

# Exercise and Metabolic Syndrome

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## 1. Preface

With the progress of scientific technology and of civilization the lifestyle of mankind also shifts from physical-intensive into mechanical, automatic and information-oriented. Physical activities have reduced to great extent. Moreover, economic development and abundant material life lead people to take in more calories and come along with emerging different diseases of civilizations, including heart disease, atherosclerosis, stroke, tumor, diabetes, liver cirrhosis, obstructive pulmonary, kidney failure, osteoporosis and obesity, etc.

**Metabolic Syndrome** (briefed as MS in the following text) is the symptom of numerous diseases of civilization, also regarded as the dangerous and predictable factors for cardiovascular diseases. Generally speaking, it indicates the general metabolic diseases or the clustering phenomenon of dangerous factors of cardiovascular disease. MS indicates that the chances to get diabetes, hypertension (high blood pressure), high blood cholesterol, heart disease, and brain stroke are respectively 6, 4, 3, and 2 times higher than the average. MS is not a disease but the syndrome to get the above-mentioned diseases. The diagnoses criteria are stricter than hypertension, high blood sugar and diabetes. It is taken as the pre-warning sign to one's health so that the patient could be more cautious and take preventive actions in advance. Over the recent years, MS has gradually been recognized as a highly-concerned health issue. According to the researches done by Department of Health in 2002 on the 3-high indicators (hypertension, high blood sugar, and high blood cholesterol), 15% of Taiwanese above 15 years old had MS; male and female, respectively, 16.9% and 13.8%. Plus, with the increasing aging population, MS becomes phenomenon. Based on the statistics of 2008 major death reasons, 29% of the people died of MS-originated diseases (heart disease, brain vascular disease, diabetes, kidney and hypertension-related disease). This figure has surpassed the death number of cancer, 27.3%, as the leading death reason, that



is, in 2008, there were 41,944 Taiwanese died of MS-originated diseases. Over the recent years, these diseases have been at the high social health-insurance cost. Obviously, it has become a significant public, health issue in Taiwan.

## 2. History of the Metabolic Syndrome

In the early time of 1920, Swedish Dr. Kylin already found out that hypertension, high blood sugar and metabolic arthritis could simultaneously happen to the same person. In 1947, Vague indicated that obesity, diabetes, cardiovascular diseases are co-related. In 1967 and 1979, German research teams respectively discovered the clustering phenomenon of dangerous factors of metabolic syndrome.



These factors result in high chances of

cardiovascular diseases. In 1988 American Professor Mr. Gerald M. Reaven at the Stanford University School of Medicine presented the insulin resistance and impaired glucose tolerance. He explained the factors which lead to metabolic syndrome and indicated that insulin does not function normally in the blood so that cells cannot absorb glucose and turn it into energy. Reaven was honored by American Diabetes Association with Banting Award. At the awarding speech, he initially brought up the concept of X Syndrome and described the co-relationship among insulin resistance, high blood cholesterol and hypertension. Undoubtedly, Reaven is the forerunner and academic scholar well-known in the field of metabolic syndrome.

In 1989, Professor Mr. Norman Kaplan at Medicine Faculty, Texas University, concluded the features of insulin resistance, high blood cholesterol and hypertension. Furthermore, plus central obesity, he called these 4 dangerous factors of MS as the Deadly Quartet.

In 1992, Professor Steven Haffner clearly proved that insulin resistance is the common phenomenon of cardiovascular diseases as well as the dangerous factors. He named the clustering phenomenon of these dangerous factors as insulin resistance syndrome. Thus, MS is not only the dangerous factor of cardiovascular diseases but also that of diabetes. In 1999, World Health Organization (WHO) officially named this peculiar clustering phenomenon as Metabolic Syndrome (MS) and also set the diagnose criteria. In 2001, according to the American National Cholesterol Education Program, NCEP, there is another updated version which gives new definition of MS and diagnoses criteria. And the criteria have been adopted from 2005 onwards by American Heart Association. The major change is the diagnoses criteria of MS, including one of the criteria, waist size which varies with the different group of people; in other words,

the threshold is lower for those who easily produce insulin resistance. And the blood sugar criteria at the condition of empty stomach are also lowered to  $\geq 100$  mg/dL.

At present, most medicine academics, institutes and practices in Taiwan adopt the criteria of American Heart Association. Because the physical size and features of eastern people are different from westerners, Department of Health in Taiwan defines obesity are the males whose waist size is more than 90 cm and the females, more than 80 cm.

