TREATMENT BENEFITS ON METABOLIC SYNDROME WITH DIET AND PHYSICAL ACTIVITY

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Abstract

The research has included 422 patients aged between 25 to 60, of whom 341 were men and 81 women. The purpose of research was to determine impact of diet and physical activity in the treatment of metabolic syndrome during the six month period.

Processing of results through descriptive and discriminative analysis have indicated that 6 month treatment with diet and physical activity have had an impact in the: waistline decrease by 6,05 cm or 5,50% among males, and 4,92 cm or 5,10% among females; body mass index (BMI) decrease by 1.78 or 6.20% among males, and 2,3 or 8,16% among females; decrease of blood triglycerides levels by 0,35 mmol/L or 16,28% among males, and 0,27 mmol/L or 13,30% among females; increase of blood cholesterol HDL-C by 0,48 mmol/L or 34,78% among males, and 0,06 mmol/L or 4,28% among females; systolic arterial pressure decreased by 15 mmHg or 10,18%, and diastolic blood pressure by 8,74 mmHg or 9,47% among males, and systolic arterial pressure decreased by 7,39 mmHg or 5,17%, and diastolic blood pressure decreased by 5,18 mmHg or 5,75% among females; the level of blood glucose decreased by 0,45 mmol/L or 7,04% among males, and by 0,64 mmol/L or 9,92% decreased among females.

The results show that physical exercise and diet are important factors in reducing the values symptoms of metabolic syndrome.

In order to improve symptoms of metabolic syndrome, it is necessary to keep on with healthy diet and physical exercise that means the change of lifestyle.

KEY WORDS: metabolic syndrome, diet, physical activity, walking.

Introduction

Main factors that influence the onset of metabolic syndrome are: genetic susceptibility, poor physical activity, wrong dietary habits. All experts don't agree nor with the name, neither with the definition of metabolic syndrome, even though a cluster of metabolic abnormalities such as: abdominal fat, insulin resistance, glucose intolerance, lipid disorders, and hypertension are conditions present in the body and make up the traits of this syndrome. Clinical manifestations and disorders that derive from this syndrome that have been earlier proposed to be included as parts of the syndrome are vascular inflammation, hyper coagulation, hyper uricemia and micro albuminuria. Since then till now, several names have been used for this syndrome, such as: "insulin resistance syndrome", "syndrome X", "plurimetabolic syndrome" and recently very often used name is "cardio metabolic disease" (1). In the middle of previous century many scholars have noticed that overweight, lipid disorders, glucose intolerance and hypertension are present at the same time among many people, which has lead German researchers to dub this condition as metabolic syndrome (2). It is necessary to distinguish the metabolic syndrome as diagnosing category from the metabolic syndrome as pathologic entity, the latter being common denomination for the similar metabolic abnormalities (3, 4). During the last 25 years various studies have offered evidences proving that insulin resistance at the level of muscles and in fatty tissue is a common disorder which increases the probability for development and onset of not only diabetes mellitus type 2, but also the cardiovascular diseases among population (5). The World Health Organization (WHO) in 1998 have approved the official name and definition for the metabolic syndrome (6). The metabolic syndrome is a genuine multi-component disorder developed due to the lifestyle and impact of environment, but also the genetic susceptibility has important role in this disorder. National Cholesterol Education Program – Adult Treatment Panel III, NCEP-ATPIII held in 2001 has recognized and defined the metabolic syndrome as a group of abnormal conditions that increases the risk of cardiovascular diseases and diabetes mellitus type 2 (7) . The NCEP-ATP III program also underlined the impact of waistline size in the manifestation of metabolic syndrome. Very significant derangements of metabolic syndrome are glucose intolerance and insulin resistance. The latter is considered as one of the most important factors causing the metabolic syndrome. Causes for manifestation of insulin resistance are very complex. There are numerous hereditary and environmental factors that contribute to the development of this condition. But today, with full plausibility, it is accepted that insulin resistance is fully expressed among overweight individuals, those who consume excessive calories, individuals who have specific lifestyle and little physical activities. Fatty tissue has specific correlation to insulin resistance; namely, the abdominal fatty tissue reacts differently in comparison with fatty tissue distributed in the extremities. Fatty tissue cells (adipocytes) in the abdomen have different action in comparison to adipocytes of other parts of the body. These adipocytes excrete substances called inflammatory cytokine that aggravate the insulin resistance (8, 9). Researches have revealed that insulin resistance, along with increased levels of insulin in the blood, leads to many other disorders that may act as risk factors for the onset of the heart and blood vessels disease. As a consequence, disorders in the lipid metabolism are reported, namely the blood levels of triglycerides are increased, whereas the blood HDL C cholesterol levels are decreased. High insulin concentrations have direct damaging impact on the cells of blood vessels endothelium, because it leads to deranged balance between the blood clotting and thrombolysis in favour of first process, which subsequently favours the thrombotic episodes (10) Hyperinsulinemia have an impact in the elevation of blood pressure, which is by itself an important factor in the development of cardiovascular diseases. The metabolic syndrome is a multiplex risk factor that consists of several risk correlates of metabolic origin. In addition to dyslipidemia, hypertension, and hyperglycermia, the syndrome carries a prothrombotic state and a proinflammatory state (11). The metabolic syndrome (MS) is a cluster of metabolic derangements that are associated with primary disturbances in adipose tissue. Abnormal visceral fat accumulates from physical inactivity and excess calories in genetically susceptible individuals (12). High levels of physical activity are associated with a better profile of inflammatory factors and adipocytokines and a lower risk of the MetS in middle-aged and older Chinese people (13). Physical exercise protects against the development of cardiovascular disease, partly by lowering plasmatic total cholesterol, LDL-

