REVIEW ARTICLE

**The Epidemic of Metabolic Syndrome: Health Promotion Strategies**

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**A B S T R A C T:** Metabolic Syndrome is consisted by a group of metabolic disorders, such as hyperglycaemia, dyslipidemia, blood pressure, central adiposity and it is recently identified as a major risk factor for cardiovascular disorders causing diseases and deaths in modern world. Metabolic Syndrome criteria are not well-defined and both their definition and parameters evaluation in clinical practice vary according to age, gender and race, as new risk factors are daily recognized and established. Detection frequency of Metabolic Syndrome in overweight and obese people regarding to general population, is constantly increasing and therefore it's necessary to detect Metabolic Syndrome in the general population. Metabolic Syndrome management should be based upon an individualized risk evaluation and not upon a simple summation and effort in getting treatment separately for each metabolic disorder. Prompt diagnosis and treatment of patients with multiple risk factors will contribute substantially to prevention by adopting a healthy lifestyle and reducing future syndrome complications.

**K E Y – W O R D S:** Metabolic Syndrome, central adiposity, hypertension, diabetes, health promotion.

**Introduction**

During the last years, one of the most commonly used terms in medicine is "Metabolic Syndrome", describing the coexistence of a group of disorders in one individual. These disorders are noticed with great frequency in western world and they constitute risk factors of vascular diseases.   In nowadays, there is strong evidence that this derives from a physiopathological background of all these disorders (Reaven, 2005; National Institutes of Health, 2008).

In spite of the worldwide intensive research being made in this scientific field, during the previous decade there wasn't any international and widely accepted definition which could describe accurately Metabolic Syndrome. Thereupon, the various names that were attributed to the Syndrome (Table 1) reflected various approaches of the subject and they weren't identical (Ford, 2004).

Over recent years, a fixed reference point was created according to the basic disorders, which were included in the Syndrome and as a result the term "Metabolic Syndrome" prevailed.

**What is Metabolic Syndrome**

Metabolic Syndrome is a group of metabolic disorders; its key features are mostly the following: central adiposity, dyslipidemia, low HDL cholesterol levels, arterial hypertension and diabetes mellitus. Central adiposity, which is related to gender, is defined by waist circumference (according to IDF and ATP III) and by

waist-to-hip ratio, as in the following Table 2 (Singh, 1993; NCEP- ATP III, 2001; Alberti et al & IDF, 2004).

Table1. **History: Descriptions of Metabolic Syndrome (Ford, 2004)**

| | |
|---|---|
| Hypertension, Hyperglycaemia and Hyperuricemia Syndrome (Kylin, 1923) | Kylin, 1923 |
| Metabolic Trisyndrome (Petrie et al, 1998) | Camus, 1966 |
| Plurimetabolic Syndrome (Avogaro et al, 1967) | Avogaro, Crepaldi et al, 1967 |
| Wohlstand Syndrome (Gries et al, 2003) | Mehnert and Kuhlmann, 1968 |
| Metabolic Syndrome (Hanefeld et al, 1981) | Hanefeld and Leonhardt, 1981 |
| Syndrome X (Reaven, 2005) | Reaven, 1988 |
| Deadly quartet (Kaplan, 1989) | Kaplan, 1989 |
| Insulin resistance Syndrome (Defronzo et al, 1991) | DeFronzo and Ferrannini, 1991 |

Table 2
**Central adiposity related to gender**
According to IDF, ATP III and WHR

| Waist circumference | | |
|---|---|---|
| | IDF | ATP III |
| Men | $\geq$94 cm | $\geq$102 cm |
| Women | $\geq$80 cm | $\geq$88 cm |
| WHR= Waist to Hip Ratio | | |
| | Increased Risk | |
| Men | WHR >1.0 | |
| Women | WHR >0.85 | |

The widely used clinical classification of Metabolic Syndrome has been suggested by the American Experts Committee (NCEP-ATP III), according to which three or more of the risk factors should be above allowable limits (Table 3).

