



# Selenium:

## Understanding Benefits & Risks

By Gene Bruno, MS, MHS

In this article, we will examine the effects of the trace mineral selenium in the human body. Specifically, we'll take a look at selenium's biological functions, interactions with other nutrients, its role in human health, its intake in the U.S. and the rationale for selenium supplementation. You will also see why it is important to avoid an excessive intake of selenium in order to enjoy its benefits to human health.

### Biological functions

Selenium is essential in small amounts as a trace mineral, but toxic at high levels. As selenocysteine, selenium is incorporated into a number of selenoproteins (selenium-dependent antioxidant enzymes).<sup>1</sup> It is these selenoproteins that are responsible for selenium's biological functions. These selenoproteins protect against free radicals and other damaging reactive oxygen

species, help regulate cell growth and viability, help produce biologically active thyroid hormones, support muscle metabolism, support protein production, support sperm formation, and may be involved in inflammatory and immune responses.<sup>2</sup>

### Interaction With Other Nutrients

In the form of selenoproteins, selenium helps to convert vitamin E<sup>3</sup> and vitamin

C<sup>4</sup> from their oxidized forms back into their non-oxidized/antioxidant forms. Selenium also works with copper and zinc to produce the antioxidant enzyme superoxide dismutase, and with iron to produce catalase.<sup>5</sup> In addition, as selenoprotein selenium works with iodine in the T4 thyroid hormone to the biologically active T3 hormone.<sup>6</sup>

### Human Health

There are a number of areas in which selenium can make a positive contribution toward human health. In the case of diabetes, however, the jury is still out regarding potential harm or benefit. Following is a review of the relationship between selenium and diabetes, and well as other areas of human health where it may make an impact.

**Autoimmune Thyroiditis:** Autoimmune thyroiditis (Hashimoto's thyroiditis) is a disease in which the body sees the thyroid glands and its hormones as threats, resulting in the production of antibodies that target and destroy thyroid cells. Clinical research has demonstrated that three to 12 months of treatment with 200 mcg selenium daily in combination with the medication levothyroxine significantly reduces thyroid peroxidase antibodies by about six to 30 percent more than placebo in patients with thyroiditis after.<sup>7-13</sup> Both sodium selenite and selenomethionine were used as sources of selenium in the research, but doses under 200 mcg daily may not be as effective.

**Cholesterol Levels:** In a randomized, double-blind, placebo-controlled study<sup>14</sup>, patients with relatively low selenium levels received 100 mcg, 200 mcg and 300 mcg of selenium (as high-selenium yeast) daily for six months. Those receiving 100-200 mcg experienced significant reductions in total cholesterol. Patients receiving 300 mcg daily, however, did not. Rather, they experienced a significant decrease in HDL cholesterol (the "good cholesterol"). It is not clear whether selenium supplementation would have the same impact on cholesterol levels in patients with higher selenium levels.

**Diabetes:** Selenium has been shown to activate key proteins involved in the insulin-signal cascade.<sup>15</sup> Furthermore, one study found that selenium status was lower in men with type 2 diabetes than in non-diabetic men.<sup>16</sup> Likewise, in those individuals who had type 2 diabetes for four to six years, lower plasma levels of selenium were found.<sup>17</sup> Inter-

estingly, serum selenium levels were also found to be lower in relatives of diabetic patients, compared to controls.<sup>18</sup> In addition, low selenium and glutathione peroxidase (a selenoprotein) activity observed in diabetic patients is associated with thrombosis and cardiovascular complications<sup>19</sup>, and may be implicated in diabetic nephropathy (kidney disease).<sup>20</sup>

Conversely, other research has reported higher serum selenium levels in type 2 diabetics<sup>21</sup>, and a recent randomized, double-blind, placebo-controlled study in 1,202 men and women found that selenium supplementation (200 mcg/day) was linked to an increase in prevalence of type 2 diabetes.<sup>22</sup> Although the mechanism associated with this increased risk is not understood, it may make sense for individuals at risk for diabetes to limit their daily intake to 100 mcg. Another consideration is that in animal research, supplementation with a form of selenium known as methylselenocysteine (MSC) was associated with an improvement of both blood glucose levels and kidney function.<sup>23</sup> Consequently, it may be wise for diabetics or those at risk to use MSC if they plan to supplement with selenium.

**Immune Response:** In studies of healthy individuals<sup>24,25</sup> and those with head and neck cancer<sup>26</sup> who were supplemented with 200 mcg/day of selenium as sodium selenite for eight weeks showed enhanced immune cell response to foreign antigens compared with those taking a placebo. Research also indicates that selenium plays a role in regulating the expression of cell-signaling molecules called cytokines, which orchestrate the immune response.<sup>27</sup>

**Cancer Cells:** A case-control study within a prospective study of more than 50,000 male health professionals in the U.S. found a significant inverse relationship between selenium status in the body and the incidence of prostate cancer cell development.<sup>28</sup> Individuals whose selenium status was consistent with an average dietary intake of 159 mcg/day of selenium daily had a 65 percent lower incidence of risk of prostate cancer cell development compared to those whose selenium status was consistent with an average intake of 86 mcg/day. Similar results were seen in other studies of examining selenium intake and the incidence of cancer cells from the lung<sup>29,30</sup> and liver.<sup>31</sup>

**Cardiovascular Health:** Promoting selenoprotein activity could help pro-

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mote healthy cardiovascular function by decreasing lipid peroxidation and influencing the metabolism of cell-signaling molecules known as prostaglandins.<sup>8</sup> Research has demonstrated a higher rate of cardiovascular disease in individuals with lower serum selenium levels compared to those with higher levels.<sup>32-34</sup> In a multi-center study in Europe, the lowest levels of selenium status were also associated with myocardial infarction (i.e., heart attack).<sup>35</sup>

**Rheumatoid Arthritis:** Surveys indicate that individuals with rheumatoid arthritis often have reduced selenium levels in their blood.<sup>36,37</sup> In addition, some of these same individuals have a low selenium intake.<sup>38</sup> The rationale for the interplay between selenium and joint function has to do with selenium's antioxidant properties. Consider that the body's immune system naturally makes free radicals that can help destroy invading organisms and damaged tissue, but that can also harm healthy tissue<sup>39</sup> such as joint tissue. As an antioxidant, selenium may help control levels of free radicals in joint tissue<sup>40</sup>, which in turn may help support a healthy inflammatory response.

## Intake & Rationale for Supplementation

Benefits for immune response and reduced incidence of cancer cell development were associated with supplementation of 200 mcg daily of selenium supplementation or 159 mcg daily of selenium from the diet. However, standard dietary intake of selenium in the U.S. is about 100 mcg daily.<sup>41</sup> That means to enjoy these benefits we still need roughly another 50 to 100 mcg of selenium daily. Clearly, this can be achieved through supplementation.

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