### 3. Diagnoses criteria

From the viewpoint of medical treatment, MS has been talked about and the relevant health issues are also under spotlight. People are highly advised to take actions to control or prevent from MS. Therefore the diagnoses criteria are much stricter than other relevant diseases. In 1999, World Health Organization first described the diagnoses criteria of metabolic syndrome. In the same year, European Insulin Resistance Research Team also prescribed its European-versioned diagnoses criteria based on the features of Europeans. In 2001, American National Cholesterol Education Program regulated American diagnoses criteria of metabolic syndrome. Additionally, American Association of Clinical Endocrinologists (AACE) also announced its diagnoses criteria.

In 2004, based on the diagnoses criteria of American Cholesterol Education Program and the physical characteristics of Asians, Taiwan prescribed the diagnoses. Related researches indicate that 80% of the MS cases have the problem of central obesity and 40% of the cases all have high body mass index (BMI). According to the study, the central obesity is the better indicator to reflect the relationship between health and obesity. In 2007, the indicator, BMI, was abandoned. Only the indicator of waist circumference is kept; the blood sugar value at the condition of empty stomach is reduced from 110 mg/dL to 100 mg/dL. Now the diagnoses criteria of MS in Taiwan are briefed as follows. People who have one of the warning signs are at the high-risk of MS and those who have all these three warning signs are regarded as the MS group.

	Dangerous factors	Abnormal Value
1 <sup>st</sup> warning sign	Central obesity	Male: Waist Circumference $\geq 90$ cm (35.5 inch) Female: Waist Circumference $\geq 80$ cm (31 inch)
2 <sup>nd</sup> warning sign	High blood pressure	Systolic blood pressure $\geq 130$ mmHg Diastolic blood pressure $\geq 85$ mmHg
	High blood sugar at the condition of empty stomach	High blood sugar at the condition of empty stomach $\geq 100$ mg/ dL
Abnormal blood cholesterol	High triglyceride (TG)	Triglyceride (TG) $\geq 150$ mg/ dL
	Low cholesterol of high-density lipoprotein	Male $< 40$ mg/dL Female $< 50$ mg/dL

#### 4. Causes of Metabolic Syndrome

Due to the fast economic development and sufficient material life, many labor-intensive work is replaced by mechanics and plus the high-pressure lifestyle, many people do not have healthy active and exercising lifestyle. Therefore, it results in metabolic syndrome. The major reasons are overtake of cholesterol and insufficient physical activities, western-style high-cholesterol food and the shifting social lifestyle, such as watching TV, playing computer games or using computer and other long-time sedentary lifestyle. As a result, much calorie left inside of the body and from the physical appearance, the increasing central obesity and the large waist size might be observed. And it is not difficult to see more and more obese people.

The over-sized waist and central obesity refer to the over-accumulated visceral fat. The relevant studies indicate that visceral fat is more active than subcutaneous fat. Therefore, it is easily dissolved into free fatty acids and brings in resistance to insulin. The sensibility of insulin decreases and it cannot function normally so that glucose cannot enter blood cells. Then pancreas will produce more insulin to reduce blood sugar and consequently hyperinsulinemia appears. Furthermore the second type of diabetes, increasing blood pressure, abnormal blood cholesterol including high triglyceride, low cholesterol of high-density lipoprotein and other problems. At the end, all the above-mentioned health problems lead to metabolic syndrome.

#### 5. Treatment principles of Metabolic Syndrome

In 2001 American National Cholesterol Education Program (NCEP) publicized the diagnoses criteria of MS. In the following year, the treatment guidelines were soon presented. There are three measures: 1) control body weight; 2) increase physical activities; 3) curb the dangerous factors of cardiovascular diseases. In addition, American College of Sports Medicine (ACSM) also brought up the principles to treat MS. The suggestions are 1) moderately control energy intake; 2)

increase physical activities and the best is to do 30-minutes moderate exercise; 3) change eating habits; 4) take medicine to control the dangerous factors of cardiovascular diseases.

#### 6. Importance and principles of exercise for Metabolic Syndrome

The reason to bring up MS is to prevent from the related diseases, such as obesity, hypertension, diabetes, high blood cholesterol and so on. Many reports show that regular exercise can improve physical constituency, reduce body fat, increase lean body mass and reduce systolic and diastolic blood pressure. And there are also other benefits such as increasing sensibility of insulin, bettering the conditions of diabetes, lower total cholesterol, increasing cholesterol of high-intensity lipoprotein, etc. American College of Sports Medicine emphasizes that regular exercise plays a significant role in improving MS and from its viewpoint, the measures of doing regular exercise are set as follows:

- The exercise modes, frequency, strength, time duration for those with MS should do the same exercise as normal people like aerobics, resistance training and flexibility.
- Weekly the lowest moderate physical activities shall be 150 minutes, 30 minutes every day. The best is to do exercise every day.
- MS group show numerous dangerous factors of cardiovascular diseases. Thus, while suggesting the measures of doing exercise, the said factors should be especially put into concerns. In the meantime, the expecting goals from the participants or those under the medical care should be also put into consideration.
- In the beginning, MS group shall do moderate exercise (40~60% maximal oxygen consumption to keep up the heart rate) and later gradually increase the strength of exercise (50~70% maximal oxygen consumption to keep up the heart) so as to reach the best health condition and to improve physical fitness.
- A great number of people with MS are obese. If they can gradually increase the time to do exercise, doing exercise

for 300 minutes every week or 50~60 minutes every time and five days in a week. There will be more considerable effects to improve MS.

