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MANGANESE NEUROTOXICITY: PRELIMINARY RESULTS OF A FOLLOW-UP STUDY ON PREVIOUSLY EXPOSED WORKERS

R. Lucchini (1), D. Mergler (2), S. Bélanger (2), F. Larribe (2), M. Baldwin (3), M. Panisset (4). (1): Institute of Occupational Health University of Brescia, Italy (2): CINBIOSE, Université du Québec Montréal, Québec (3): Concordia University, Montréal, Québec (4): McGill University, Montréal, Québec.

Aim: To assess, four years after plant closure, the evolution of neurobehavioral symptoms and the presence of parkinsonism in workers previously exposed to manganese in a ferro and silico manganese alloy production plant.

Methods: A questionnaire was sent to 115 workers and 145 referents, who had participated in a previous study carried out in 1990, prior to plant closure. The questionnaire included a) an update of job history and non-occupational exposures to neurotoxins, personal life and habits and health problems; b) the symptom checklist from the previous study; c) questions screening for parkinsonism.

Results: The participation rate was 77.6%, with 6.1% refusals. Mean age was 48y (SD 6.2) for the workers and 47.5y (SD 7.2) for the referents. Personal life and habits had not changed during the past years, however the workers' socioeconomic status had worsened. While in 1990 the workers' total symptom score (TSS) was significantly higher than the referents' (58.2 vs 48.8; $p < 0.001$), in 1995, the inter-group TSS reporting was similar (56.6 vs 57.4), although symptoms of memory loss and peripheral tingling and numbness were still reported significantly more frequently by the workers. Trends towards the same direction were also observed for hand tremor and articular pain. Symptoms of parkinsonism were reported by 7 workers (9.26%) and 4 control subjects (3.64%) (NS).

Conclusions: Memory loss, peripheral tingling and numbness and maybe hand tremor and articular pain may be best representative of stable impairment related to long-term exposure to manganese. Increased symptom reporting by the referent group could be related to other workplace factor(s). Symptoms of parkinsonism are higher than expected in this population.

STUDY ON NEUROTOXIC EFFECTS IN MANGANESE FERRO-ALLOY INDUSTRY

Carrer P.¹, Maroni M.^{1,2}, Cavallo D.¹, Cassitto M.G.¹, Garattini S.³, Gilioli R.¹
¹ "Clinica del Lavoro L. Devoto" ICP and Institute of Occupational Health University of Milan, Italy. ² International Centre of Pesticide Safety, Busto Garolfo, Italy. ³ Local Health Unit of Breno, Italy.

OBJECTIVE. To assess the consequences on the nervous functions of long-term exposure to metals in workers of manganese ferro-alloy industry.

METHODS. The study was conducted on 125 workers of three manganese ferro-alloy plants and 46 controls of plants without exposure to neurotoxic chemicals. Environmental and biological monitoring were made to assess metal exposure. Subjective symptom questionnaire, Webster scale for extrapyramidal signs, visual and auditory Brain Evoked Potentials, Conduction velocity of the median nerve, Neurobehavioral tests (MANS automated battery) and Vocabulary test were evaluated for all subjects.

RESULTS. The foundry workers were grouped into highly exposed and low exposed (median air manganese concentration respectively 414 and 48 $\mu\text{g}/\text{m}^3$). The median manganese concentration in blood was 1.2 $\mu\text{g}/100\text{ ml}$ in high exposed, 0.7 $\mu\text{g}/100\text{ ml}$ in low exposed and 0.6 $\mu\text{g}/100\text{ ml}$ in controls. Urinary manganese concentration were higher than 1 $\mu\text{g}/\text{l}$ in exposed subjects, and equal to 0.3 $\mu\text{g}/\text{l}$ in the control group; a statistically significant correlation between air manganese concentration and post-shift urinary manganese concentration was observed ($r=0.60$ $p < 0.05$). The highly exposed workers also showed a remarkable exposure to lead (median concentration 48.5 $\mu\text{g}/\text{m}^3$; median blood concentration 38 $\mu\text{g}/100\text{ ml}$). Highly exposed workers more frequently complained symptoms related to the nervous system, showed some significant differences at the neurological examination (particular tremor) and a worse performance in neurobehavioral tests than the low exposed workers and the controls. No significant differences were noted on the electrophysiological testing.

