.6			
T-Chol (mg/dL)	Beginning	231.5	38.9	57.74	24.9	0.000
	After 8 weeks	173.8	38.1			
LDL-Chol (mg/dL)	Beginning	172.5	50.3	57.87	33.6	0.000
	After 8 weeks	114.6	40.7			
	Beginning	47.0	11.2	5.74	12.2	0.102

HDL-Chol (mg/dL)	After 8 weeks	41.2	10.5			
TG (mg/dL)	Beginning	236.0	81.7	102.77	43.6	0.000
	After 8 weeks	133.2	70.8			

Table 5. Comparison between time periods; from baseline to 8 weeks results concerning the indicators of body composition (BMI, WC), biochemical parameters and inflammatory markers of all 20 patients.

Body weight was reduced from mean value 101.6 kg in the beginning to 96.0 kg, after 8 weeks p= 0.129. The average level of BMI was 37.8 in the beginning and after 8 weeks it was reduced to 35.8 kg, p=0.142 and mean difference was 5.4%. Mean WC was 106.1 cm in the beginning and after 8 weeks it was reduced to 101.8 cm, p= 0.139 and mean difference was 4.1%. Mean glucose level was 101.2 mg/dl in the beginning and after 8 weeks it was reduced to 96.9 mg/dl p= 0.097 and mean difference was 4.2%. Mean Insulin level was 23.7 mIU/L in the beginning and after 8 weeks it was reduced to 16.1 mIU/L) p= 0.003 mean difference was 7.6% and reached a statistical significance after the diet the same results were also for HOMA-IR, CRP fibrinogen and lipid profile.

Parameter	Baseline		8 weeks		Absolute change (%)	p value	Mean Difference (%)
Intolerance	Mean	Std. Deviation	Mean	Std. Deviation			
Weight (kg)							
MedDiet	101.3	12.1	97.5	11.7	3.8	0.485	3.75
MedDiet plus FI	101.8	11.7	94.5	10.9	7.4	0.163	7.22
BMI							
MedDiet	37.5	4.1	36.1	3.9	1.4	0.443	3.76
MedDiet plus FI	38.1	4.7	35.4	4.7	2.6	0.224	6.94
WC (cm)							
MedDiet	106.3	8.3	102.7	8.2	3.6	0.343	3.39
MedDiet plus FI	105.9	11.7	100.9	8.2	5.0	0.282	4.72
ALT (U/L)							
MedDiet	28.6	11.7	23.5	10.5	5.1	0.321	17.73
MedDiet plus FI	48.6	36.1	29.3	7.8	19.3	0.116	39.66
AST (U/L)							
MedDiet	23.2	5.9	21.7	4.9	1.5	0.540	6.51
MedDiet plus FI	35.5	20.1	28.1	8.6	7.4	0.305	20.85
Glucose (mg/dL)							
MedDiet	100.5	6.8	97.9	7.5	2.6	0.430	2.58
MedDiet plus FI	102.0	10.4	96.0	7.2	6.0	0.153	5.85
INSULINEMI (mIU/L)							
MedDiet	24.3	9.7	17.8	6.0	6.5	0.089	26.79
MedDiet plus FI	23.1	8.3	14.4	5.1	8.7	0.011	37.64
HOMA-IR							
MedDiet	6.0	2.4	4.3	1.3	1.8	0.062	29.12
MedDiet plus FI	5.7	1.8	3.0	1.1	2.7	0.001	47.47
CRP (mg/dL)							
MedDiet	0.6	0.2	0.4	0.2	0.3	0.004	39.78
MedDiet plus FI	0.7	0.4	0.4	0.1	0.3	0.015	48.01
Fibrinogen (g/L)							
MedDiet	403.1	42.0	352.5	34.1	50.6	0.008	12.55
MedDiet plus FI	405.5	55.5	354.6	40.7	50.9	0.031	12.55
T-Chol (mg/dL)							
MedDiet	223.9	38.6	184.3	20.0	39.6	0.012	17.68
MedDiet plus FI	239.2	39.8	163.3	49.1	75.9	0.001	31.73
LDL-Chol (mg/dL)							
MedDiet	170.7	44.3	130.9	25.4	39.8	0.024	23.32
MedDiet plus FI	174.2	58.1	98.3	47.5	75.7	0.005	43.58

HDL-Chol (mg/dL)							
MedDiet	46.8	10.0	46.2	10.1	0.6	0.896	1.26
MedDiet plus FI	47.1	12.8	36.3	8.7	10.9	0.039	23.10
TG (mg/dL)							
MedDiet	223.1	77.5	126.9	57.3	96.3	0.278	43.14
MedDiet plus FI	248.8	87.8	139.5	84.8	109.3	0.011	43.92

Tab 6. Comparison between groups (MedDiet vs MedDiet plus FI) and between time periods for all variables.

