LETTER TO THE EDITOR

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Selenium's Role on Thyroid Autoimmunity and Cognitive Dysfunction in Elderly

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Abstract

Selenium is a trace element essential for the human body. The amount of this element, which is found in nature and in the human organism, varies depending on the geographical region and intake with food. Selenoproteins play an important role in maintaining the immune system, antioxidant system, hormone synthesis and living metabolism. Selenium can affect thyroid autoantibodies in autoimmune thyroid diseases and participate in the biosynthesis of thyroid hormones in the body. There are also studies showing that selenium is a protective factor for cognitive dysfunction, especially for the elderly population.

Keywords: Aging, clinical geriatrics, cognitive disorders, selenium, thyroid autoimmunity

Dear Editor,

Selenium in the Human Organisms

Selenium (Se) is a micronutrient first described in 1817; the name Se is derived from the Greek word "Selene", which means moon, by analogy with the shiny and gray appearance of this compound when melted. Se levels in the body depend on population characteristics, nutrient intake, and primarily on the composition of the surrounding soil in the living region (1). Se is an essential bioelement required for the functioning of all organisms. The optimal daily dose of Se has been determined as 55 µg. Se is found in trace amounts in the human organism and normal plasma serum Se levels vary between populations due to many factors (2-4). Skeletal muscles in the body are the main organs containing 46.9% of the total content of Se, while the kidneys contain only 4% of Se. The indicator of Se sufficiency is serum Se concentration of 60-120 ng/mL. The maximum Se concentration is reached in adulthood. The concentration of this element in the serum gradually decreases after the age of 60 (5,6). An excess of Se can cause severe anemia, hair loss, and the development of blindness. The ideal Se level in the organism is in a very narrow range. The recommended daily dose of Se is different depending on the geographical region, as we mentioned earlier. The World Health Organization recommends a daily dose of 55 µg of Se for adults. In addition, a daily dose of 400 µg is considered safe in terms of side effects. The Food and Nutrition Board in the USA has recognized that the amount of Se needed varies with age and is 40-70 µg for adult men and 45-55 µg for adult women (7). The recommended daily dose for children is 25 µg (Table 1) (8).

The main sources of Se in the diet are foods such as grains, meat and dairy products, fish, seafood and nuts. Fruits and vegetables contain relatively low Se. The Se content in 100 grams of some foods using the US department of agriculture database is given in Table 2 (9).

The Importance of Se in Biologically Active Compounds and Thyroid Autoimmuniy

Glutathione peroxidase, selenoprotein P, and thyroxine 5-deiodinase are selenoenzymes commonly found in mammals. Glutathione peroxidase and selenoprotein P catalyze redox reactions and have antioxidative effects (10). Glutathione reductase is another Se-containing enzyme. This enzyme is involved in the decomposition of organic peroxides and hydrogen. Glutathione reductase is responsible for maintaining the appropriate level of reduced glutathione to protect cells from

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peroxide accumulation and damage (11). Se aids in the proper synthesis, activation and metabolism of thyroid hormones. This enzyme is responsible for the conversion of thyroxine (T4) deiodation to its active form known as 3,3,5-triiodothyronine (T3) or the inactive form-rT3 isomer. Deiodination occurs in peripheral tissues, particularly in the kidneys, liver, and skeletal muscles. This process can be disrupted by a lack of Se in the organism. This indicates the important role of Se in the metabolism of thyroid hormones. Therefore, it is useful to consider the levels of this element in the presence of thyroid diseases (12). Se acts synergistically with vitamin E. There are studies showing that the synergistic effect of Se and vitamin E helps to protect organs against the destructive effects of free radicals (13). Low Se levels have been found in the African region of Zaire, where myxoedema is endemic. To gain a clear understanding of the role of Se, study was planned with a group of students in Zaire. After Se supplementation, increased serum thyroxine and decreased triiodothyronine concentrations were detected in the students (14). There are studies showing that low Se intake is associated with the risk of developing antithyroid antibodies. There are also publications showing that Se supplementation can reduce antithyroid antibody titers (15). Furthermore, in the presence of autoimmune thyroid disease, there is the possibility of a potential reduction in the required levothyroxine replacement dose for hypothyroidism and/or preventing the progression of subclinical hypothyroidism, but not all studies agree with this conclusions (16). There is still no high-quality level of evidence for its use except from the treatment of mild Graves' orbitopathy (17). Therefore, more studies are needed to confirm the effect of Se in autoimmune thyroid diseases.

