

Manganese Health Research Program: Recent published literature

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Introduction

This report presents the bibliographic details of papers identified as being first published during the period December 2009 to February 2010.

The papers were selected because they address research areas that are considered of direct relevance to the health effects of manganese (Mn); in order to aid review, the papers are presented under the following categories:

Section 1 - EXPOSURE MEASUREMENT AND MODELLING: Papers relating to the measurements or modelling of environmental and occupational Mn exposure, the development of biomarkers of exposure or effect.

Section 2 - HEALTH EFFECTS: Papers on the influence of Mn on health, disease and dysfunction.

Section 3 - MECHANISM: Papers on the physiological, biochemical and cellular mechanisms underlying the toxic effects of Mn.

Section 4 - HUMAN SUSCEPTIBILITY: Papers relating to assessment of the influence of genetic and epigenetic factors on human susceptibility to the effects of Mn.

Section 5 - TREATMENT AND IMAGING: Papers on the development and implementation of new medical approaches to the treatment of excessive Mn exposure.

Section 6 - MISCELLANEOUS: Other papers considered of interest or potential relevance to the study of the health effects of Mn.

The papers presented herein were identified using a series of structured searches of the following on-line databases: Medline, Toxline, Biological Sciences and Proquest Health. The paper abstracts were reviewed and categorised by an experience Scientist to confirm their relevance before inclusion in this report.

1. EXPOSURE MEASUREMENT AND MODELLING

Andersen, M.E., Dorman, D.C., Clewell Iii, H.J., *et al.* (2010) Multi-Dose-Route, Multi-Species Pharmacokinetic Models for Manganese and their use in Risk Assessment. *Journal of Toxicology and Environmental Health - Part A*, 73(2-3), 217-234.

Bailey, L.A., Goodman, J.E. & Beck, B.D. (2009) Proposal for a Revised Reference Concentration (RfC) for Manganese Based on Recent Epidemiological Studies. *Regulatory Toxicology and Pharmacology*, 55(3), 330-339.

Brown, M.T. & Foos, B. (2009) Assessing Children's Exposures and Risks to Drinking Water Contaminants: A Manganese Case Study. *Human and Ecological Risk Assessment*, 15(5), 923-947.

Cowan, D.M., Zheng, W., Zou, Y., *et al.* (2009) Manganese Exposure among Smelting Workers: Relationship between Blood manganese-iron Ratio and Early Onset Neurobehavioral Alterations. *Neurotoxicology*, 30(6), 1214-1222.

Marti-Cid, R., Perello, G. & Domingo, J.L. (2009) Dietary Exposure to Metals by Individuals Living Near a Hazardous Waste Incinerator in Catalonia, Spain: Temporal Trend. *Biological Trace Element Research*, 131(3), 245-254.

Menezes-Filho, J.A., Paes, C.R., de C. Pontes, Â.M., *et al.* (2009) High Levels of Hair Manganese in Children Living in the Vicinity of a Ferro-Manganese Alloy Production Plant. *Neurotoxicology*, 30(6), 1207-1213.

Olmedo, P., Pla, A., Hernández, A.F., *et al.* (2010) Validation of a Method to Quantify Chromium, Cadmium, Manganese, Nickel and Lead in Human Whole Blood, Urine, Saliva and Hair Samples by Electrothermal Atomic Absorption Spectrometry. *Analytica Chimica Acta*, 659(1-2), 60-67.

Pellegriti, G., De Vathaire, F., Scollo, C., *et al.* (2009) Papillary Thyroid Cancer Incidence in the Volcanic Area of Sicily. *Journal of the National Cancer Institute*, 101(22), 1575-1583.

Winder, B.S. (2010) Manganese in the Air: Are Children at Greater Risk than Adults? *Journal of Toxicology and Environmental Health - Part A*, 73(2-3), 156-158.

Yoon, M., Nong, A., Clewell, H.J.,3rd, *et al.* (2009) Evaluating Placental Transfer and Tissue Concentrations of Manganese in the Pregnant Rat and Fetuses After Inhalation Exposures with a PBPK Model. *Toxicological Sciences*, 112(1), 44-58.

Yoon, M., Nong, A., Clewell, H.J.,3rd, *et al.* (2009) Lactational Transfer of Manganese in Rats: Predicting Manganese Tissue Concentration in the Dam and Pups from Inhalation Exposure with a Pharmacokinetic Model. *Toxicological Sciences*, 112(1), 23-43.