CONCLUSION. Some symptoms related to nervous system, signs indicative of extrapyramidal disorders and reduction of neurobehavioral performance seem to be associated with exposure to manganese and lead in ferro-alloy workers.

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ASSESSMENT AND CONTROL OF LEAD HAZARD IN SMALL-SCALE INDUSTRIES IN THE RURAL AREA

Liang, Y.X., Yang, H.G., Wang, Y.L., Chen, Z.Q., Li, P.J.
School of Public Health, Shanghai Medical University,
Shanghai 200032, P.R. China

To assess health risks of lead exposure in small-scale industries (SSIs) and explore the appropriate control technology, an intensive study was conducted in small-scale lead industries in the suburban area of Shanghai.

Methods. Ten lead battery manufacturing factories and 1 smeltery with 196 lead-exposed workers, and 124 well-matched controls were investigated. The grab sampling, and blood lead (Pb-B), zinc protoporphyrin (ZPP), routine medical examination and the WHO-Neurobehavioral Core Test Battery (NCTB) were applied to the survey. In addition, assessment of ambient lead pollution in the surrounding area and its residents' health, as well as a cost benefit analysis for the control technology were also included.

Results. 130 of the 239 air samples (54.4%) were found higher than the MACs currently adopted in China. Worksites with highly Pb-producing process, such as smelting, reconditioning, assembling, welding, coating and mixing, were found to be the processes with higher risk. The average PbB level of workers in smeltery was over 50 $\mu\text{g}/\text{dl}$. Despite that most of the Pb-exposed workers surveyed were characterized with insidious symptoms and signs, the prevalence of certain type of relevant syndromes were positively associated with lead exposure. Decreased scores obtained from half of the NCTB subtests were observed in Pb-exposed group. The ambient air lead levels and lead in vegetables were 6 to 27 and 0.4 to 5.8 times of the relevant standards, respectively. The effectiveness of the selected control technologies have been satisfied in improving work environment and workers' health. The ratio of the benefit to the cost reached 2.88.

Conclusion. Health and environmental problems were profound in small-scale lead industries due to poor production process and lack of control measures. However, the low cost and simplified control technology was proved to be effective and appropriate for SSIs.

LEAD LEVELS CUMULATIVE BLOOD AND NEUROBEHAVIORAL TEST PERFORMANCE

Chia, S.E., Chia, H.P., Ong, C.N., Jeyaratnam, J.
Department of Community, Occupational & Family Medicine, National University of Singapore, Lower Kent Ridge Road, Singapore 0511.

Objectives. To compare the neurobehavioral test performances of a group of lead exposed workers and a referent group; and to study the association of the neurobehavioral test performances with the present blood lead levels, and cumulative blood lead-years levels results.

Materials and Methods. 50 lead battery workers and 97 non-exposed (referent) workers from a vehicle maintenance workshop were evaluated on their neurobehavioral performance using the World Health Organisation Neurobehavioral Core Test Battery (WHO-NCTB) and 37 symptoms questionnaire. The geometric mean present blood lead of the exposed (PPb) and referent were 37.1 (range 13.2 - 64.6) $\text{mg}/100\text{ml}$ and 6.1 (range 2.4 - 12.4) $\text{mg}/100\text{ml}$, respectively. Cumulative blood lead index (CBI) of 47 workers' previous blood lead levels (3 workers previous blood lead results were not available) and PPb were used to study its association with the neurobehavioral test results.

Results. There were no significant differences in all the 37 symptoms questionnaire between the exposed and referent groups. However, the exposed had significantly poorer manual dexterity, perceptual-motor speed, and motor steadiness. The standardised partial regression coefficients were higher for CBI than PPb for most of the neurobehavioral tests results. In the group with age > 35 years, there were significantly stronger association between CBI and Digit Symbol & Trail Making Part A results.

Conclusion. Cumulative exposure to lead does affect performances in the neurobehavioral tests in adult; especially perceptual and motor skill. CBI is a better predictor than PPb of the effects of lead on neurobehavioral performances.