cholesterol and increased HDL-cholesterol levels. In addition, it is now established that reduction plasmatic adiponectin and increased C-reactive protein (CRP) and plasminogen activator inhibitor-1 (PAI-1) levels play a role in the maintenance of an inflammatory state and in the development of cardiovascular disease (14,15). Metabolic syndrome means the presence of numerous disorders at the same time, whereby each of them by itself increases the risk of developing the cardiac and vascular diseases. The more deranging component factors of syndrome are present, the more risk for the onset of disease is multiplied. Thus, problem tackled in this paper is as important and actual, because there is an increased necessity to identify exogenous factors, particularly **diet and physical exercise**, so that in a safe and efficient manner we might determine the diagnose, set out the program, and subsequently directly lead and monitor the processes aiming to prevent and treat the metabolic syndrome . The purpose of research was to determine the effects of diet and physical activity in the treatment of metabolic syndrome during the six month period.

Material and Methods

Patients

In the research have been included 460 patients with metabolic syndrome, but for the purpose of research results of 422 patients have been processed. Out of total number of patients, 341 were male and 81 female. The research has included patients aged from 25 to 60 who have been diagnosed with at least three symptoms of the metabolic syndrome Diagnostic criteria applied for diagnosing of metabolic syndrome were in accordance with NCEP ATP III and the diagnoses of metabolic syndrome is ascertained if at least three of below mentioned symptoms were present (6): Waistline perimeter: > 102 cm males, > 88 cm females; triglycerides > 1,7 mmol/L HDL (high density lipoprotein, "good" cholesterol) < 1,03 mmol/L males, < 1,29 mmol/L females respectively; blood pressure > 130/85mmHg; fasting blood glucose > 5,6 mmol/L. For the purpose of research the following parameters of metabolic syndrome were applied: **Waistline perimeter** is measured in centimetres (cm). **BMI** – Body mass index, or body fat tissue index indicates proportion of fat in the total body mass. The World Health Organization (WHO) prefers the body mass index as most adequate parameter for assessment of body fat tissue. Proportion of body fat mass is measured through calculation of body height and weight, so that body height is divided with body weight and obtained index indicates the level of body fat. Body mass index (BMI) = kg/m2 = m/v2. Underweight < 18,5; Normal body weight 18,5-24,9; Overweight 25-29,9; and obesity 30 and over. Values of **triglycerides** are expressed with mmol/L; Values of **cholesterol HDLC** (High-level Data Link Control) in mmol/L; **Systolic** blood pressure in mmHg; **Diastolic** blood pressure in mmHg; Fasting **Glucose** mmol/L. Blood biochemical analysis: Values of triglycerides, cholesterol Values of HDLC (High-level Data Link Control) and fasting Glucose has been carried out in the Department of Clinical Biochemistry at the Medical Faculty of Prishtina. Other symptoms as indicators of metabolic syndrome: Waistline perimeter, Body mass index (BMI), Systolic Blood Pressure and Diastolic Blood Pressure have been measured in the Internal Clinic in Prishtina. Patients included in the research have also undergone simultaneously a 6-month treatment with diet and physical activity. The patients, during their treatment, received dietary food on daily basis, but they were recommended not to drink tea with sugar, fruit juices and carbonated juices with glucose concentration and no alcohol. Sugar-free juices reduce caloric intake values for 200 kcal on daily basis (16). For sweetening of teas tablets such as saharin, aspartame, cyclamate and alike have been recommended. During this time patients were suggested to drink juices with the sign "Light." Treatment with physical exercises has included medium intensity walking 4.5 km/h once a day, 5 times a week) which corresponds to an average walk of 110 steps per minute or 6600 steps per hour. Walking has been conducted in the Recreation Center "Gërmia" in Prishtina and the walking path was flat. Time for walking has been set by the patients themselves. Walking 4.5 km/h complies with the consumption of calories in 1 kg of weight for 2.80 kcal / hr / kg (16). In the course of treatment with diet and physical activity, patients did not use medicines against metabolic diagnosed syndrome symptoms and they were constantly under the supervision of a doctor. The small number of patients who have expressed their willingness to be involved in the experiment as well as economic conditions have made it possible individual organization of the research and its lasting five years from 2003 to 2008.