Table 3. **Diagnosis Criteria of Metabolic Syndrome**
In accordance with WHO
(WHO & Alberti et al, 1999)
& NCEP-ATP III (2001)

| Fasting glucose | $\geq$110 mg% |
|---|---|
| Triglycerides | $\geq$150 mg% |
| HDL – cholesterol | < 50 mg% Men, <60 mg% Women |
| Systolic/ Diastolic arterial pressure | $\geq$130/85 mmHg |
| Umbilical circumference | >102 Men, >88 Women |
| Syndrome diagnosis | 3 criteria or more |

Besides the five key features of Metabolic Syndrome, there is also a group of other disorders related due to their metabolic reference, even if they don't define the syndrome. These are as follows: insulin resistance, hyperuricemia (overproduction of uric acid and decreased renal excretion of uric acid) and fatty liver, polycystic ovary syndrome, increased blood coagulation e.t.c. (Hoffstedt et al, 1996; Gries and Liebermeister 2003).

Disorders composing Metabolic Syndrome may cause both coronary and other heart diseases and patients run great risk of heart failure, myocardial infarction and incident stroke. Studies associate Metabolic Syndrome with a fourfold risk of cardiovascular death and they conclude a twofold risk of coronary heart disease when Metabolic Syndrome is combined with diabetes (Alexander et al, 2003). Furthermore, it contributes to the appearance of diabetes mellitus type II in individuals with Metabolic Syndrome but not with diabetes (Zierath et al, 1998), sleep apnoea syndrome and fatty liver (Lewis et al, 1991).

Despite the fact that the consequences of Metabolic Syndrome vary in several studies, it's certain that individuals with this syndrome are in great

risk of cardiovascular complications (12-17%), diabetes (30-50%) and increased mortality (6-7%) (Ford, 2005). A recent study shows that Metabolic Syndrome prevalence in Europe is rated up to 38% in men and to 36% in women (Zimmet et al, 2005).

Lately, it has been laid emphasis on body fat distribution, as the visceral (intra-abdominal) fat relates to diabetes type II, to increased cardiovascular risk (Lebovitz et al, 2005; Sunyer, 2005) and to specific population groups (such as Asian descendance); central adiposity is considered as the best prediction morbidity rate (Fujimoto et al, 1995; Janssen et al, 2002).

Pathogenesis of Metabolic Syndrome consists of multiple factors involving genetic, metabolic and environmental agents (Woods et al, 2002; Ogden et al, 2007). Epidemiological studies (Formiguera, 2004; Kraja et al, 2005; Ebersole et al, 2008) prove that obesity becomes an increasingly serious problem of developed and developing societies (Formiguera, 2004; Kraja et al, 2005; Ebersole et al, 2008). The modern lifestyle (dietary habits, way of living and working) helps reducing physical activity (Caterson, 2002); as a result there are over 1 billion overweight individuals worldwide and around 300 million obese individuals (Hunt et al, 2004; Reaven, 2005). Hypertension, increased levels of cholesterol, diabetes mellitus and smoking represent more than 75% of cardiovascular incidents which are the first cause of death in western world (Laaksonen et al, 2002; Athyros et al, 2004).

A big survey on health and nutrition which is still being conducted in USA, NHANES III (Third National Health and Nutrition Examination Survey III, 2003; Alexander, 2003) underlines that over 65% of adults are overweight or obese (Flegal et al, 2002; Sturm, 2003; Grundy et al, 2005), whereas the prevalence of Metabolic Syndrome is 24%, meaning around 47 millions of adult Americans with this syndrome (Ford, 2002; Alexander, 2003; Ginsberg, 2003; Grundy, 2004). The epidemiological data of the Greek survey, entitled ATTICA (2004), are troubling about the syndrome's

frequency in the future, since 1 of 5 participants (19.8%) present metabolic risk factors, as male population presents the double rates. Lifestyle habits seem to weigh in the appearance of the syndrome. The adoption of a Mediterranean-style diet, as it was evaluated by the use of a graduated scale by a special nutritional diet, seems to reduce the risk of having Metabolic Syndrome by 19%, while the presence of physical activity even in low levels (<7 Kcal/ min) reduced the risk by 25% (Panagiotakos et al, 2003 and 2004; Yannakoulia et al, 2006). According to a study of the Hellenic Medical Association for Obesity (2006), 67% of male adults and 48% of female adults is overweight or obese whereas the appearance of obesity in children is quite impressive (Kapantais et al, 2006). The meta-analysis results of the Mayo Clinic College of Medicine (2007) underline that patients with Metabolic Syndrome have 1.78 times higher risk of suffering from cardiovascular incidents or death in relation to patients without Metabolic Syndrome (Gami et al, 2007).