Table 1. Recommended daily intake of selenium

Age (years)	Selenium (µg/day)
1-3	15-20
4-13	30-40
14-50	55-70
51 +	70-100

Table 2. Selenium contents of foods

Foods	Selenium (µg/100 gr)
Brazil nuts (selenium enriched)	1917.6
Tuna (fresh, dry-heat cooked)	108.2
Oysters (raw)	76.9
Mussels (steamed)	64.0
Flounder (dry-heat cooked)	55.4
Shrimp (steamed)	49.5
Salmon (dry-cooked)	46.8
Noodles (enriched and cooked)	20.6
Crab (steamed)	44.3
Beef (lean, steamed)	36.0
Chicken meat (baked in the oven)	30.3
Rice (brown, long grain, cooked)	10.3
Sunflower seeds (dry)	53.0
White bread	28.8
Milk (skimmed)	16.3

Cognitive Dysfunction and Se

The difficulty of precisely measuring dietary Se is one of the main problems in studies. In addition, the fact that the Se content in the soil is different in different regions, the lack of specific food composition tables for this trace element in many countries, the loss of up to 40% by evaporation, and the varying amounts due to cooking/processing of foods make it difficult to provide standardization in studies (18). Unfortunately, data on Se levels and disease associations in the elderly patient population are very rare. However, some studies of age-related differences in Se concentration show that Se concentrations are lower in older adults than in younger adults (19). In a study which is conducted with 219 healthy patients with the 20 years folow up period and 58.32 median age at baseline it was shown that Se concentrations decreased significantly during aging reagardless of gender. Average Se concentrations dropped from 85.19 (17.15) µg/L to 79.28 (17.69) µg/L after about 20 years (20).

Studies on the relationship between trace elements and cognitive function are limited and there is some controversy. Although Se is shown as a protective factor for cognitive dysfunction in most studies, there are results that argue the opposite. In a study conducted with 1006 patients in the geriatric population with a mean age of 71 in 2022, lower levels of whole blood Se were found in patients with mild cognitive impairment than in healthy individuals. Especially in female patients, this difference was more pronounced (21). In another study with a 9-year follow-up, cognitive decline was associated with a decrease in plasma Se over time. The greater the reduction in plasma Se, the greater the likelihood of cognitive decline. However, no relationship was found between short-term 2-year Se changes and cognitive changes (22). In another study conducted in Australia, Se concentration was not found to be associated with cognitive performance in older adults. However, it was suggested that this lack of association may be due to optimization of selenoprotein synthesis as a result of adequate Se intake in the study population (23).

In conclusion, serum Se level and dietary Se are directly related, and a desired serum Se level can play a role in preventing many chronic diseases, including autoimmune thyroid diseases. In this letter, we wanted to present evidence and raise awareness about these situations. But it is clear that high-quality evidence is needed. Rich sources of Se, such as oilseeds, nuts, chicken, fish, turkey, seafood, cereals and eggs, should be taken daily with

an adequate and balanced diet. The ideal reference ranges for Se concentrations in various geographic regions are not clear, and thyroid tissue-specific biomarkers need to be identified for functional evaluation of Se. There is a decrease in Se levels with aging, and this decrease in particular has been associated with a decrease in cognitive functions.

Ethics

Peer-review: Externally peer-reviewed.

Authorship Contributions

Concept: G.S., Y.B., Design: G.S., Y.B., Data Collection or Processing: G.S., Y.B., Analysis or Interpretation: G.S., Y.B., Literature Search: G.S., Y.B., Writing: G.S., Y.B.

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