2. HEALTH EFFECTS

Cowan, D.M., Zheng, W., Zou, Y., *et al.* (2009) Manganese Exposure among Smelting Workers: Relationship between Blood manganese-iron Ratio and Early Onset Neurobehavioral Alterations. *Neurotoxicology*, 30(6), 1214-1222.

Myers, J.E., Fine, J., Ormond-Brown, D., *et al.* (2009) Estimating the Prevalence of Clinical Manganism using a Cascaded Screening Process in a South African Manganese Smelter. *Neurotoxicology*, 30(6), 934-940.

Nahar, Z., Azad, M.A., Rahman, M.A., *et al.* (2010) Comparative Analysis of Serum Manganese, Zinc, Calcium, Copper and Magnesium Level in Panic Disorder Patients. *Biological Trace Element Research*, 133(3), 284-290.

Spangler, J.G. & Reid, J.C. (2010) Environmental Manganese and Cancer Mortality Rates by County in North Carolina: An Ecological Study. *Biological Trace Element Research*, 133(2), 128-135.

Winder, B.S. (2010) Manganese in the Air: Are Children at Greater Risk than Adults? *Journal of Toxicology and Environmental Health - Part A*, 73(2-3), 156-158.

3. MECHANISM

Antonini, J.M., Sriram, K., Benkovic, S.A., *et al.* (2009) Mild Steel Welding Fume Causes Manganese Accumulation and Subtle Neuroinflammatory Changes but Not Overt Neuronal Damage in Discrete Brain Regions of Rats After Short-Term Inhalation Exposure. *Neurotoxicology*, 30(6), 915-925.

Aschner, M., Erikson, K.M., Hernández, E.H., *et al.* (2009) Manganese and its Role in Parkinson's Disease: From Transport to Neuropathology. *NeuroMolecular Medicine*, 11(4), 252-266.

Au, C., Benedetto, A., Anderson, J., *et al.* (2009) SMF-1, SMF-2 and SMF-3 DMT1 Orthologues Regulate and are Regulated Differentially by Manganese Levels in *C. Elegans*. *PLoS ONE*, 4(11), e7792.

Boyes, W.K. (2010) Essentiality, Toxicity, and Uncertainty in the Risk Assessment of Manganese. *Journal of Toxicology and Environmental Health - Part A*, 73(2-3), 159-165.

Burton, N.C. (2009) Synaptic, Genetic and Neurodegenerative Effects of Chronic Manganese Exposure in Non-Human Primates. *Dissertation Abstracts International*, 69(12, suppl. B). [John Hopkins University Dissertation]

Chang, Y., Woo, S.T., Lee, J.J., *et al.* (2009) Neurochemical Changes in Welders Revealed by Proton Magnetic Resonance Spectroscopy. *Neurotoxicology*, 30(6), 950-957.

Chowdhury, A., Azam, M.S., Aktaruzzaman, M., *et al.* (2009) Oxidative and Antibacterial Activity of Mn₃O₄. *Journal of Hazardous Materials*, 172(2-3), 1229-1235.

Failli, P., Bani, D., Bencini, A., *et al.* (2009) A Novel Manganese Complex Effective as Superoxide Anion Scavenger and Therapeutic Agent Against Cell and Tissue Oxidative Injury. *Journal of Medicinal Chemistry*, 52(22), 7273-7283.

Fortoul, T.I., Velez-Cruz, M., Antuna-Bizarro, S., *et al.* (2010) Morphological Changes in the Tongue as a Consequence of Manganese Inhalation in a Murine Experimental Model: Light and Scanning Electron Microscopic Analysis. *Journal of Electron Microscopy*, 59(1), 71-77.

Gasser, M., Riediker, M., Mueller, L., *et al.* (2009) Toxic Effects of Brake Wear Particles on Epithelial Lung Cells in Vitro. *Particle and Fibre Toxicology [Electronic Journal]*, 6(1), 30.

Gow, A.G., Marques, A.I.C., Yool, D.A., *et al.* (2010) Whole Blood Manganese Concentrations in Dogs with Congenital Portosystemic Shunts. *Journal of Veterinary Internal Medicine*, 24(1), 90-96.