The key risk factors of Metabolic Syndrome are as the following: age (Ginsberg, 2002; Panagiotakos et al, 2004), gender (Flegal et al, 2002; Panagiotakos et al, 2003 & 2004), race and nationality (Chen et al, 1999; Cossrow & Falkner, 2004; Reynolds & He, 2005; Laakso & Kovanen, 2006; Moebus & Stang, 2007; Prussian et al, 2007), family background (Hunt et al, 2000; Peak et al, 2006), obesity (Scrinivasan et al, 2002; Despres et al, 2006), birth weight (Hales et al, 1991; Dwyer et al, 2002; Kanade et al, 2008) and hypertension (Sinaiko et al, 2002 ; Fulop et al, 2006).

**In which ways can we prevent Metabolic Syndrome's appearance and development?**

Metabolic Syndrome is a complex disease, highly related to lifestyle and, as it seems from the increasing rates of prevalence worldwide, it tends to get epidemic with far-reaching implications for public health. Knowing the risk factors of Metabolic Syndrome is particularly important, since we can eliminate the risk of syndrome's appearance and

development and avoid its complications by adopting a suitable lifestyle and healthy practices. Hyperinsulinemia and/ or insuline resistance constitute the link of Metabolic Syndrome risk factors (Alberti et al, 2005). Losing weight and exercising help in reducing hyperinsulinemia and insuline resistance as well as the other risk factors for cardiovascular diseases (Alberti and Zimmet, 1999).

### 1. Changing lifestyle

Each individual, which accumulates some of the basic features of Metabolic Syndrome, should consider and change practices concerning nutrition and physical activity as well as its emotional reactions related to the syndrome. A program of changing lifestyle should be based on self-control. It should be useful to conduct group sessions in weekly or monthly basis, which could apply in a program of long-term surveillance of individuals having or risk of having Metabolic Syndrome (Wadden, 1993). Risk factors treatment strategies include certain limitations, such as meals in some places and hours, avoiding a challenging environment related to unhealthy nutrition and sedentary life (such as vacations, food outside home, travels), encouragement in an active participation in physical exercise, dealing with stress with relaxing techniques and daily physical activity (Institute of Medicine Food and Nutrition, 1995). Excessively ambitious programs should be avoided. Progressively rise of lifestyle changes approach is the most preferable. (Palmer and Schaffner, 1990; Franzese et al, 1997; Ueno et al, 1997).

Changing lifestyle consists in adopting proper dietary habits and in increasing physical activity aiming at the ideal body weight maintenance.

### 2. The benefits of a proper nutrition

Metabolic Syndrome's answer is the achievement and maintenance of the ideal body weight by eating properly. The "toxic" environment (abundance in nutrition with high intake of saturated fat and sucrose, low intake of fibers, increased food portion, reduced physical activity e.t.c.) of developed western societies plays unfortunately the key role in the epidemic development of obesity,

one of the basic risk factors for Metabolic Syndrome.

The link between Mediterranean diet and Metabolic Syndrome has also been confirmed by scientific studies, such as Lyon Diet Heart Study (De Lorgeril et al, 1999; Spence, 2002) which indicates that Mediterranean diet can reduce from five to seven times lower the risk of cardiovascular incidents. The results of the Greek survey ATTICA are indicative, according to which the low syndrome's frequency in our country comparing with others is due to a Mediterranean-style diet whose benefits are found in a reduced intake of saturated fats and an increased intake of monounsaturated fats (mostly from olive oil), as well as of fruits and vegetables (Panagiotakos et al, 2003). The antioxidants' contribution is very important (Vitamins A, C, E, Coenzyme Q10) as they are included in the Mediterranean diet, they "shield" human body from free radicals invasion and they have a protective effect on cardiovascular diseases (Shadid and Jensen, 2003).

