

Natural Treatments for Metabolic Syndrome

Using Nutraceuticals to Thwart a Deadly Trend

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Metabolic syndrome, also known as syndrome X or cardiovascular metabolic syndrome, is comprised of hyperlipidemia (elevated triglycerides and low levels of high-density lipoprotein [HDL] cholesterol), central (abdominal) obesity, hypertension, and concomitant insulin resistance/glucose intolerance. Although no specific cause-and-effect relationship has been established, the outcomes of these associative factors are significantly increased risks for developing diabetes and heart disease.

Eric S. Freedland, M.D., a senior editor, based in Boston, Massachusetts, of *Metabolic Syndrome and Related Disorders*,* notes that “the escalating worldwide epidemic of metabolic syndrome affects each of us—either directly or indirectly. It demands multidisciplinary efforts and cooperation to [e]nsure better understanding of its causes and to develop effective approaches to preventing and treating its associated conditions.”

Using a sample of 3477 Mexican American, 3305 African American, and 5581 Anglo American men and nonpregnant/lactating women 20 years and older, the Third National Health and Nutrition Examination Survey’s assessment of metabolic syndrome-associated factors and prevalence¹ revealed the following information about the syndrome in the United States:

- Metabolic syndrome was present in 22.8 percent of men and 22.6 percent of women.
- Age-specific prevalence was highest in male and female Mexican Americans and lowest in male and female African Americans.
- Ethnic differences did not change after adjusting for age, body-mass index (BMI), and socioeconomic status.
- Metabolic syndrome was present in 4.6 percent of normal-weight men.
- Metabolic syndrome was present in 22.4 percent of overweight men.
- Metabolic syndrome was present in 59.6 percent of obese men.
- A similar distribution was noted for women.
- Increasing age, postmenopause, elevated body-mass index, cigarette smoking, avoidance of alcohol, physical inactivity,

low socioeconomic status, and Mexican American ethnicity are associated with an increased occurrence of metabolic syndrome.

The researchers’ conclusions were that approximately 20 percent of adults in the United States have metabolic syndrome and it is associated with several modifiable lifestyle factors.¹ Metabolic syndrome, as defined by the Adult Treatment Panel III criteria include:

- a waist circumference greater than 102 cm in men and 88 cm in women
- blood pressure of 130/85 mm Hg
- fasting serum glucose level of 110 mg/dL
- serum triglycerides of 150 mg/dL
- high density lipoprotein cholesterol less than 40 mg/dL in men and 50 mg/dL in women.²

Individually, these risk factors have been known for some time to contribute to chronic disease. It is the clustering of these factors into a syndrome and their prevalence that bring metabolic syndrome X into the forefront of epidemic conditions in the United States. But “poor nutrition heads the list of lifestyle factors that make up the underlying causes of metabolic syndrome. Lifestyle intervention, including a focus on improving macro- and micronutrient consumption, may provide a solution,” Dr. Freedland observes.

The Connection Between Diet and Nutrients

Sixty-one (61) percent of adult Americans are obese or overweight, and the prevalence of serious obesity among the adult population has doubled in the last decade despite mass marketing of diet and weight-loss plans and products, fitness clubs, and home exercise machines and videos.³ American children have also increased their girth. Weight problems are not unique to Americans either; the World Health Organization has estimated that 1 billion people on the planet are obese.⁴

It is well-known that the Western diet of refined carbohydrates, saturated fat, and sugary foods is the primary suspect in this epidemic and other conditions such as cancer. Consumption of refined carbohydrates elevates insulin, cholesterol, and triglyceride levels, and reversal of this trend with a low-glycemic index (GI), low-fat, high-protein diet is attainable.⁵

Hyperinsulinemia and insulin resistance are identified as key players in the development of metabolic syndrome. Elevated insulin contributes to obesity and high blood pressure, which are

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Strategies for Preventing Metabolic Syndrome

- Increasing fiber intake is associated with decreased insulin resistance.
- Reducing saturated fat intake to reduce insulin resistance.
- Increased consumption of vegetables with carotenoids is associated with decreased fasting insulin.
- Exercise prevents and reverses insulin resistance.
- Stress reduction reduces insulin resistance.
- Magnesium produces favorable changes in insulin sensitivity.
- Chromium picolinate produces favorable changes in insulin sensitivity.
- Alpha-lipoic acid exerts antioxidative effects and improves insulin resistance.
- *Inula racemosa* produces favorable changes in insulin sensitivity and blood glucose levels.
- *Gymnema sylvestre* produces favorable changes in insulin sensitivity and blood glucose levels.

also reversible, using similar dietary therapies.⁶ Other therapies directed toward decreasing insulin resistance are thought to mitigate problems associated with this syndrome; these approaches include lowered saturated fat intake, low-GI food consumption, obesity prevention, and exercise.⁷

Therapeutic strategies aimed at reducing the morbidity of the 4 factors that comprise metabolic syndrome are currently widely available. Today, weight loss, physical activity, and treatment of the individual risk factors are the main approaches. In the meantime, research efforts focus on determining a particular genetic susceptibility to the syndrome and the interrelationships among bodily organs that may precipitate insulin resistance, with the aim of developing improved therapies.

