

Lead poisoning in Chinese children: risk factors and preventive measures

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China has the largest population in the world, in which there are about 259 million children younger than 14 years, and about 24.58% of the population are child-bearing age women, aged 15-45, and both are sensitive to lead poisoning. Recent studies on lead poisoning have focused on the intelligence, psychology and physical development of children.^[1] The chances for Chinese children to contact with lead are increasing in recent years. The discharge of exhausted gas particles from automobiles has become a distinct pollution source. With the development of industry in the rural and township areas, waste materials, gas, water and electronic products, etc expand the scope of lead pollution. Actually lead has entered the daily life of people by means of house decoration, smoking, printing materials, electronic products, toys, stationery, etc.

The blood lead concentration and lead poisoning incidence are higher in Chinese children than in children of developed countries.^[1-2] Related to lead poisoning, factors influencing the blood lead concentration of children vary in different countries. They include housing, living conditions, dietary habits and others. Lead poisoning in children may take place through the respiratory tract and alimentary canal.

Blood lead concentration in children tends to increase within 6 years of age. The reported odds ratio of lead poisoning for 3 to 6 years old children is 1.0207 times that for children younger than 3 years old.^[1] The older the children, the higher the risk of lead exposure. Comparative studies^[1-3] showed that risk factors for lead poisoning are less in younger children than in older children and they are mostly family and feeding related. With the growing age, children become self-controlled and have more outdoor activities, thus leading to more chances of lead exposure.^[3]

The higher blood lead concentration in boys than

in girls indicates that the boys have a higher risk of lead poisoning.^[1-3] Their blood lead concentration is significantly higher than that of girls of the same age group, and the difference is more significant in the older age group than in the younger age group.^[4] The reason may be that the sexual characteristics of children appear gradually and that boys are more active to do something while being more apt to have risk factors for lead poisoning. Logistic regression also has shown that boys have more risk factors of lead poisoning than girls.^[2,3]

Family factors known to be closely related to blood lead concentration in children include occupation, education, incomes, and behaviors of their parents. Among them, the lead-related occupation of parents is of utmost importance. The occupationally lead exposed parents will bring lead dust to home, which enhances lead exposure to their children. The blood lead concentration, the volume of lead exposure, parents' occupation, and exposure time are closely related to lead dust in houses. A study showed that the blood lead concentration was increased in 38 (42%) of the 91 children whose parents are engaged in lead occupation and 10 of them required treatment. Another study revealed that the children whose parents are engaged in lead-related occupation have a higher blood lead concentration than their schoolmates of the same age.^[5] The education of parents is related to the blood lead concentration of their children. The parents who have a low education often know nothing about lead hazards or lead poisoning and hardly guide their children to avoid the risk factors.

Environment pollution is the earliest factor that draws the attention of the public. The factors influencing the living environment vary. The blood lead concentration and incidence of lead poisoning in children living near the lead-related work sites or industrial areas are higher than those of controls.^[5]

The high blood lead concentration of children living near a major highway or busy street is due to the exhausted gas particles from mobiles.^[5-7] The levels of the building in which children are living are contributable to the incidence of lead poisoning because the atmosphere closer to the ground contains more lead.^[7] In some cities, the lead concentration is about 0.18 $\mu\text{g}/\text{m}^3$, but the concentration of one meter above

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the ground is as high as $13 \mu\text{g}/\text{m}^3$. The findings indicate that children living in the lower stories of the building are exposed to more lead than those living in the higher stories.^[1,8] Besides, the risk of lead poisoning is increased for children living in the new houses decorated with materials containing more lead than those living in the old houses without recent renovations.^[8,9]

Lead gets into children's body via respiration and hand-mouth activities. Since the odds ratio of lead poisoning for children who do not wash their hands before meal compared with those who wash hands is 1.227-1.285, children should be trained to develop hygienic habits, for instance, washing hands before eating.

Another source of lead is the paint from toys and stationery. Habitually biting pencils increases the blood lead concentration of children. Children have more chances to take in lead by playing toys, a high possibility of lead poisoning.^[2]

In children, 90.0%-98.5% of lead is taken by the alimentary canal and 1.5%-10.0% by the respiratory tract.^[5] Popcorns, preserved eggs, and puffed foods may lead to lead poisoning if they are made conventionally. The old-fashioned popcorn machine is made from lead alloy, which releases lead to the popcorns. Preserved eggs are made with lead oxide as a food additive.

Lead pollution may exist in the production process of children's favorite foods like canned foods, canned vegetables, canned fruits and canned juices, soft drinks and candies. Children eat such foods in an increasing volume and daily intake of lead is thus increased with their age. Obviously, lead intake in children is related to the variety and quantity of foods as well as to their lead concentration.

In prevention, dairy products and regular supplements of calcium, zinc or iron are proved to be effective to lower the risk of lead poisoning in children. Dairy products have a chelate interaction with lead, which prevents the absorption of lead, and the nutritional status of calcium, zinc and iron is related to lead poisoning. These elements have something common in the process of absorption. They are all absorbed by the small intestine and transported by the same transport protein. Therefore supplementary dairy products and calcium, zinc or iron can effectively prohibit the absorption of lead in the small intestine while decreasing the hazard of lead.

The following measures should be taken to prevent lead poisoning in children. Firstly, laws and regulations concerning environmental control of lead and prevention lead poisoning should be formulated by the government in cooperation with relevant departments and institutions of health, environmental protection, education, science and technology, and the society. Secondly, standards and criteria including *Guidelines*

on Lead Poisoning Screening in Children; Laboratory Guidelines on Blood Lead Detection; Diagnosis and Classification of Lead Poisoning in Children; and Guidelines on the Prevention and Intervention of Lead Poisoning in Children should be established or modified if they have been issued. Implementing these recommendations can help to achieve the goal of eliminating lead poisoning in children.

Besides, the monitoring and quality control system for lead poisoning should be improved under the supervision of the Ministry of Health. The most important thing should be done at present in China is to disseminate the knowledge about lead poisoning and its prevention measures to families, schools, communities and the public at large.

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