



# Nutritional Considerations of **Obesity** and **Bariatric Surgery**

**Obesity is regarded as a chronic medical disease with serious health implications caused by a complex set of factors.**

## **MICRONUTRIENTS AND OBESITY**

Obesity is a complex, multi-faceted, chronic disease involving social, environmental, genetic, physiological, metabolic, behavioral and psychological components. It is the second leading cause of preventable death in America, second only to cigarette smoking, and increases risks of illness from over 30 medical conditions including diabetes, hypertension, cancer, infertility, arthritis and heart disease. Prescription medications used to treat many of these conditions often induce micronutrient deficiencies as well.

**In fact, an astounding 98% of bariatric surgery patients exhibit micronutrient deficiencies within two years of surgery.**

Ironically, nutritional deficiencies co-exist when excess caloric intake occurs. This is due in part to the fact that adipose tissue has its own nutritional requirements, acting somewhat like an independent organ, often draining nutrients from other tissue systems. Similarly, the bio-availability of fat-soluble nutrients which are stored in adipose tissue is limited, making functional deficiencies common in obese patients.

## **BIO-AVAILABILITY OF NUTRIENTS**

Obesity often reduces the bio-availability of certain nutrients such as vitamin D. In fact, the effectiveness of vitamin D supplementation is largely dependent on how overweight a person is. Obese patients often require higher doses of vitamin D to achieve vitamin D repletion compared with individuals with normal body weight. In a recent study, over 50% of obese patients were evaluated for vitamin D status and found to be deficient.

Since adipose tissue (fat cells) has its own nutritional requirements, fat cells will draw from nutritional reserves in much the same way other organs do in order to perform normal cellular functions. The combination of reduced bio-availability and increased demand for nutrients caused by excess adipose tissue ultimately causes multiple deficiencies that need to be addressed.

## **REGULATION OF HORMONES LINKED TO OBESITY**

Niacin (vitamin B3) treatment has been shown to increase levels of adiponectin, which is a beneficial enzyme that regulates metabolism of glucose and fatty acids. Decreased adiponectin levels are associated with obesity and heart disease. In a similar study, vitamin B5 raised the activity of lipoprotein lipase, an enzyme that helps break down fat cells so they can be processed by the body.

Epidemiological studies have reported that low zinc status is associated with a higher prevalence of obesity. In fact, one animal study reported that zinc deficiency in mothers contributes to an increase in body fat of their offspring. This may be due, in part, to the relationship between zinc and leptin, a beneficial hormone that regulates appetite. Zinc depletion reduces leptin levels, while zinc repletion reverses this effect.

## **FAT CELL FORMATION**

Animal studies suggest that a form of vitamin E (tocotrienol) inhibits pre-fat cells from changing into mature fat cells, resulting in a decrease in body fat. Calcium intake has also been associated with weight loss through its ability to inhibit the formation of fat cells. It also promotes the oxidation, or burning, of fat cells, therefore reducing the risk of obesity.

## **THE EFFECT OF AMINO ACIDS ON BODY COMPOSITION**

Carnitine is an important amino acid that helps muscle cells utilize energy and burn calories. Evidence shows that supplementation with carnitine when combined with an exercise program may induce positive changes in body composition by reducing visceral adiposity (belly fat) more efficiently than without supplementation. Another amino acid, glutamine, has been shown to reduce fat mass and improve glucose uptake in skeletal muscle, which consequently reduces insulin resistance, a major risk factor that contributes to obesity. Supplementation of the relatively unknown amino acid asparagine can improve insulin sensitivity by increasing the amount of sugar that is taken into muscle tissue to be burned for fuel. It also increases the capacity of muscles to utilize fatty acids for fuel, thus contributing to more efficient energy production and reduced obesity.

## **OBESITY AND INSULIN RESISTANCE – PARTNERS IN CRIME**

Obesity severely impairs the body's ability to efficiently burn dietary carbohydrates.