According to a great number of studies, Mediterranean diet constitutes the shield of the cardiovascular system health and reduces the risk of atherosclerosis. Under the "The Seven Countries Study", Crete's inhabitants appeared to have the lowest morbidity and death rates due to coronary disease in comparison with the inhabitants of Northern Europe, USA, Japan and Italy. Therefore, these results were related to a high intake (approximately seventy grams per day) of virgin olive oil, the most distinctive element of the Mediterranean diet (Keys, 1980; Keys et al, 1986).

### 3. The importance of physical activity

Lack of physical activity increases the risk of obesity, diabetes and hypertension, in other words it increases the risk for Metabolic Syndrome resulting in heart aging. Physical activity is important for the heart, as with every cardiac beat, it pumps a sufficient amount of blood, contributes to delay artery stenosis of heart and brain and it helps body to consume extra fat, to reduce blood pressure, to improve good cholesterol levels and to uphold normal blood glucose levels. Studies demonstrate that one hour

running per week reduces the risk of heart diseases by 42%, whereas walking running for 30 minutes per day reduces the risk of heart diseases by 18% and incident strokes approximately by 11% (Kohli and Greenland, 2006). Present recommendations require at least 30 minutes exercise – walking type of exercise – for 5 days a week. However, its beneficial effect is multiple, since it seems that it contributes to reduce blood pressure, to correct atherogenetic lipidemic profile and to improve glucose tolerance (Palmer and Schaffner, 1990). In accordance with a Canadian study, good physical condition reduces Metabolic Syndrome's implications and furthermore the risk of diabetes and cardiovascular diseases (Labrador et al, 2006). A practical way to increase physical activity is to increase daily activities, such as going up and down stairs, household duties, gardening, walking from and towards work or market (Kral et al, 2004).

### 4. Quit Smoking and control lipids

In some individuals, physical activity or weight loss could eliminate most of the risk factors developing Metabolic Syndrome. Special interest has the smoking which is a great risk factor for coronary disease, particularly when there is diabetes at the same time and it increases the possibilities of blood vessels occlusions. Quit smoking reduces substantially the possibility of damaging coronary and lower extremities vessels (Haire-Joshu et al, 1999; Eliasson, 2003).

Reducing level of lipids can reduce at the same time the risk of developing the syndrome by using initially conservative means and medication, where it is necessary, according to which type of lipids is increased (cholesterol or triglycerides or both) (Grundy, 1998).

### 5. Avoiding stress

Chronic stress at work is an important cause for heart disease and diabetes. Stress increase at work is related to a greater risk of being affected by the Metabolic Syndrome (Vrijkotte et al, 1999). British researchers examined the link between chronic stress and Metabolic Syndrome in 10,308 public servants in London, between 1985 and 1999. The results of this study indicate that the greater the stress due to

work, the greater the risk of having Metabolic Syndrome. Men and women with chronic stress had double chances to present the syndrome, as well as those that were low-graded at work. These findings confirm previous studies, which showed that Metabolic Syndrome presents variations according to social level (Chandola et al, 2006). A possible explanation for the aforementioned findings is that the extended exposure at working stress affects autonomic nervous system. It is also likely that chronic stress reduces body endurance and adaptability. As a consequence, normal mechanisms that keep body metabolism in normal levels are being disrupted. Biology of stress is characterized by affecting autonomic nervous system provoking in turn disorders of neuroendocrine type. An illustrative example is the increased cortisone secretion in blood due to chronic psychological stress. Cortisone is a competitor of insuline and thereby there is a predisposition to Metabolic Syndrome. Non-glucose tolerance and reduced HDL cholesterol, which are features of Metabolic Syndrome, have been related to increased cortisone secretion (Vitaliano et al, 2002; Furukawa et al, 2004).

## CONCLUSIONS – SUGGESTIONS

Metabolic Syndrome is consisted by a group of metabolic disorders which lead to serious complications in vital organs, such as coronary and cerebral vessels as well as vessels of the low extremities. Every feature of Metabolic Syndrome is an independent risk factor, but usually they accumulate in one individual resulting to a great increase of risk implications. It is imperative to develop and implement prevention programs, if we consider that obesity, which is the key risk factor for Metabolic Syndrome, has had tremendous effects on adults as well as in children and adolescents. The component measures aim at immediately quitting smoking, losing extra weight, adopting healthy habits, modifying individual's dietary behaviour and increasing physical activity.