However, one does not need to look far for the basic causes of metabolic syndrome. All four conditions (obesity, hypertension, hypertriglyceridemia, and hyperinsulinemia) can be linked to one related cause: poor dietary choices, namely, imbalanced consumption of simple carbohydrates.

Thus, the main treatment for metabolic syndrome is dietary therapy. However, a complete reversal of consuming refined carbohydrates and saturated fats and switching to a complex carbohydrate, protein-rich diet with healthy fatty-acid ratios is not likely to occur overnight. Patient compliance may be less than optimal, especially after 40–50 years of undesirable dietary habits.[†]

Attention must be paid to the metabolic costs of a highly refined carbohydrate diet; in particular, one must look at nutrients (minerals and vitamins) that are used to metabolize pro-

cessed foods. During metabolism, the body uses simple carbohydrates (sugars and starches) to create energy. However, these foods contain very little or, in some instances, no vitamins or minerals, mainly as a result of food processing.

The combined effect of eating these foods produces nutritional deficits because the nutritional cofactors (various vitamins and minerals) that are inherently missing from these foods are recruited from body stores to help the body metabolize nutritionally bereft foods.

Over time, depletion and inadequate consumption of nutritional cofactors may make the body unable to function properly, which culminates in disease processes. The burden that these foods put on the body contributes to long-term suboptimal micronutrient levels that may result in the lower levels of micronutrients, such as chromium and magnesium, in persons who have metabolic syndrome. Perhaps, over time, chronic underreplacement of micronutrients may lead to yet another syndrome of which we are currently unaware. Today, we are only in the early stages of truly understanding and appreciating the roles that micronutrients play in human health and must deal with metabolic syndrome.

Addressing Insulin Resistance

Consumption of lower-GI foods and physical fitness will contribute to decreased insulin secretion and resistance, respectively. For patients who receive treatment for this syndrome, insulin regulation is indicated. Borrowing from our knowledge of treating diabetes with natural medicines, many of the same treatment principles may be applied as part of the treatment regimen, including consumption of specific nutrients via diet or supplementation. The remainder of this article concentrates on supplementation and exercise.

Magnesium

A low ratio of intracellular magnesium to intracellular calcium has been identified in all four of the conditions that comprise metabolic syndrome.⁸ Thus, low magnesium levels are implicated as an important precipitating factor in metabolic syndrome. Ionic intracellular imbalances are associated with cardiovascular diseases and occur in this syndrome as well.⁹

Magnesium also plays a main role in controlling insulin-mediated cellular glucose uptake and in counteracting calcium-directed arterial constriction.¹⁰ According to epidemiologic studies, magnesium supplementation for patients with type 2 diabetes and people with hypertension is protective against these disorders, whether they occur alone or are coexistent in an individual.¹¹ In one study, patients with diabetes were observed to be significantly hypomagnesemic compared to control subjects, and magnesium supplementation exerted positive effects on blood-lipid profiles.¹² The disorders of metabolic syndrome occur less frequently in regions where magnesium sources (in diets and water) are replete.¹³ This type of evidence underscores the important role of magnesium for potentially preventing the conditions that comprise metabolic syndrome.¹⁴

[†]EDITOR'S NOTE: For more information on weight-loss and metabolic problems and how to address them, see "Natural Methods for Accelerating Weight Loss: The Low Glycemic Index Diet, Green Tea, Chromium, and 5-Hydroxytryptophan," by Shari Lieberman, Ph.D., C.N.S., F.A.C.N., in this issue.

