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THE INFLUENCE OF SPORTS AND PHYSICAL ACTIVITY ON THE METABOLIC SYNDROME: A SYSTEMATIC REVIEW

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Abstract: Metabolic Syndrome (MS) is one of the most significant causes of world death rate, associating several abnormalities: increased values of blood pressure, blood glucose, lipid metabolism disorders and obesity, or large abdominal circumference. In an attempt to decrease the burden of this pandemic disease by implementing more effective prevention and treatment strategies, numerous clinical trials have been conducted in order to establish a proper therapeutic course, also by using physical activity as the central link to treatment. Given this background, we have analysed the recently published data, strictly focusing on the significance and benefits of the physical activity over patients with MS. The conclusions that have emerged have highlighted that sport and physical activity play a major role in the management of the Metabolic Syndrome, both in improving all components as well as in some cases determining its reversibility.

Key words: Metabolic Syndrome (MS), physical activity, movement, prevention, sport

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INTRODUCTION

Metabolic Syndrome (MS) is currently a significant cause of world death rates (Sung et al., 2015) because it doubles the risk of atherosclerotic cardiovascular disease and increases five times the risk of diabetes mellitus type 2 (Grundy et al., 2005). Given the characteristics of modern society, highly urbanised and mechanised, where physical activity and effort have decreased considerably, in parallel with the excessive ingestion of hyper-caloric foods and sedentary lifestyles, there has also been an increase in obesity. Obesity is one of the most significant links of MS and it is a combination of metabolic imbalances. The literature review and observations made over time have highlighted the direct link between sport, namely physical activity, and the positive implications in preventing and mitigating the effects of the metabolic syndrome. Moreover, sport and physical activity are essential life elements with beneficial health implications (Tătar et al., 2018; Warburton et al., 2006; Haskell et al., 2007) and psychosocial behaviour (Shephard, 1991; Wankel and Berger, 1990, 1991). Among the psycho-social benefits, we can name the following: increase in life quality (Kozma, 2014; Ilieș et al., 2014; Guo et al., 2018), increase in self-esteem (Vella et al., 2016), reducing depression and anxiety (Camliguney

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et al., 2012; Muñoz-Bullón et al., 2017), etc., while among the ones related to the improvement of health one can notice the prevention and mitigation of the effects associated with cardiovascular diseases (Warburton et al., 2006; Berlin and Colditz, 1990; Macera et al., 2003; Oguma and Shinoda-Tagawa, 2004), diabetes (Gregg et al., 2003; Helmrich et al., 1994; Laaksonen et al., 2005); cancer (Holmes et al., 2005; Rohan et al., 1995); osteoporosis (Berard et al., 1997; Carter et al., 2001; Kujala et al., 2000; Wolf et al., 1999; etc.).

From all of the above, it results that the concerns of scientists regarding the link between physical activity and the Metabolic Syndrome are relatively recent, being closely related to the changes that occurred at global and local level, with the passing of human society from a primary economy (based on endosomatic tools and movement) to a tertiary type focused on exosomatic instruments and artificial intelligence (Herman et al., 2017; Ilie et al., 2017; Ilieș et al., 2017; Masteikiene and Venckuviene, 2015; Pekarskiene and Susniene, 2014; Simonceska, 2012). On this background, once with the increase in the population's standard of living, associated with the increase in obesity and its related disorders, experts have begun to recommend doing sports or physical activity for preventive purposes.

WORKING METHODOLOGY

This study is the result of the specialized bibliographic research and of international databases (pubmed, medscape) regarding the physical activity and its role in the prevention and treatment of the metabolic syndrome. Thus, the conceptual model of the study 'The Influence of Physical Activity on the Metabolic Syndrome' has been aimed at the following defining aspects: establishing the scientific context, definition and historical evolution of the concept of metabolic syndrome, epidemiological dimension of the metabolic syndrome, overweight / obesity treatment through physical activity and conclusions.

DEFINITION AND HISTORICAL EVOLUTION OF THE 'METABOLIC SYNDROME' CONCEPT

The 'Metabolic Syndrome' concept was first approached in the last century and underwent continuous mutation over time, from a terminological point of view, in close correlation with the progress of research in the field. Thus, it was known as 'the Reaven Syndrome', 'the X Syndrome,' 'Dismetabolic Syndrome,' 'Obesity Syndrome', 'Deadly Quartet,' etc. In 1988, Reaven described 'Syndrome X' and introduced for the first time the term of 'insulin resistance' related to patients with a high blood pressure, dyslipidemia and compensatory hyperinsulinemia. Since then, on patients with previously listed dysfunctions, it has been observed that they would be prone to a higher risk of cardiovascular disease (Reaven, 1988). Then there followed several names and changes, until 1999 when WHO introduced the notion of 'Metabolic Syndrome' defining for the first time the Insulin Resistance Syndrome (World Health Organization, 1999). Subsequently, there were numerous debates and proposals on the term 'MS' because there were many controversies, so that in 2009 the competent international organizations (International Diabetes Federation - IDF, National Heart, Lung, Blood Institute - NHLBI, American Heart Association - AHA, International Atherosclerosis Society - IAS, World Heart Federation - WHF) met and proposed a consensual description of 'MS', namely the presence of at least three of the following defining criteria for MS (Eckel et al., 2010): abdominal obesity: waist circumference > 80 cm for women and > 94 cm for men, for the European population (102 cm for men, 88 cm for women for the American population); high blood pressure: systolic BP ≥ 130 mm Hg, diastolic BP ≥ 85 mm Hg or use of anti high blood pressure medication; low serum values of lipoproteins with high density: low HDL - cholesterol (< 40 mg / dl on men and < 50 mg / dL on women); hypertriglyceridemia (≥ 150mg / dl); or the use of lipid-lowering medication; glycemia à jeun ≥ 100 mg / dl or antidiabetic treatment.

