

Manganese exposure among smelting workers: relationship between blood manganese-iron ratio and early onset neurobehavioral alterations.

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A biomarker for detection of early onset neurobehavioral alterations in manganese remains unknown. The purpose of this study was to use a neurobehavioral test battery to identify subtle changes in Mn-induced motor and memory dysfunction and to relate the quantifiable neurological dysfunction to an established Mn-exposure index such as blood manganese-iron ratio (MIR). A total of 323 subjects were recruited to control (n = 106), low-exposure (122), and high-exposure (95) groups. The test battery consisted of standard testing procedures including the nine-hole and groove-type steadiness tester, Benton visual retention test, and Purdue pegboard coordination test. No significant health problems or clinically diagnosed neurological dysfunctions were observed. Benton test did not reveal any abnormal memory deficits among Mn-exposed smelters, nor did the groove and nine-hole tests detect any abnormality in dynamic and static steadiness in tested subjects. Purdue pegboard test showed a remarkable age-related decline in fine movement coordination among all study participants regardless of the Mn-exposure condition. Mn exposure significantly exacerbated this age-related deterioration. Statistical modeling revealed that the plasma and erythrocyte MIR (i.e., pMIR and eMIR, respectively) were associated with Purdue pegboard scores. Among all subjects whose MIR were above the cut-off value (COV), pMIR was significantly correlated with pegboard scores ($r = -0.261$, $p = 0.002$), whereas for those subjects over the age of 40, the eMIR, but not pMIR, was associated with declined pegboard performance ($r = -0.219$, $p = 0.069$). When both factors were taken into account (i.e., age > 40 and MIR > the COV), only pMIR was inversely associated with pegboard scores. Combining their usefulness in Mn-exposure assessment, we recommend that the blood Mn-Fe ratio may serve as a reasonable biomarker not only for assessment of Mn exposure but also for health risk assessment.

Keywords: Manganese, Manganese-iron ratio, Early onset neurobehavioral alterations, Exposure assessment