Minerals and trace elements in nutritional supplements

Jacqueline van Schoor
M. Pharm.
Amayeza Info Centre

The diets of many Westernised people are considered poor in nutritional quality – low in fruits, vegetables and whole grains and high in fat and sugar. Western diets increase the risk of four of the top 10 major causes of death – i.e. heart disease, certain forms of cancer, stroke and type 2 diabetes.

On the other hand, under-nutrition and a lack of varied and quality food sources is a major problem in developing countries, including South Africa. However, people in developing countries who have adopted a more Western diet show an increasing incidence of the above lifestyle and diet-related diseases.

Although supplementation with a multivitamin and mineral combination product is a consideration, especially for certain patient populations at greater risk of dietary deficiencies e.g. pregnant women, obtaining the essential micronutrients (i.e. vitamins and minerals) from food sources is still believed to be the best approach to good nutrition.

The interactions and interrelationships between the different micronutrients are complex. The ratios of one mineral to another can be beneficial or antagonistic, for example:
- High levels of zinc consumption impair copper absorption
- Zinc absorption is impaired by high intakes of iron

It is evident that singling out a particular micronutrient for higher or lower intakes can cause a cascade of events that may interfere with the optimal metabolism and absorption of other nutrients. This may explain the conflicting clinical research results that examine supplementation of single nutrients.

How then should health professionals address the issue of micronutrient supplementation? This brief review illustrates the roles of various minerals and trace elements in the diet and provides the latest information on the recommended daily allowances for these micronutrients as contained in foods and food supplements.

More about minerals and trace elements

Like vitamins, minerals and trace elements are critical in numerous metabolic processes in the body. Dietary minerals classified as "macromineral" are required in relatively large amounts (e.g. sodium, potassium, calcium, magnesium, iron, phosphorous, chloride). Conversely "microminerals" or "trace elements" (e.g. copper, iodine, chromium, manganese, selenium, fluoride) are required in relatively small amounts.

Deficiencies in certain minerals and trace elements are common in certain populations throughout the world. Calcium, iron, zinc, copper, chromium, fluoride, selenium and iodine deficiencies are the most prevalent mineral deficiencies.

Minerals and trace elements can be toxic when consumed in excess, but the body has several defense mechanisms that help protect against toxicity e.g. limited absorption, excretion of excess intake and deposition in bone. For most minerals and trace elements, toxic levels are unlikely to occur from dietary sources and more often are associated with dietary supplementation and environmental sources.

Furthermore, some minerals are contraindicated in patients with certain disease conditions. For example, patients with hypertension need to limit sodium intake while individuals with impaired kidney function are at higher risk of magnesium and potassium toxicity.

Mineral bioavailability – the amount consumed versus the amount absorbed and available for use by the body – is an important consideration and is influenced by several factors such as:
- Physiological need
- The source of the mineral – minerals from animal sources are usually more bioavailable than those from plant sources

Mineral to mineral and vitamin to mineral interactions
- Mineral to mineral and vitamin to mineral interactions
- The amount of fibre in the food source

Taking minerals and trace elements – The Recommended Daily Allowances

(See table 2) The May 2003 report of the UK ‘Expert Group on Vitamins and Minerals’ determined doses of vitamins and minerals that individuals could take daily on a life-long basis in reasonable safety. The setting of these levels provides a framework within which the consumer and the health professional can make an informed decision about supplemental micronutrient intake, having the confidence that harm should not ensue.

In summary

Mineral and trace element supplementation is included in some dietary recommendations, especially for certain patient populations. However, obtaining the essential micronutrients directly from healthy food sources remains the best approach to good nutrition.

Table 2 Recommended daily allowances of minerals and trace elements

(Adapted from Jobson 2003 & Prudence 1996)

<table>
<thead>
<tr>
<th>Mineral/Trace element</th>
<th>Recommended daily allowance (RDA) for persons older than 10 years</th>
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<tbody>
<tr>
<td>Calcium</td>
<td>800 – 1100 mg</td>
</tr>
<tr>
<td>Phosphorous</td>
<td>800 – 880 mg</td>
</tr>
<tr>
<td>Magnesium</td>
<td>300 – 350 mg</td>
</tr>
<tr>
<td>Potassium</td>
<td>Not specified</td>
</tr>
<tr>
<td>Iron</td>
<td>14 mg</td>
</tr>
<tr>
<td>Zinc</td>
<td>15 mg</td>
</tr>
<tr>
<td>Iodine</td>
<td>150 mcg</td>
</tr>
<tr>
<td>Selenium</td>
<td>0.055 mg</td>
</tr>
<tr>
<td>Copper</td>
<td>Not specified</td>
</tr>
<tr>
<td>Chromium</td>
<td>Not specified</td>
</tr>
<tr>
<td>Cobalt</td>
<td>Not recommended</td>
</tr>
<tr>
<td>Manganese</td>
<td>Not specified</td>
</tr>
</tbody>
</table>
### Table 1: Role of key minerals and trace elements in the body