This is caused primarily by the body's inability to use insulin, which is the hormone that transports sugars into muscles where they can be used for fuel instead of being stored as fat. Obesity and insulin resistance typically go hand in hand, negatively reinforcing the metabolic abnormalities that cause both. Optimal micronutrient status can help break this negative cycle.

For example, vitamin K supplementation can reduce the progression of insulin resistance since vitamin K dependent proteins are present in liver and pancreas – two organs essential for proper glucose (sugar) metabolism. Lipoic acid has been shown to increase the rate of glucose uptake into muscle cells, which helps a person burn sugars more efficiently.

Several B vitamins play an important role in the regulation of sugar and fat metabolism, which ultimately helps alleviate insulin resistance. Riboflavin (vitamin B2) helps metabolize food into energy, deficiency in vitamin B6 can induce glucose intolerance and biotin, another nutrient B vitamin family is required for the proper metabolism of fats and carbohydrates. In recent studies, the combination of chromium and biotin supplementation significantly improved glycemic control in overweight patients.

Several minerals are necessary for proper insulin function as well, and deficiencies are common in overweight people. Copper deficiency can impair glucose metabolism and increase insulin resistance. The mineral chromium is a cofactor in the major hormone that is necessary for proper sugar metabolism. Recent studies have shown that chromium deficiency could negatively affect the ability to burn glucose effectively, thus contributing to a pre-diabetic or obese state.

### **VASCULAR HEALTH IN OBESITY**

Blood vessels in overweight individuals are typically not as pliable and healthy as normal weight people, due to various inter-related physiologic factors. Vitamin C supplementation has been demonstrated to improve vascular function in overweight people. Similarly, minerals such as magnesium, zinc, calcium and copper have all shown positive effects on blood pressure and vascular health.

Overweight people tend to have high blood pressure, which is exacerbated by vitamin deficiencies. Since so many nutrients (folate, biotin, carnitine, vitamins A, C, E and several minerals) are involved in the maintenance of health blood vessels of both normal weight and overweight people, a comprehensive evaluation of how they are performing in the cells of obese patients is invaluable.

### **OXIDATIVE STRESS AND INFLAMMATION**

Numerous studies link oxidative stress and inflammation with obesity. Visceral adiposity (fat around the belly) is particularly high in dangerous enzymes that cause oxidative stress. Weight loss certainly counteracts this phenomenon and studies show that the amount of weight lost directly correlates to decreases in oxidative stress.

Visceral adiposity also causes inflammation of the liver, which is particularly common in obese people (known as fatty liver). One recent study demonstrated that coenzyme Q10 decreased obesity-induced inflammation of the liver. Similarly, inflammation in blood vessels of obese patients contributes to heart disease and stroke, which can be alleviated in part through proper antioxidant supplementation.

Since oxidative stress contributes to inflammation, and inflammation causes oxidative stress, it is imperative that antioxidant status be optimized, especially in the obese patient. SpectraCell's micronutrient testing measures several specific antioxidants. However, our Spectrox<sup>™</sup> test goes even further – it gives an overall picture of how well all the antioxidants are working together, thus providing invaluable insight on how well the body is fighting oxidative stresses of all kinds.

### **MALABSORPTION ISSUES AFTER BARIATRIC SURGERY**

The impaired ability to absorb nutrients after bariatric procedures routinely causes multiple vitamin and mineral deficiencies in patients. Due to fat malabsorption after bariatric surgery, deficiencies in fat soluble vitamins (A, D, E and K) are extremely common. As is typical with nutrients, they work synergistically. Oleic acid, another nutrient tested by SpectraCell facilitates the absorption of vitamin A from the gut, for example.

Neurological complications such as confusion, impaired muscle coordination, even seizures may manifest after bariatric procedures, due to a lack of B vitamins, especially thiamine. These complications can occur acutely or decades later. A comprehensive evaluation of nutritional status in bariatric patients is critical in maintaining post-op health.

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