- There is also another way to increase daily physical activities, that is, to do at least 10-minutes moderate physical activity every time and several times in a day.
- For those who need to lose or to maintain weight, they need to gradually increase their exercise time up to 60~90 minutes.

### 7. Correct concepts of exercise to fight against Metabolic Syndrome

People with MS are often patients who have obesity, hypertension, or diabetes problems. The correct concepts of doing exercise are briefed as follows:

#### A) The correct exercise concepts for the people with obesity:

- The energy intake shall not be lower than 1200 calories daily. And energy intake should not be over-controlled so as to prevent from malnutrition.
- The diet must be acceptable for the people who like to lose weight. Thus, social and cultural background, eating habits, flavor, cost, food accessibility and the preparing difficulty are all these factors in need of consideration.
- The total energy intake shall be lower than energy consumption. Thus the people could reach the goal to consume their energy and lose weight. Every week, the total lost weight shall not surpass one kilogram. It is important to lose weight gradually so that people are not at the risk of losing health.
- In cooperation with changing behavior measures to recognize and abandon the bad habits which leads to obesity.
- To do aerobic and strength-training activities, such as walking, jogging, swimming, cycling, etc. and do it with low-level strength but long continuous time; the best is to consume 300 calories by daily exercise.
- The suggested food and exercise plan shall be a lifelong plan for people who want to lose weight so that they can maintain their ideal weight at good health condition.





#### B) The correct exercise concepts for the people with hypertension

- Before exercise training, it is necessary to take the exercise pressure test.
- Those with higher blood pressure, the exercise strength shall be lower.
- Do not do strong strength and short-time exercise.
- Before and after doing exercise it is necessary to warm up and to do stretch exercise.
- To avoid weight training.
- Not to do uncomfortable or breath-holding exercise.
- Not to overdo sport so as to avoid exhaustion.
- To increase exercise strength at a gradual level and develop exercise habits.
- Patients who take diuretics and their blood would be reduced. Thus, it is necessary to be aware of heat injury.
- Not to do exercise at the freezing or humid environment.
- Avoid upside-down exercise.
- It is the principle to do 30-minutes exercise every time.

#### C) The correct exercise concepts for the people with diabetes

- To do exercise only when the blood sugar is under control as predicted and there is no ketoacidosis.
- Before exercise training, it is necessary to take the exercise pressure test.
- There is no uniformed exercise for patients with diabetes. Exercise plan shall be designed individually based on personal physical condition, blood sugar stability, exercise mode, emotion and weather condition, etc.
- To chose aerobics and do it at a fixed time every day.
- The blood sugar goes up after dining and goes down while doing exercise or taking insulin. It is better to take some snacks and to reduce intake of insulin.
- Do not to do exercise before dining so as to avoid the condition of low blood suger.
- While doing long endurance physical activities or exercise, take carbohydrate for examples, candies, chocolate or juice.
- It is better to find company to do exercise together. While doing exercise alone, inform family or friends of the leaving and returning time for exercise.
- Young patients with diabetes may consider doing contact sports. For the elderly patients, they shall take walks, jog or do other aerobic exercise.
- To inform family or close friends of the health problem of diabetes and try to deal with low blood suger altogether. Possibly, bring a tag: I am a diabetes patient.
- Before, during and after exercise, to measure blood sugar is the only good way to see if blood sugar is under control.

## 8. Conclusion

Due to the progress of industrialization, modern technology, sufficient material life, people lack of physical activities, overtake too much energy and accumulate too much fat. Consequently, more and more people easily have problem like diabetes, cardiovascular, strokes, metabolic syndrome and other related diseases. The medical community has emphasized the importance of prevention and health care. Particularly with the focus on these dangerous factors such as obesity, hypertension, high blood sugar and high blood cholesterol, it is constructive to set sounder, stricter diagnosis criteria to define metabolic syndrome. Thus, people will pay more attention to these diseases and take preventive actions. In fact, it is not difficult to prevent from metabolic syndrome as long as people do exercise regularly, control food, and develop health living habits during lifetime. Doing regular exercise is certainly the key to fight against the dangerous factors of metabolic syndrome and to avoid the related cardiovascular diseases. As people often say "health is above everything!" And sport is the road to one's lifelong health. I hope that all of us are healthy by keeping a exercising life!