Statistical analysis

Statistical parameters used for the presentation of the results: arithmetic average (X) and standard

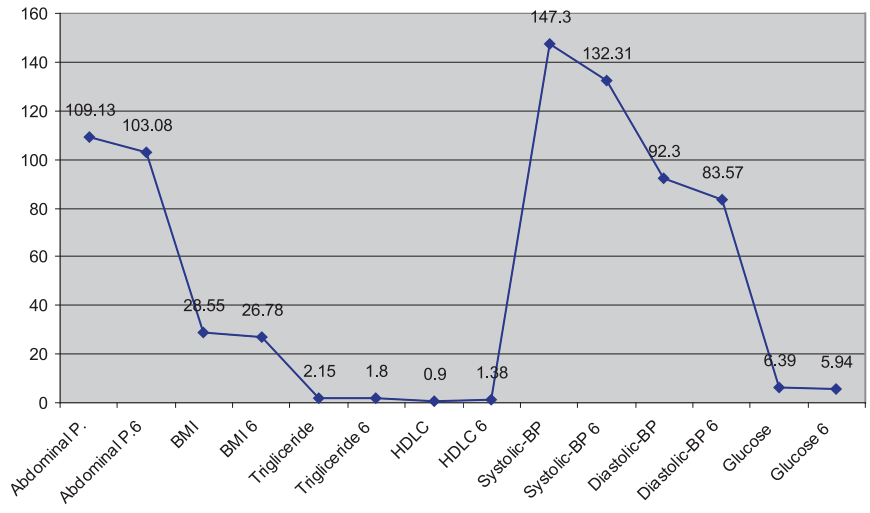
	In start			In finish			Probability	
Variable	N	X	SD	N	X	SD	t	df	Sig.
Abdominal P.	341	109,13	4,13	341	103,08	3,88	19,94	340	0,000
BMI	341	28,55	2,01	341	26,78	1,95	18,57	340	0,000
Triglyceride	341	2,15	0,22	341	1,80	0,13	38,87	340	0,000
HDLC	341	0,90	0,13	341	1,38	0,39	-24,88	340	0,000
Systolic-BP	341	147,30	17,75	341	132,30	15,10	46,62	340	0,000
Diastolic-BP	341	92,31	7,09	341	83,57	8,57	35,06	340	0,000
Glucose	341	6,39	0,71	341	5,94	0,31	17,86	340	0,000

TABLE 1. Changes in the symptoms of metabolic syndrome prior and after the 6 month treatment with diet and physical activity among males.

deviation (SD). T-test have been used to determine differences between group or result. Probability level was expressed by p<0,01 and p<0,05.

