Commentary

Critical level of lead resulting in adverse health effects in adults and children

Lead is a toxic element causing a variety of adverse effects such as encephalopathy, peripheral neuropathy, anemia, and renal failure in humans, although it is used in the manufacture of batteries, paints, metal products, and ceramic glazes. The Scientific Committee on Neurotoxicology and Psychophysiology and the Scientific Committee on the Toxicology of Metals of the International Committee on Occupational Health in 2006 recommended that the standard for blood lead (BPb) levels be reduced to 30 μg/dL for industrial workers and 5 μg/dL for children. To examine whether the critical level of lead producing adverse effects truly differs between workers and children, we provided an overview of studies addressing the critical level of lead in workers, together with a perspective on lead toxicity in children. In 25 reports published in English with keywords of "benchmark dose (BMD)," "lead" and "humans," only five studies proved to be relevant to lead toxicity. Four more studies with figures illustrating significant relationships between lead and neurotoxic outcomes were selected. Baed on data from previous reports using a BMD approach, the critical organ of lead in workers was thought to be the nervous system and the critical BPb level (number-weighted mean) was between 10.7 and 17.5 μg/dL. The neurotoxic effects of lead exposure at such levels seemed reversible. The BPb level at which lead-associated intellectual deficits occurred in children was as low as the critical level of BPb (below 5 μg/dL) for inhibited heme synthesis in workers. The neurotoxic effects of lead in adults appear to be initiated at BPb levels of 10 μg/dL, which are somewhat higher than the critical level of lead neurotoxicity in children. Each national institute for risk management should take evidence-based preventive action against subclinical lead poisoning in adults, as well as in children (Murata *et al*., 2009).

By the way, Menke *et al*. (2006) measured BPb in a nationally representative sample of 13,946 adult participants of the National Health and Nutrition Examination Survey recruited in 1988 to 1994 and the cohort was followed-up for 12 years for cardiovascular mortality. The BPb range of the cohort was between 1 and 10 μg/dL (geometric mean, 2.58 μg/dL). After multivariate adjustment, the hazard ratio for comparisons of participants in the highest tertile of BPb ($\geq$3.63 μg/dL) at mean age of 50.7 years with those in the lowest tertile (<1.93 μg/dL) at mean age of 36.7 years was 1.55 (95% CI, 1.08 to 2.24) for cardiovascular mortality. On the other hand, Shankar *et al*. (2008) performed a prospective cohort study among 58,044 participants aged $\geq$45 years (55.9% women) without preexisting cardiovascular disease. Compared with persons with a sleep duration of 7 hours (referent), the multivariable relative risk of coronary heart disease mortality for a sleep duration of $\leq$5 hours was 1.57 (95% CI, 1.32 to 1.88); for a sleep duration of $\geq$9 hours, it was 1.79 (1.48 to 2.17). Also, similar risks due to sleep duration in postmenopausal American women have been reported by Chen *et al*. (2008). In the study carried out by Menke *et al*., the range of BPb was extremely narrow (*i.e*., the past critical level was not included within the whole range of BPb); and, nevertheless the highest tertile group of BPb was 14 years older than the lowest tertile group, sleep duration depending on lifestyle was not used as a crucial confounder in the data analysis. Therefore, which of lead exposure and sleep duration affected cardiovascular mortality and whether the hazard ratio for cardiovascular mortality can increase with elevated BPb (*i.e*., >10 μg/dL) remain unclear. Further research with a wide range of BPb is required to establish the critical level of lead in adults.

References

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