Data were expressed as means± SD, comparison between groups done by Pearson Correlation

We found a reduction in average values for BMI and WC between time periods (8 weeks), at the two interventions, without any statistical significance but the reduction of weight was greater in the MedDiet plus FI from 101.8 to 94.5 kg compared 101.3 kg to 97.5 kg (7.4%vs3.8%) the reduction of BMI was greater in the group with MedDiet plus FI than only MedDiet intervention 6.94% vs3.76% respectively. The percentage of variation in WC for the group MedDiet plus FI was -4.72% whereas MedDiet alone showed a reduction of -3.39%. The biochemical assessment showed a significant decrease in values of triglycerides, total-Cholesterol, HDL-cholesterol; LDL-cholesterol (43.92% ,43.14%, 23.1% and – 43.58%, respectively; P <0.05. only in the MedDiet plus FI group for triglycerides and HDL-Cholesterol and was p<0.05 in both groups for Total and LDL-cholesterol. The metabolic assessment showed a significant decrease in values of insulin and HOMA- IR 37.64% (p=0.011), 47.47%, p=0.001 respectively; in the MedDiet plus FI group vs MedDiet alone and blood glucose level was decreased after 8 weeks in both groups but didn't reach the statistical significance.

A comparison of inflammatory markers, shown at table 6. revealed a significant decrease in the average value of fibrinogen and CRP in both groups MedDiet plus FI and MedDiet alone corresponding to 12.55% vs 12.52 % (p=0.031 vs p= 0.008) for fibrinogen reduction of 48.01% MedDiet plus FI vs 39.78% MedDiet alone. There were no significant variations in the other markers.

Discussion

Food intolerances is also one of the probable causes of low-grade inflammation because increase the calories may contribute to the onset of obesity (3,21,23,24). In our study the groups were homogeneous for all variables (P> 0.05). They have similar baseline demographic, anthropometric, metabolic, and inflammatory characteristics. Those were some strong points for this study. In the recent years has been concluded that obesity is an inflammatory disease and weight loss programs through different model of diets has been shown to decrease the inflammation (1-26). As shown in our analyses, an increase in severity of obesity corresponded to higher concentrations of blood glucose, fasting plasma insulin, total-cholesterol and triglycerides. A higher BMI was associated with higher values for insulin resistance (HOMA-IR). Acute phase proteins such as CRP was increased in patients with obesity, CRP was elevated in 75% of patients (15) from them 9 were female and 6 males. The value of CRP usually isn't high then two-fold of normal value. These data are founded in this study. In previous study CRP level correlated with degree of adiposity which is consistent with our findings that an increase in severity of obesity corresponded to higher CRP level, so our study demonstrates a positive correlation between BMI and serum CRP. These findings suggest a state of low-grade systemic inflammation in obese individuals [5,27-29]. Higher BMI is associated with higher CRP concentrations, even among young adults aged 17 to 39 years. These findings suggest a state of low-grade systemic inflammation in overweight and obese persons [2,14,30]. Fibrinogen was elevated in 5 patients (25%), 3 female and 2 males. The prevalence of insulin resistance is increased in obese individuals, also in our study HOMA-IR was elevated in all 20 participants. When we use Linear logistic regression fibrinogen showed a stronger association with BMI (5.4%, p=0.005 and with WC (r=3.4% p=0.001), HOMA-IR showed a stronger association with BMI (3.6%, p=0.041). The prevalence of insulin resistance is increased in obese individuals [28,31-34].

From our study it was identified that there was statistically significant improvement in the metabolic parameters and inflammatory marker after the food intolerance elimination diet compared with only MedDiet. The same result came from the study of Gubur et al [19]. A recent clinical study by Madsen and colleagues investigated the effects of short-term and long-term weight loss on levels of CRP and fibrinogen among obese subjects and founded that long-term weight loss was associated with decreased CRP and fibrinogen concentrations [35].

Limitations

One of the most important limitations in this study was the patient's number. We will be preferred to have more patients, but financial support was crucial.

Conclusion

Obesity is a major health problem concerning public health all over the world and is associated with much health risk with increased morbidity and mortality rate. The most effective way to reduce weight in obesity is the proper diet and continued regularly. One of the methods is through elimination diet after identification and removing of the food that are reactive in the food intolerance test. The result of our study suggests that food intolerance elimination diet gave positive changes on body composition and metabolic parameters in obese people. Even the sample size of our study was small we can consider such a diet as a potential treatment of medical nutrition therapy for obesity.

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