<table>
<thead>
<tr>
<th>Mineral</th>
<th>Physiological role in the body</th>
<th>Comments</th>
</tr>
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| Sodium  | • Major electrolyte responsible for regulating water balance | • 80% of dietary sodium in Western diets comes from processed food  
• Over consumption may lead to water retention and increased blood pressure  
• Excess sodium may increase calcium excretion and bone turnover – relevant for postmenopausal women at risk of osteoporosis |
| Potassium | • Nerve and muscle function | • Increased potassium intake reduces the negative effects of excess sodium |
| Chloride | • Electrolyte balance | • The negative ion involved in maintaining pH and electrolyte balance |
| Calcium | • Bone mineralisation  
• Tooth formation  
• Blood clotting  
• Nerve and muscle function  
• Normal heart rhythm | • About 99% of total body calcium is found in bones and teeth  
• Insufficient calcium is associated with reduced bone mass density  
• Bioavailability of calcium is reduced by aging, poor vitamin D status and menopause  
• Inadequate intake of calcium is common in Western diets  
• Pre- and post-pubertal children require more calcium than other age groups to ensure proper bone mineralisation during peak growth periods |
| Phosphorous | • The second essential mineral primarily involved in bone formation  
• Energy production  
• Acid-base balance | • Works in conjunction with calcium  
• 85% of total body phosphorous is found in the skeleton |
| Magnesium | • Bone and tooth formation  
• Nerve and muscle function  
• Enzyme activation | • The majority of magnesium in the body is found in bone |
| Iron | • Formation of enzymes  
• Main component of red blood cells and muscle cells  
• Strengthens immune system | • Iron absorption is influenced by food source, the form of iron and the body stores  
• Iron intake is often inadequate in infants and young children, adolescents, women in child-bearing years and pregnant women  
• In addition to anaemia, iron deficiency can result in impaired cognitive performance, impaired immune function and reduced resistance to infection  
• Excess iron is toxic, causing vomiting, diarrhoea and damage to the intestine |
| Zinc | • Component of several enzymes and insulin  
• Wound healing  
• Growth and development of sexual organs  
• Healthy skin | • Zinc is not stored in large amounts within tissues and daily supplies are important |
| Copper | • Component of enzymes  
• Formation of red blood cells  
• Bone formation | • Excess consumption of zinc leads to copper deficiency as does over consumption of antacids |
| Selenium | • Facilitates anti-oxidant actions  
• Facilitates iodine metabolism | • Reduces the body’s need for vitamin E  
• The presence of selenium in food depends on soil conditions. In geographical areas where soil is depleted of selenium, supplementation may be necessary  
• Selenium supplementation may increase sperm motility in individuals with low selenium status |
| Iodine | • Critical to proper functioning of the thyroid gland | • Like selenium, food content of iodine varies widely according to soil composition  
• Nearly 80% of iodine in the body is found in the thyroid gland  
• Iodine deficiency is problematic in developing countries  
• Iodide is added to some commercial salt – iodised salt |
| Chromium | • Plays a role in insulin and carbohydrate metabolism | • Chromium deficiency is difficult to determine  
• There is some evidence of a relationship between chromium status and type 2 diabetes mellitus  
• Diabetes and coronary heart disease may increase the need for chromium  
• Chromium in the form of chromium picolinate may have the potential to cause cancer – Consumers are advised not to take chromium in this form |
| Manganese | • Component of enzymes  
• Facilitates anti-oxidant actions | • Manganese levels are lower in women with osteoporosis  
• Manganese is essential for enzymatic activity required for bone formation  
• Bone mineral density improves when trace minerals including manganese are added to calcium supplements  
• Excess supplementation should be avoided as more than 11mg/day may cause neurotoxicity |
| Fluoride | • Bone and teeth formation | • Reduces bacterial growth in the mouth and tooth demineralisation leading to dental caries |
| Cobalt | • Component of vitamin B₁₂ | • If the vitamin B₁₂ status of an individual is adequate, there is no additional need for cobalt in the diet |