Chromium

A relationship between chromium status and insulin resistance is known to exist in humans,¹⁵ and various studies in animals have demonstrated a link between chromium deficiency and insulin resistance.¹⁶ The benefits of chromium supplementation on serum glucose, lipids, and insulin resistance have occurred in both diabetes types, with a dose-dependent effect.¹⁷ One study that examined the effects of high-dose chromium supplementation (with a calculated reference dose of 70 mg per day) noted the occurrence of DNA fragmentation.¹⁸ Despite a few anecdotal reports of chromium toxicity, and the tendency of chromium to accumulate within the kidney tissues, no other side-effects have been reported in the literature. Chromium as a treatment cofactor in insulin resistance is supported further by research that implies that a lack of, or low amounts of, ingested chromium may be associated with glucose and insulin-regulation disorder. Thus, using a chromium supplement may help to prevent these occurrences.¹⁹

However, despite the established role of chromium in regulation of glucose and insulin resistance, much controversy exists as to which form of chromium is most effective, and ongoing research in this area is continues.[†]

Vanadyl Sulfate

Vanadyl sulfate (VOSO₄), a form of the trace mineral vanadium, is associated with improved insulin-receptor sensitivity.²⁰ Vanadyl sulfate has been shown to reduce hyperglycemia and insulin resistance in patients with type 2 diabetes who took 150 mg per day for 6 weeks.²² In these subjects, fasting plasma glucose levels, hemoglobin A(1c), total cholesterol, and low-density lipoprotein (LDL) cholesterol were all decreased.²¹

Vanadium acts as an oral-insulin mimic, decreasing hyperglycemia and improving beta-cell insulin storage and secretory function,²² thus indicating that vanadium supplementation can be used to treat prediabetic and recently diagnosed insulin-dependency conditions, making it also a useful choice for treating metabolic syndrome. Although much of the research surrounding vanadium has been conducted on streptozotocin-induced diabetic models and its normalizing effect on elevated blood glucose, vanadium has been shown, in subsequent studies, to lower cholesterol and triglycerides.²³

Poucheret et al. indicated that, although vanadium is deposited in bone, this does not appear to affect bone strength or modeling negatively and that, while a definitive mechanism of action for vanadium is yet to be completely elucidated, vanadium may act as a phosphatase inhibitor, activating protein kinases beyond the insulin receptor.

Alpha-Lipoic Acid

Originally classified as a vitamin upon its discovery more than 50 years ago, alpha-lipoic acid is an endogenous coenzyme that acts in conjunction with pyrophosphatase in carbohydrate metabolism and synthesis of adenosine triphosphate (ATP).

Adjunctives for Treating Metabolic Syndrome

- 40–50 minutes of aerobic exercise, 4–5 times per week (after physician consent)
- 5–6 servings per day of vegetables
- 1–2 g of magnesium, in divided doses, per day (may act as a cathartic laxative)
- 600 µg of chromium, in divided doses, per day
- 25–50 mg of vanadyl sulfate, twice per day
- 600 mg of alpha-lipoic acid, three times per day (high dose is used for severe conditions)
- 500 mg of *Inula racemosa* (root powder), three times per day
- 400 mg per day of *Gymnema sylvestre* (GS4, a water-soluble, standardized extract of the leaves of this herb)

Supplemental alpha-lipoic acid exerts potent antioxidant activity and is well-known for its usefulness as an intra- and extracellular free-radical scavenger and as a water- and fat-soluble antioxidant. In addition, alpha-lipoic acid can regenerate endogenous antioxidants, such as vitamin E, vitamin C, and glutathione.²⁴

Patients with type 2 diabetes who took alpha-lipoic acid daily experienced improved insulin resistance and glucose tolerance after several weeks of treatment in one study.²⁵ Both single and short-term administration of alpha-lipoic acid have produced increased insulin sensitivity; one study demonstrated an increased glucose clearance of nearly 50 percent.²⁶ In another trial, daily infusions of 500 mg of alpha-lipoic acid over 10 days in patients with type 2 diabetes resulted in approximately a 30-percent increased glucose metabolized clearance.²⁷

Studies such as these, as well as the known potent antioxidant/replenishing effects of alpha-lipoic acid, support using this supplement for treating metabolic syndrome. It is a wise choice for helping to normalize metabolism by enhancing insulin effectiveness and performing general antioxidation to address the pro-oxidative effects of the conditions comprising metabolic syndrome.

Pushkarmoola

A traditional Ayurvedic botanical medicine, *Pushkarmoola* (*Inula racemosa*), has demonstrated blood glucose-lowering effects and enhanced liver glycogen storage without elevating plasma insulin in animal studies. This effect was not due to increased adrenal gland activity or beta cell degranulation.²⁸ In addition, the researchers involved in one animal study suggested that the hypoglycemic response that inula produces may occur peripherally via enhancement of insulin sensitivity, not via upregulation or release of insulin itself.