RESULTS

In the Table 1. and Graph 1. are presented basic statistical parameters for males before and 6 month after the treatment with diet and physical activity, as well as the difference between these results. Average of waistline prior to diet and physical activity was 109,13 cm, while the standard deviation of arithmetic mean value was 4,13. After the 6 month period waistline mean value dropped to 103,08cm, while standard deviation was 3,88. Differences in arithmetic mean values of waistline among males in the beginning of treatment and 6 month later after application of diet and physical activity indicate that there is a significant statistical difference (p<0,000). Results from the body mass index - BMI prior to treatment with diet and physical activity indicate that arithmetic mean value was 28,55, standard deviation was 2,01, while after 6 month of treatment arithmetic mean value was reduced to 26,78 while standard deviation dropped to 1,95. Differences in the arithmetic mean values obtained before and after the treatment with diet and physical activity indicate that there is a significant statistical difference in the body mass index – BMI (p<0,000). As for the biochemical parameters, prior to treatment the mean value for triglycerides was 2,15 mmol/L and standard deviation was 0,22, whereas after the diet and physical activity the mean value for triglycerides dropped to 1,80 mmol/L while standard deviation was 0,13 which is a significant statistical difference (p<0,000). Mean value for cholesterol (HDL-C) in the table is 0,90 mmol/L and standard deviation is 0,13 while at the end of treatment with diet and physical exercise the mean value for HDL-C decreased to 1,38 mmol/L while standard deviation changed to 0,39. These differences in the mean arithmetic values indicate the significant statistical difference (p<0,000). Systolic arterial pressure (systolic BP) in the beginning have had mean value 147.30 mmHg, the standard deviation value was 17,75. At the end of treatment with diet and physical activity, the mean value for systolic arterial pressure was 132,30 mmHg, while standard deviation changed to 15,10. Obtained differences in the mean arithmetic values indicate the significant statistical difference (p<0,000). Mean value for diastolic arterial pressure (diastolic BP) prior to treatment was 92,31 mmHg, standard deviation



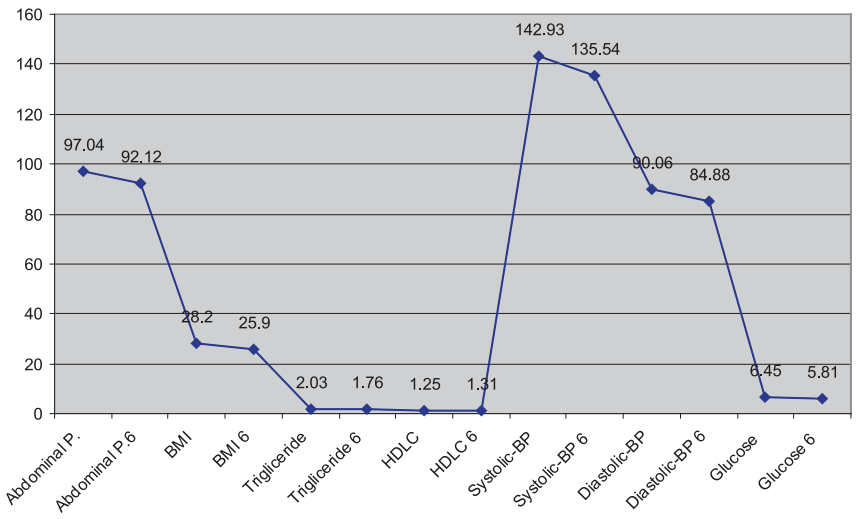
GRAPH 1. Graphic demonstration of changes in the parameters of the metabolic among males before and after the 6 month treatment with diet and physical activity

	In start			In finish			Probability		
Variable	N	X	SD	N	X	SD	t	df	Sig.
Abdominal P.	81	97,04	5,92	81	92,12	7,02	4,561	80	0,000
BMI	81	28,20	3,24	81	25,90	2,49	6,257	80	0,000
Triglyceride	81	2,03	0,34	81	1,76	0,28	6,849	80	0,000
HDLC	81	1,25	0,23	81	1,31	0,18	-2,220	80	0,029
Systolic-BP	81	142,93	11,87	81	135,54	10,45	5,281	80	0,000
Diastolic-BP	81	90,06	7,72	81	84,88	9,25	5,292	80	0,000
Glucose	81	6,45	0,87	81	5,81	0,63	5,940	80	0,000

TABLE 1. Changes in the symptoms of metabolic syndrome prior and after the 6 month treatment with diet and physical activity among males.

was 7,09, while after the 6 month treatment with diet and physical activity the diastolic pressure reduced to 83,57 mmHg, while standard deviation changed to 8,57, which indicates that there is a significant statistical difference (p<0,000) between these two mean arithmetic values. Mean value for blood glucose level prior to examination was 6,39 mmol/L, standard deviation 0,71, whereas after the six month treatment with diet and physical activity the level of blood glucose dropped to 5,94 and standard deviation reduced to 0,31. These differences in the mean arithmetic values indicate the significant statistical difference (p<0,000).