Maybe it's not quite clear yet how proper diet and physical exercise reduce

death rate in patients with Metabolic Syndrome. However, it should alert the competent authorities to create campaigns featuring the value of healthy diet and physical exercise as a philosophy and a lifestyle.

Just like in other developed countries, also in our country sanitary strategies and health programs should focus more on finding ways of preventing Metabolic Syndrome and improving health status of the entire population. Strategies and programs are compatible with new scientific data, which warn for global "explosion" of appearing and developing Metabolic Syndrome factors in all age groups. Health promotion strategies and sanitary programs development should include actions centrally, locally (mostly in a community level and local government) as well as personally. This intervention should be for each level multidimensional and versatile.

Scientists and health professionals in collaboration with the competent public authorities and decisions-takers aim at promoting health for each sanitary policy planning. Studies continuation, which will record dietary and physical activities habits, diabetes, central adiposity and all the other features of Metabolic Syndrome on a large scale, they will deliver reliable evidence and identify the groups that we should pay more attention to. Results from surveys related to great samples, which can also have an epidemic character, they are a prerequisite and the foundation for planning every sanitary strategy.

Informing and educating the public should include nutritional and physical activities issues, as well as prevention or management of central adiposity, diabetes, atheromatosis and hypertension. Health professionals need to be aware of and advise that prevention and control of all the aforementioned is the most effective way to deal with Metabolic Syndrome and its implications. Furthermore, they should motivate all population groups to change stereotyped perceptions and behaviours aiming at health and quality of life promotion.

European Committee has also set the same agenda after having recorded health professionals' concerns. In 2004, it began an ambitious six-year research program, entitled LipGene: **"**Diet, genomics and the metabolic syndrome: an integrated nutrition, agro-food, social and economic analysis". Its primary focus is on Metabolic Syndrome. This collective effort from 25 research centres will help to understand the link between nutrition and syndrome's genetic composition of each individual. The program, which will also contribute to the development of effective measures to combat Metabolic Syndrome, includes a large scale study about human nutritional intervention, development of new technologies for increasing food content in "good fat", education campaign (Lipgene Community Final Workshop 2004-2009; Buttriss and Nugent, 2005).

Another one four-year program, the EPODE, was initiated in 2004 in 113 communities in France along with the support of Health Ministry, the active participation of communities and private initiative of multinational food companies. This program address to 5-12 year-old children in collaboration with school doctors, parents and teachers. It includes medical examinations and BMI calculation annually; children are encouraged to adopt healthy dietary and physical activities behaviours through a range of activities, organised games and educational visits at food production locations (Westley, 2007). European Committee examines all the possible ways to put into effect the EPODE program across all E.E. countries in collaboration with community participants, food industries, consumer associations aiming to inform mostly children and adolescents (Watson, 2007). Commission of the European Communities White Paper (2007) defines the new community strategy for health (2008-2013)**,** aiming to enhance community collaboration, to achieve greater understanding for health issues in European and world level, to promote the proper measures for health promotion of elderly people, active population and children in order to boost population productivity and health since population ages, as well as to take additional measures mostly concerning nutrition (Commission of the European

Communities, 2007). A European Parliament's decision concerns policies and programs about public health and consumers' protection within an integrated frame in order to ameliorate information and knowledge about public health development and activities for promoting health which are linked to actions and special ways of reducing and eliminating risk in collaboration with the competent international organisations, such as World Health Organisation (European Parliament, 2007).

In our country, there is a lack of information about the risk factors for Metabolic Syndrome and at the same time there aren't too many services for managing these risks, only by isolated initiatives. Consequently, the development of related services, the compliance with the European Parliament's decisions and participation in health programs run by the Commission of European Communities are essential and it seems to correspond to a great portion of unsatisfied demand, while it reinforces and improves health education and promotion programs working closely with all participants of health and public information services.

All health scientists and health professionals, dietitians and nutritionists, and community as a whole, play significant role in developing and adopting healthy behaviours. Within this collaboration, promoting health should combine various methods and ways of approach, such as communication, education, legislation, financial measures, structural changes, community development, as well as local activities against risks for Metabolic Syndrome threatening public health.

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