Inula extract decreased serum glucose concentration in corticosteroid-induced hyperglycemia animal models also, suggesting that additional studies of this botanical medicine may shed light on its use for treating insulin sensitivity.²⁹ Additional research in human models is needed to quantify the effects of this herb further as an adjunctive treatment for metabolic syndrome.

Potential Lifestyle Factors Contributing to Metabolic Syndrome

- High-fat diet
- High-carbohydrate diet
- High glycemic-index foods
- Low-protein diet
- Low consumption of vegetables or fibers
- High consumption of refined sugars and starches
- Micronutrient deficiencies (calcium, magnesium, chromium, vanadium)
- Lack of exercise or sedentary lifestyle
- High stress level

Gymnema

Another botanical medicine from the Ayurvedic system, gymnema (*Gymnema sylvestre*) leaf extract, is used in as an adjunctive to insulin and oral hypoglycemic therapies for treating patients with either type 1 or type 2 diabetes. Gymnema causes additional reductions in blood glucose levels as well as decreasing glycosylated hemoglobin.³⁰ In addition, this herb is effective for lowering total cholesterol and triglycerides in patients with type 2 diabetes, and researchers have speculated that therapy with a specific gymnema extract may stimulate production of endogenous insulin by regenerating and/or revitalizing residual beta cells in these patients.³¹

Other studies have shown that gymnema decreases blood-sugar levels, serum triglycerides, and total cholesterol including very low-density lipoprotein and LDL cholesterol.³² One early study suggested that gymnemic acids, which are derivatives of the leaf, may inhibit intestinal absorption of glucose and may stimulate pancreatic beta-cell growth.³³

Although this herb is a useful adjunct for lowering blood sugar, more research is needed, especially to examine claims regarding beta-cell regeneration with their obvious implications concerning the usefulness of this plant. In the meantime, gymnema is another tool for promoting metabolic normalcy via control of blood sugar and insulin levels. It is interesting that gymnemic acid can inhibit the ability to taste sweet or bitter items without affecting pungent, sour, or astringent tastes.

Exercise

Physical activity is quite possibly the single most important preventative choice among patients whose diseases and conditions arise from a sedentary lifestyle. Sedentary lifestyle is one of the main risk factors for multiple chronic disease conditions today and sedentary death syndrome was identified and named to describe the growing life-threatening health problems caused by this lifestyle.

Exercise remains the most effective therapy for preventing and reversing insulin resistance.³⁴ The literature contains numerous references citing how effectively exercise ameliorates cardiovascular risk factors (low HDL cholesterol, obesity, hypertension, and hypertriglyceridemia) and mitigates insulin resistance and glucose intolerance.³⁵

Regular exercise causes a loss of abdominal body fat in a preferential fashion (increased abdominal girth is used as a quantifying factor in diagnosing metabolic syndrome), and can increase resting fatty-acid metabolism.³⁶

Exercise has produced improvement of insulin sensitivity in both skeletal muscle and fatty tissue, leading to decreased fasting blood-sugar and insulin levels.³⁷ Exercise performed for 4 months improved the factors associated with metabolic syndrome, including insulin resistance in obese children, and these effects were reversed with discontinuation of exercise over time.³⁸

Physical fitness produces numerous positive effects on the human body, with negligible adverse results on metabolic function (with the exception of overtraining injuries and syndromes). The availability, ease, and benefits of physical fitness in all human conditions make it the most superior therapy for prevention and treatment of metabolic diseases. All four factors of metabolic syndrome are improved directly by exercise, with continuous benefits produced for the duration of the regimen.

Conclusions

In modern populations, metabolic syndrome is a deadly combination of obesity, hypertension, elevated triglycerides, and hyperinsulinemia. The syndrome is primarily a nutritional disease caused by eating the wrong types of foods and is one of the largest disease epidemics to ever strike North America.

The search for genetic propensities and for improved pharmaceutical medications for treating metabolic syndrome may very well help us to determine the root cause of this condition.

The statistics tell the story vividly—metabolic syndrome affects 20 percent of the U.S. population alone. Thus, it is imperative to teach both physicians and patients to recognize and treat this condition early in life, before symptoms become manifest.

Food is our fuel as well as our medicine. Poor dietary habits continue to disrupt the order of Nature, playing a major contributory role in decreasing the quality of human health.

Metabolic syndrome really is no mystery. Better dietary habits, exercise, and ingestion of the very nutrients that are discarded by food processing will help patients to normalize their metabolism. Botanical medicines also help to repair metabolic processes that have gone awry. □

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