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Trace elements and minerals in autism spectrum disorder theranostics

Prof. Anatoly V. Skalny
skalny3@gmail.com
MD, PhD, DSc, prof.

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ABSTRACT

The objective of a series of studies was to evaluate trace element and mineral metabolism in children with autism spectrum disorder (ASD) in relation to disease severity, and metabolic profile to estimate the potential therapeutic targets. More than 2000 children with ASD and 2000 sex- and age-matched controls were examined. We revealed low serum Zn, increased Cu/Zn ratio, low Mg, increased serum Se, Fe, and Mn in the Russian children with ASD, whereas in hair a trend to reduced trace element levels was observed. In Russian children with ASD no significant increase in toxic metal body burden, whereas in the examined cases from Saudi Arabia and Taiwan the levels of toxic metals including Hg and Pb exceeded the control values. Different patterns of metal accumulation in children with ASD from different regions may be at least partially mediated by polymorphisms in genes involved in detoxification processes. Multiple regression analysis revealed a significant association between the presence of psychopath-like syndrome and serum Fe and hair Fe (inverse), speech development delay and hair Cu and serum Co (positive), infantile psychosis and hair Zn content (inverse). The association between metal(loid) and trace element levels in autism and catatonia was also revealed. The levels of trace elements and minerals in hair and serum was associated with CARS values. We also revealed a significant relationship between serum trace element and mineral levels with neuroinflammatory markers. It has been demonstrated that Mg levels were characterized by inverse, whereas that of Fe and heavy metals, especially Cd, by direct association with neuroinflammation in ASD patients. Furthermore, a significant association between circulating trace elements and amino acid levels was observed, with the most profound relationship between hydroxyproline, Se (negative) and As (positive), phosphoserine, Se and Co (positive), taurine, Cr (positive) and Fe (negative), as well as glutamate/glutamine ratio with Mn and Mg. These findings demonstrate that impaired trace element and mineral metabolism in children with ASD may significantly contribute to neurotransmitter dysregulation, neuroinflammation, and connective tissue pathology, altogether resulting in the relation with clinical severity of ASD. The obtained data was used for development of predictive models for evaluation of disease severity.