Results of basic statistical parameters for females before and 6 month after treatment with diet and physical activity, as well as the difference between the results of these parameters are indicated in the Table 2 and Graph 2. Parameter indicating the obesity, namely the waistline in the beginning was 97,04 cm, the standard deviation of arithmetic mean value was 5,92 while after the 6 month treatment the mean value of waistline reduced to 92,7 cm whereas the standard deviation change to 7,02. Differences between arithmetic mean values of waistline among females, respectively the difference of mean arithmetic value in the beginning and after 6 months of treatment with diet and physical activity indicate that there is a significant statistical difference (p<0,000) of parameters before and after the treatment. Body mass index - BMI prior to treatment with diet and physical activity indicates that arithmetic mean value was 28,20, standard deviation was 3,24, whereas after the 6 month treatment with diet and physical activity mean arithmetic value for body weight dropped to 25.90 while the standard deviation to 2,49. Differences of mean arithmetic values for the body mass index (BMI) before and after treatment with diet and physical activity indicate that there are significant statistical differences (p<0,000). Mean value of triglycerides in the blood was 2,03 mmol/L with standard deviation value 0,34 prior to treatment, and subsequently after the 6 month treatment with diet and physical activity have reduced the mean value of triglycerides to 1,76 mmol/L with the standard deviation value 0,28. Obtained results indicate a significant statistical difference (p<0,000). The mean values for cholesterol (HDL-C) in the blood are indicated on the table and initially they were 1,25 mmol/L with standard deviation 0,23, while at the end of treatment with diet and physical activity the mean values for cholesterol (HDL-C) changed to 1,31 mmol/L while standard deviation reduced to 0,18.



GRAPH 2. Graphic demonstration of changes in the parameters of the metabolic syndrome among females before and after the 6 month treatment with diet and physical activity

Differences between these arithmetic mean values indicate a significant statistical difference (p<0,029). Systolic arterial pressure (systolic BP) prior to treatment among females have had a mean value 142,93 mmHg, with standard deviation 11,87, while at the end of treatment with diet and physical activity the mean value for systolic arterial pressure reduced to 135,54 mmHg, with standard deviation 10,45. Obtained differences among mean arithmetic values indicate an important statistical difference (p<0,000).

Mean diastolic arterial pressure (diastolic BP) value prior to treatment was 90,06 mmHg, with standard deviation 7,72, whereas after the 6 month treatment with diet and physical activity the diastolic BP reduced to 84,88 mmHg with standard deviation 9,25, which indicates an important statistical difference (p<0,000) among these two arithmetic mean values. Mean values of glucose in the blood initially were 6,45 mmol/L, with standard deviation 0,87, while at the end of the 6 month treatment with diet and physical activity blood glucose level dropped to 5,81 with standard deviation 0,63. Obtained differences among mean arithmetic values indicate an important statistical difference (p<0,000).

Discussion

When talking about the health care, healthy lifestyle habits are of utmost importance. Healthy lifestyle habit consists of knowledge and care on healthy diet, as well as of necessity for physical activities, namely walking. Our body is constructed in such way that for exercising of many of its vital functions it is very important to engage in the physical activities. Therefore, today physical activity as a part of recreation has become an important part of life for many people around the globe and moreover, it is becoming the part of lifestyle. With application of best contemporary drug in our research, theoretically it is possible to cure each component of the metabolic syndrome, which can lead to healing of each individual symptom of metabolic syndrome. However, starting point of our efforts was focused in employment of methods that will improve several symptoms of the metabolic syndrome at the same time. Application of two methods in this research, namely diet treatment and physical activity (walking) that aimed to improve the symptoms of metabolic syndrome have been proved to be the best method for improving the parameters of research. Also other authors have confirmed these methods to be the best ones (17).

