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Serum Essential and Non-Essential Metal(loid)s Concentrations and Their Relationship with Metabolic Syndrome in a Slovenian Cohort

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The rising prevalence of metabolic syndrome (MetS) is a major public health concern, driven by increasing obesity rates and declining physical activity. MetS is defined by a cluster of metabolic abnormalities, including abdominal obesity, dyslipidemia, hypertension, and hyperglycemia. While unhealthy lifestyles are well-established risk factors, emerging evidence suggests metal exposure may also contribute to MetS development.

Recent studies link non-essential metal(loid) exposure to higher obesity and MetS risk. Metal(loid)s are found in food, water, soil, dust, and consumer products. They are categorized into three groups: i) essential (e.g., sodium, calcium, magnesium, potassium, iron, copper, chromium, selenium, cobalt, molybdenum, zinc); ii) probable-essential (e.g., manganese, nickel); iii) non-essential (e.g., aluminium, arsenic, cadmium, lead, antimony). The impact of essential and probable-essential metal(loid)s on MetS remains unclear. While these elements play vital roles in metabolism, deficiencies and excess levels can have negative effects. Some studies suggest links between essential metal(loid)s, such as copper, chromium, magnesium, manganese, and iron, and conditions like MetS and diabetes.

Given limited high-quality studies and inconsistent findings, this research explored associations between metal(loid) exposure and MetS in 100 middle-aged Slovenian adults with different dietary patterns. It examined the predictive effects of essential, probable-essential, and non-essential metal(loid)s on MetS and its components.

Findings showed that body composition and biochemical measurements were influenced by essential and non-essential serum elements. After adjusting for sex, age, diet, physical activity, and BMI, only copper, zinc, magnesium, manganese, and molybdenum remained significantly associated with MetS. Participants with MetS had higher serum concentrations of aluminium, copper, calcium, selenium, zinc, molybdenum, antimony, and arsenic, while potassium and cobalt levels were lower. Differences in serum metal(loid) levels were also observed between individuals with no MetS components and those with one or two components. Despite higher aluminium and antimony levels in MetS participants, no strong correlation was found after adjustments, likely due to low exposure.

Since blood metal levels reflect recent exposure rather than total body burden, longitudinal studies are needed to clarify the causal relationship between non-essential metal exposure and MetS risk.