EPIDEMIOLOGICAL DIMENSION OF THE METABOLIC SYNDROME

SM prevalence varies depending on the geographical area, social and economic factors, gender, age, race, but it seems that about 25% of the adult population of the world suffers from MS (O'Neill and O'Driscoll, 2015) being considered a real pandemic, a real burden, also from a financial perspective, due to comorbidities and its evolution (Aguilar et al., 2015). Also, the MS prevalence has grown in parallel with the increase in global obesity among adults and teenagers/children, becoming a major public health concern. According to data published by the World Health Organization (WHO) in 2016, about 650 million adults were obese, representing about 13% of the worldwide population (World Health Organization, 2017). Obesity is a determining factor in the development of many chronic conditions, such as diabetes mellitus, cardiovascular diseases, cancer and musculoskeletal diseases. Obesity is considered a multifactorial disease, being the result of interaction between genetic, environmental and behavioural factors. A sedentary lifestyle and food imbalance represent the main causes of obesity, which is reversible if changes in lifestyle are made. For the assessment of obesity, one uses the body mass index (BMI), which assesses the total adipose tissue (except for athletes with significant muscle mass). People with a BMI over 25 kg / sq.m. are considered to be overweight, and people with a BMI of over 30 kg/sq.m. are considered to be obese. The body mass index is calculated according to the formula: BMI = weight (kg) / height (sq.m.).

For this reason, currently, a growing significance is given to obesity, both in the ethiology of MS complications as well as in its treatment, being the first step on which one acts, both in the prevention and in the treatment of MS. Prevention of MS actually represents the prevention of obesity, of the central factor in this pathological constellation, because the prevention and treatment of obesity represents the simplest, non-pharmacological, useful and widely available method with significant results in the prevention and recovery of patients with MS.

Schematically, the MS treatment is initiated with recommendations for changing the atherogenic food/ diet, of unhealthy habits, of the sedentary lifestyle, prevention against overweight and obesity, smoking cessation, currently being known that acting over these modifiable factors one decreases in fact the risk of cardiovascular disease and mortality (Rizzuto and Fratiglioni, 2014). The diet will have to be one low in calories, a significant restriction of calories (about 1.000 calories / day), often requiring the help of nutritionists. The most favourable diet, according to the studies, seems to be the Mediterranean one, which has low carbohydrates content, but opts for increasing the daily consumption of whole grains, fruits, vegetables, nuts and olive oil, namely an increased content of fibres and proteins of plant origin (Bach-Faig et al., 2011; Martinez-Gonzalez et al., 2015). Subsequently, when the first measures do not give the expected result on non-compliant patients and / or on whom the gravity of the medical conditions imposes it, one shall also use the medicines treatment. Since currently there is no single pharmacological agent acting precisely on the pathophysiological mechanism of MS, specific medicines will be used in order to treat each MS component, thus BP shall be decreased when it exists, dyslipidemia shall be treated (by using statins, fibrates, and, if necessary, ezetinib and nicotinic acid), hyperglycaemia and insulin resistance will be treated. In carefully selected cases on those with morbid obesity (with BMI over 35kg /sq.m.) and refractory SM one may also consider bariatric surgery (Busetto et al., 2017).

TREATMENT OF OVERWEIGHT / OBESITY THROUGH PHYSICAL ACTIVITY

As shown by recent studies (Park et al., 2013; Gerstel et al., 2013; Greenfield et al., 2014), in order to avoid the therapy cessation, the first step will consist in providing counselling and education for the patient in order for him to become aware of the central role of the lifestyle changes and of the sustained physical activity, determining him develop his own regular schedule of physical activity and movement until it becomes a habit / lifestyle. MS pathophysiology is closely linked to the positive energy balance, and the fat excess is deposited in the adipose tissue and in ectopic tissues (e.g. liver, skeletal muscles, pancreas, and on internal organs) (US Department of Health and Human

Services, 2008). The new lifestyle should consist in increasing the physical activity along with reducing the energy consumption, namely the diet, these together being the most useful tools both to prevent and to treat MS. Benefits of physical activity: decreases the blood glucose, insulin resistance, increases the tissues sensitivity to insulin; improves the lipid profile; weight loss and abdominal circumference; decreases / normalizes BP values; glucose is used in the muscle tissue, decreasing the liver production; improves the cerebral circulation and increases the self-esteem and the perception over one's own person (Gerstel et al., 2013; Ekelund et al., 2015; Ilanne-Parikka et al., 2010).