High values of waistline and body mass index – BMI are main parameters that describe human overweight and are the most important indicators for identification and diagnosing the metabolic syndrome (18). Obtained results from the 6 month treatment with diet and physical activity (walking) have resulted in reduction of all parameters related to symptoms of the metabolic syndrome. Decrease of waistline by 6,05 cm among males indicate that treatment with diet and physical activity (walking) during the 6 month period have had an impact in the decrease of abdominal fat by 5,50%. Dietary treatment along with physical activity among females have had an impact in the decrease of waistline by 4,92 cm or 5,10% lower. Obtained values of waistline indicate that in order to achieve the ideal waistline value it is necessary to exercise a longer dietary treatment and physical activity. Namely, the excessive weight have been gained over the long period of time, therefore we have to be patient because we cannot eliminate it quickly. Reduction of intra abdominal fat tissue and of adipocytes (which are today considered active endocrine cells) in the levels obtained in our research, diminishes the cardio metabolic risk such as: lipid profile (it is a source of free fatty acids), insulin resistance, glucose intolerance, and deranged inflammatory reaction and haemostasis (18).

Reduction of abdominal subcutaneous fatty tissue after the diet and physical activity (walking) treatment have impacted in the reduction of body mass index (BMI) value by 1,78 or 6.20% among males, and by 2,3 or 8,16% among females. When talking about fats of metabolic syndrome, namely regarding the triglycerides and cholesterol HDLC, it would be more accurate to use the phrase dyslipidemia, because it describes more plausibly the complexity of this disorder. Dyslipidemia means increase in levels of triglycerides (hypertriglyceridemia), decreased level of cholesterol HDLC, increase in levels of cholesterol LDL, decrease in LDL/HDLC ratio, increased levels of free fatty acids (18). Treatment with diet and physical activity have impacted in the reduction of level of triglycerides in the blood by 0,35 mmol/L or 16,28% among males, and by 0,27 mmol/L or 13,30% among females. In contrast, treatment with diet and physical activity has impacted in increasing the levels of HDLC cholesterol in the blood. Levels of cholesterol in the blood among males have recorded an increase by 0,48 mmol/L or 34,78% and by 0,06 mmol/L or 4,28% among females. Results obtained in the research are approximately the same with similar researches in this field (18,17). During the physical activity, cardiovascular system is

experiencing various changes such as the increase of cardiac minute output, which is in the close relationship with dilation of blood vessels in the muscles during the physical exercise. Except this direct link in the metabolic events, we must also take into account reflexive activation of sympathetic nerves in relation with heart, vascular resistance and capacity of blood circulation system. Having in mind all these facts, obtained results from the blood pressure, systolic arterial pressure (systolic BP) and diastolic arterial pressure (diastolic BP) among males and females indicate that after 6 months of dietary and physical activity treatment these parameters eventually were reduced. Reduction in systolic arterial pressure by 15 mmHg or 10,18%, and diastolic blood pressure by 8,74 mmHg or 9,47% among males, as well as reduction of systolic arterial pressure by 7,39 mmHg or 5,17%, and reduction of diastolic blood pressure by 5,18 mmHg or 5,75% among females clearly indicate the positive impact of diet and physical activity in reduction of blood pressure.

There is no doubt that diet and physical activity might impact in curing the metabolic syndrome. It is well known that diet and physical activity can impact in the insulin resistance, which is the key feature of this disorder (17,20). Obtained results from treatment with diet and physical activity (moderate walking) indicate that levels of blood glucose among males were reduced by 0,45 mmol/L or 7,04%, and by 0,64 mmol/L or 9,92% among females. As abovementioned, largest number of people with metabolic syndrome is overweight and has contemporary lifestyle (insufficient physical activity). Changes in the lifestyle are main action to be undertaken among people with metabolic syndrome. Reduction of body weight alongside the specific dietary actions is necessary step. Also, physical activity has to be shaped based on the individual needs. Walking exercise with determined intensity, duration and frequency may be successfully and without risks applied on all individuals affected with metabolic syndrome.

Conclusion

Research has shown that the impact of diet (use of glucose-free juices) and of physical activity (medium intensity walking 4,5 km / h) in the treatment of symptoms of metabolic syndrome is evident. With the reduction of waist circumference (abdomen) values of all parameters of metabolic syndrome applied in this paper have been reduced.

The results show that healing of metabolic syndrome is complex due to the fact that it must consider all components. One important link is the prevention of overweight, which means that the quality of life should be improved.

In this regard, we have to bear in mind definition of the World Health Organization (WHO) on the quality of life which takes into consideration relations of each individual with his environment. "Quality of Life as an individual's perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns. It is a broad ranging concept affected in a complex way by the person's physical health, psychological state, personal beliefs, social relationships and their relationship to salient features of their environment".

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