Is Increasing Environmental Exposure to Manganese Disturbing the Delicate Balance of an Essential Element?

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ABSTRACT

It has often been stated that since manganese (Mn) is an essential element, low level environmental exposure would not have deleterious effects. But what is the biological basis for this statement? Indeed, contrary to xenobiotics, such as lead and mercury, Mn is required in a very large number of physiological functions. However, like other essential elements, the organism's needs are very precise; persistent increases or decreases may upset the delicate balance and interfere with normal functions. As our knowledge on Mn is increasing, new evidence points to the necessity for precaution. Four issues will be discussed here:

i) Bypassing homeostatic controls: Ingested Mn is subjected to homeostatic controls, which are not present for other entry routes. The apparent contradiction between findings of Mn-related neurofunctional deficits and previous theoretical estimates of body burden from workplace and/or environn. exposures are better understood in light of the animal studies demonstrating that olfactory uptake can provide a direct route to the brain, increasing Mn levels in the olfactory lobe and other areas with high Mn affinity.

ii) Optimum Mn levels for biological functions: Since Mn is an essential element, there is most likely an optimal level for optimum functioning. On the larger scale, Mn deficiency and excess Mn can produce neurological disorders. On smaller scale, subtle changes can occur with minor increases or decreases. In our studies of a community without occupational exposure to Mn,, we have observed an inverted U-shaped response between olfactory perception threshold and MnB, with hyperosmia at lower and higher MnB concentrations. These results confirm previous workplace studies linking Mn exposure and enhanced olfactory threshold.

iii) Gender and age differences in Mn requirements. MnB increases during pregnancy and newborns have high MnB levels, which decrease with age. Adult women have higher levels compared to men. For women, MnB levels peak at 30y and then decrease with age, with the exception of menopausal women using hormonal therapy, for whom MnB remains high. For men, the highest concentrations are observed above 60y.

iv) Gender and age differences in Mn effects. Studies that shown that Mn-related neurofunctional deficits are more evident in men than in women. Moreover, older persons (≥50y) present more Mn-related deficits as compared to younger persons.

These findings suggest that because Mn is an essential element, increases in environmental exposure may have unsuspected and possibly long-lasting effects.