Tidsskriftet Tidsskrift for Den norske legeforening

Selenium – a trace element of clinical significance

FROM THE LABORATORY

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Selenium concentration in serum is determined at a few major clinical chemistry laboratories in Scandinavia. Indications for testing are suspected selenium deficiency or toxicity.

It is 40 years since selenium was first mentioned in the Journal of the Norwegian Medical Association (1). At the time, it was known that one enzyme, glutathione peroxidase, was dependent on selenium as a catalytic factor. New

knowledge shows that selenium has several critical physiological functions. There is a total of 25 genes coding for selenocysteine-containing proteins (selenoproteins) (2). Many selenoproteins are enzymes that remove peroxides and protect against oxidative damage. Three deiodinases regulate thyroid hormones. Several selenoproteins are important for calcium transport and protein folding in the endoplasmic reticulum. Selenoprotein P is synthesised in the liver, and transports selenium to peripheral tissues and helps regulate carbohydrate metabolism. Selenomethionine can replace methionine in proteins and thereby constitute an unregulated pool, but all selenium compounds have to be reduced to reactive selenide before incorporation into selenoproteins. Excess selenium is detoxified and excreted in urine, but is toxic in large quantities.

Intake

Cereal products are important sources of selenium. Scandinavia and many parts of Europe have a selenium-poor soil, and the intake is often far below the recommended amount. Finland has been adding selenium to fertiliser since the 1980s, and the selenium status of the population is good. In Norway, the population previously had a good selenium status due to imported food grains from selenium-rich areas, but because of increased cereal self-sufficiency, it has declined (2). Sweden's high degree of cereal self-sufficiency results in a low-level selenium intake.

Clinical significance

There has been little interest in selenium in clinical medicine. Overt selenium deficiency and toxic effects are rare. An endemic cardiomyopathy caused by coxsackievirus 3B, known as Keshan disease, occurring in an area of China severely deficient in selenium, disappeared completely after selenium supplementation (2). There are several indications that low selenium intake and suboptimal status may have a bearing on, for example, impaired immune response, cardiovascular disease (3, 4), cancer (5), developmental disorders of the nervous system (6) and neurodegenerative diseases (7). Of particular interest during the COVID-19 pandemic is the significance of selenium for resistance to RNA viruses and chronic inflammatory conditions (8). Findings from intervention studies on selenium have shown conflicting effects. For example, reduced cardiovascular mortality has been observed among older Swedes with a low selenium status upon selenium supplementation, while in areas with a good selenium status, such as the United States, studies have not shown any effect from supplements (2, 3).

Recommended serum levels

Relevant indications for measuring selenium are cardiovascular disease, thyroid disease, chronic inflammatory conditions, impaired immune function and total parenteral nutrition.

The daily requirement for selenium is set according to a level in which the selenoproteins are optimally expressed, using the plasma concentration of selenoprotein P as an indicator (2, 9), i.e. ≥ 1.25 µmol/L (≥ 100 µg/L) (Figure 1). The reference range 0.8–1.6 µmol/L (63–126 µg/L) only reflects the level in the population. Nevertheless, these levels are used as recommended normal levels in Norway's national user manual in medical biochemistry (*Nasjonal brukerhåndbok i medisinsk biokjemi*). The Swedish reference range is even lower at 0.7–1.2 µmol/L (55–95 µg/L). The laboratories should set recommended levels that are in accordance with the nutritional requirements. A tolerable upper intake level of 300 µg selenium from food and supplementation of organically bound selenium corresponds to a plasma concentration of about 3.0 µmol/L (2).

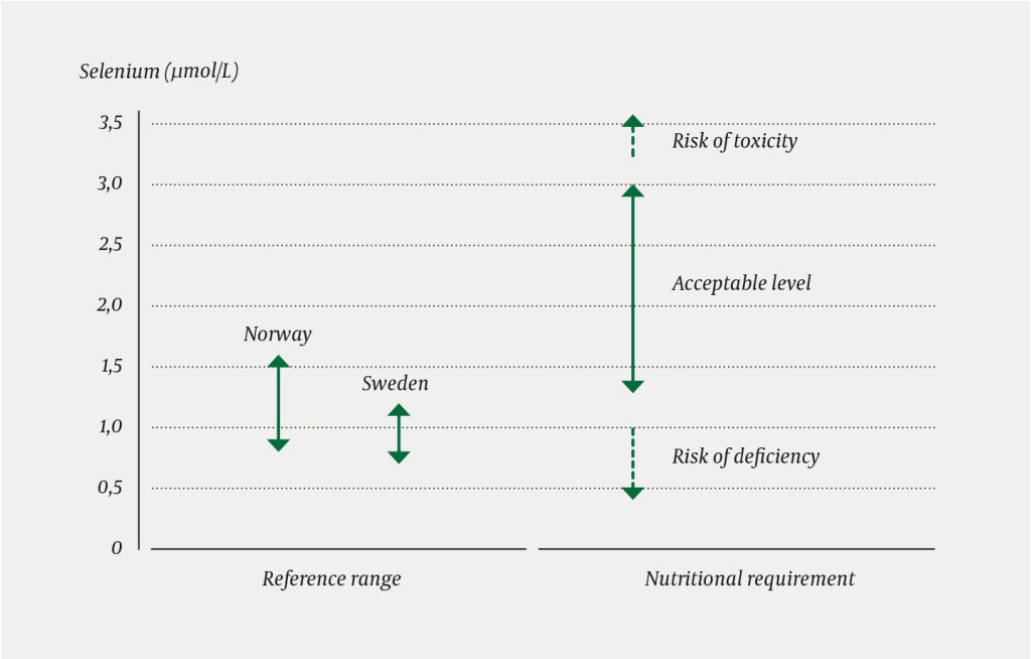

Figure 1 The left side of the figure shows reference ranges for serum/plasma concentration of selenium at hospital laboratories in Norway and Sweden, and the right side shows serum concentration based on the nutritional requirement for selenium.

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Publisert: 23 November 2020. Tidsskr Nor Legeforen. DOI: 10.4045/tidsskr.20.0675
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