There remain a lot of questions regarding the physical activity: how long should it be performed daily? / During which period of life? / With what intensity? / What are the most effective exercises? / Which muscle groups should be used the most? and etc. However, following the several observational studies, one reached the conclusion that any type of physical activity is beneficial, and any kind of movement will be encouraged. Empirically, one initially recommends 30 minutes a day, at least 5 days/week, the physical activity will subsequently by increased, depending on the tolerance of up to 60 minutes / day, the aerobic exercises and those that train large muscle groups being preferred. There is a close relationship between the physical activity and the health condition, benefits which are even higher when the minimum daily motion recommendation is exceeded (Pedersen and Saltin, 2015; Pattyn et al., 2013). WHO recommends (between 18 and 65 years) to perform minimum 150 minutes per week of moderate physical activity or, alternatively, 75 minutes per week of intense physical activity or a combination of the two (World Health Organization, 2010). Exercises of Moderate intensity are enough to decrease the cardiovascular risk, but it seems that the physical effort of a higher intensity provides greater benefits (Pattyn et al., 2014). Various aerobic training programs have been developed that use various schemes of intense exercise, some with a duration of less than 45 seconds or between 1-8 minutes of moderate intensity, followed by recovery breaks.

Given the society of the third millennium, technology and the relatively easy access to the internet, on the one hand, and the significance of MS for public health, on the other hand, interventions over the lifestyle must be effective, available and accessible to high-risk individuals. The technology of our century provides unique opportunities, such as Internet programs for developing and implementing interventions in lifestyle, physical activities at home, promoting feedback and self-monitoring (Jahangiry et al., 2014; van den Brekel-Dijkstra et al., 2016; Hansen et al., 2012). Also, to be mentioned Lin et al. who have recently shown outstanding results by using phone-based motivational interviews in a group of changing the lifestyle in a clinical trial consisting of women with MS and sedentary lifestyle, thus the women of the experimental group have increased their physical activity weekly, the percentage of those diagnosed with metabolic syndrome has decreased to approximately 81% and the number of metabolic abnormalities and abnormalities has decreased (Lin et al., 2016).

In an attempt to find and implement MS prevention and treatment programs, in order to meliorate the economic burden due to MS, numerous clinical trials have been carried out that have focused on the physical activity and diet. Thus, it has been observed that a multidisciplinary, patient-centred collaboration is necessary and effective. Highly valuable results were registered, for example, by the study CHANGE (Canadian Health Advanced by Nutrition and Graded Exercise), recently published, conducted in Canada on people diagnosed with MS, where a customized program of monitoring the diet and the physical activity was implemented. Patients were monitored for one year by a multidisciplinary team including the family physician, a dietician nutritionist and a physical therapist. It was followed if after the completion of this program of diet changing performing aerobic fitness, MS can be reversible (namely patients should have less than 3 criteria out of 5) and/or if there is an improvement of MS components. The results achieved at the end of monitoring were very promising: on 19% of patients MS was revoked (because they no longer met the criteria), and all metabolic abnormalities have meliorated (namely the abdominal circumference, weight, values of BP, glucose, lipids in blood) and

significantly decreased the risk of acute coronary events, of acute myocardial infarction (based on the PROCAM score) (Klein et al., 2017; Jeejeebhoy et al., 2017).

The effects of physical activity and aerobic training were also studied, following various variables on patients with MS. It has been shown that it positively influences the heart rate, arterial stiffness on patients with MS and BP who perform aerobic training, improving the cardiac performance and the clinical and anthropometric profile of patients with MS, as shown by a study published in 2018 by Slivovskaja et al. In 2018 there have been studied the results of the first international multicenter trial EX-MET (Tjønna et al., 2018), which assesses the effectiveness of general motion recommendations (according to the American Board of Sportive Medicine ACSM – of moderate intensity), and the effects of varying levels of aerobic training of much higher intensity but with a shorter duration (activities that use large muscle mass: running, canoeing, walking, cycling, swimming and skiing) over the risk factors that represent MS. The conclusion was that intense physical activity had better results in improving the cardiac, respiratory performance and improvement of SM parameters (Tjønna et al., 2018).

CONCLUSIONS

In conclusion, we can assert that sport and physical activity represent a first step with a major role both in the prevention of MS as well as in its treatment. Being accessible to anyone at any time, they require the intensive, multidisciplinary promotion, starting with the primary medical system, media channels for population awareness over the benefits of the physical activity especially among people already diagnosed with MS or on those at a high risk of developing MS.

In spite of, ”according to a survey carried out in 2017 (Special Eurobarometer Report, 472) two in five Europeans (40%) exercise or play sports at least once a week, while 7% do so regularly, i.e. at least 5 times per week” while ”in the case of Romania as the study analysis shows the frequency levels of doing sports are low given that 63% of Romanians never practice sports while barely 6% of Romanians practice sports regularly. Reported to the European Union average 46% of its citizens never practice sports” (Tătar et al., 2018, p. 42).

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