Lange, T.S., McCourt, C., Singh, R.K., *et al.* (2009) Apoptotic and Chemotherapeutic Properties of Iron (III)-Salophene in an Ovarian Cancer Animal Model. *Drug Design, Development and Therapy*, 3, 17-26.

Li, X., Dong, C., Wang, G., *et al.* (2009) Manganese-Induced Changes of the Biochemical Characteristics of the Recombinant Wild-Type and Mutant PrPs. *Medical Microbiology and Immunology*, 198(4), 239-245.

Lucchini, R.G., Martin, C.J. & Doney, B.C. (2009) From Manganism to Manganese-Induced Parkinsonism: A Conceptual Model Based on the Evolution of Exposure. *NeuroMolecular Medicine*, 11(4), 311-321.

- Moreno, J.A., Streifel, K.M., Sullivan, K.A., *et al.* (2009) Developmental Exposure to Manganese Increases Adult Susceptibility to Inflammatory Activation of Glia and Neuronal Protein Nitration. *Toxicological Sciences*, 112(2), 405-415.
- Moreno, J.A., Yeomans, E.C., Streifel, K.M., *et al.* (2009) Age-Dependent Susceptibility to Manganese-Induced Neurological Dysfunction. *Toxicological Sciences*, 112(2), 394-404.
- Okun, Z., Kupersmidt, L., Amit, T., *et al.* (2009) Manganese Corroles Prevent Intracellular Nitration and Subsequent Death of Insulin-Producing Cells. *ACS Chemical Biology*, 4(11), 910-914.
- Rishi, P., Jindal, N., Bharrhan, S., *et al.* (2010) Salmonella-Macrophage Interactions upon Manganese Supplementation. *Biological Trace Element Research*, 133(1), 110-119.
- Roth, J.A. (2009) Are there Common Biochemical and Molecular Mechanisms Controlling Manganism and Parkinsonism. *NeuroMolecular Medicine*, 11(4), 281-296.
- Settivari, R., LeVora, J. & Nass, R. (2009) The Divalent Metal Transporter Homologues SMF-1/2 Mediate Dopamine Neuron Sensitivity in *Caenorhabditis Elegans* Models of Manganism and Parkinson Disease. *Journal of Biological Chemistry*, 284(51).
- Suwalsky, M., Villena, F. & Sotomayor, C.P. (2010) Mn²⁺ Exerts Stronger Structural Effects than the Mn-citrate Complex on the Human Erythrocyte Membrane and Molecular Models. *Journal of Inorganic Biochemistry*, 104(1), 55-61.
- Villalobos, V., Bonilla, E., Castellano, A., *et al.* (2009) Ultrastructural Changes of the Olfactory Bulb in Manganese-Treated Mice. *Biocell*, 33(3), 187-197.
- Wang, J., Rahman, M.F., Duhart, H.M., *et al.* (2009) Expression Changes of Dopaminergic System-Related Genes in PC12 Cells Induced by Manganese, Silver, or Copper Nanoparticles. *Neurotoxicology*, 30(6), 926-933.
- Williams, B.B., Li, D., Wegrzynowicz, M., *et al.* (2010) Disease-Toxicant Screen Reveals a Neuroprotective Interaction between Huntington's Disease and Manganese Exposure. *Journal of Neurochemistry*, 112(1), 227-237.
- Xu, B., Xu, Z.F. & Deng, Y. (2009) Effect of Manganese Exposure on Intracellular Ca²⁺ Homeostasis and Expression of NMDA Receptor Subunits in Primary Cultured Neurons. *Neurotoxicology*, 30(6), 941-949.
- Yokel, R.A. (2009) Manganese Flux Across the Blood-Brain Barrier. *NeuroMolecular Medicine*, 11(4), 297-310.
- Zhang, P., Lokuta, K.M., Turner, D.A.E., *et al.* (2009) Synergistic Dopaminergic Neurotoxicity of Manganese and Lipopolysaccharide: Differential Involvement of Microglia and Astroglia. *Journal of Neurochemistry*, 112(2), 434-443.

4. HUMAN SUSCEPTIBILITY

No relevant papers identified.

5. TREATMENT AND IMAGING

No relevant papers identified.

6. MISCELLANEOUS

Santamaria, A.B. & Sulsky, S.I. (2010) Risk Assessment of an Essential Element: Manganese. *Journal of Toxicology and Environmental Health - Part A*, 73(2), 128-155.