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ABSTRACT

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Human neurobehavioral effects of mercury

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To assess early effects on the Central Nervous System due to occupational exposure at low levels of inorganic mercury (Hg), a multicenter nation-wide cross-sectional study was planned, including workers from chloro-alkali plants, chemical industry, thermometer and fluorescent lamp manufacturing. The contribution of non-occupational exposure to inorganic Hg from dental amalgams and to organic Hg from fish consumption was also considered.
Neuropsychological and neuroendocrine functions were examined in a population of 122 workers occupationally exposed to Hg, and 196 control subjects, not occupationally exposed to Hg. Neuropsychological functions were assessed with neurobehavioral testing including vigilance, motor and cognitive function, tremor measurements, and with symptoms concerning neuropsychological and mood assessment. Neuroendocrine functions were examined with the measurement of prolactin (PRL) secretion. The target population was also characterized by the surface of dental amalgams and seafood consumption.
In the exposed workers the mean urinary Hg (HgU) was 10.4±6.9 (median 8.3, geometric mean 8.3, range 0.2-35.2) μg/g creatinine, whereas in the control group the mean HgU was 1.9±2.8 (median 1.2, geometric mean 1.2, range 0.1-33.2) μg/g creatinine. The results indicated an homogeneous distribution of most neurobehavioral parameters among exposed and controls. On the contrary, finger tapping (FT) ($p < 0.01$) and the BAMT (Branches Alternate Movement Task) coordination test ($p < 0.05$) were associated with the occupational exposure, indicating an impairment in the exposed subjects. PRL levels resulted significantly decreased among the exposed workers, and inversely related to HgU on an individual basis ($p < 0.05$). An inverse association was also observed between most neuropsychological symptoms and seafood consumption, indicating a "beneficial effect" from this type of fish. On the contrary, no effects were observed as a function of dental amalgams.
After the first evaluation of the relationship between mercury exposure and each indicator of effect, further assessment was performed according to a "latent variable" approach. Two latent variables "exposure" and "effect" were identified, integrating respectively the different forms of exposure (occupational, due to dental amalgams and fish eating) and the indicators of effects on the Central Nervous System that resulted to be associated to mercury in the preliminary analysis (FT, BAMT, PRL). Other effects on the renal function, such as decreased β_2 micro-globulin (β_2MG) concentrations, and on the immunitary system, such as decreased interleukin (sIL8) levels, that were also found to be associated to mercury in this research, were considered in the model, together with possible confounding factors including age, body mass index and alcohol. This further analysis showed that an inverse association of occupational exposure to mercury with PRL and BAMT, with Hg-U mediating the effect on PRL, was predominant with respect to the other form of mercury exposure, the other indicators of effect, and the confounding factors.
In conclusion, this study supports the finding of alterations of neuroendocrine secretion and motor cohordination at very low occupational exposure levels of inorganic mercury, below the current ACGIH Biological Exposure Index. These changes seem to occur at lower levels than other subtle effects on the renal function and the immunitary system. Dental amalgams and small-size fish eating, on the contrary, do not seem to contribute to any adverse effects at these exposure levels.