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Blood lead levels in children with neurological disorders: a single centre preliminary study

Touran MAHMOUDIAN[1], *Mohamadreza MODARESI*[1], *Ali ZAREI*[2], *Parinaz POURSAFA*[3], *Roya KELISHADI*[4]

(1. *Department of Pediatric Neurology, School of Medicine, Isfahan University of Medical Sciences, Isfahan*; 2. *Isfahan University of Medical Sciences, Isfahan, Iran*; 3. *Department of Environmental Protection, Isfahan University of Technology, Isfahan, Iran*; 4. *Pediatric Preventive Cardiology Department, Isfahan Cardiovascular Research Center, Isfahan University of Medical Sciences, Isfahan, Iran*)

Abstract: **Objective** Lead poisoning is a potentially devastating problem among young children. Chronic low level lead exposure can lead to learning disabilities and behavior changes such as colic, insomnia, hyperactivity, impaired growth, hearing loss and upper extremity weakness. The purpose of this cross-sectional study was to determine the blood lead level in children with neurological disorders in comparison with healthy controls. **Methods** Blood lead concentrations were measured by flame atomic absorption spectrometry in 100 children aged 1-10 years and suffering from various neurological disorders. One hundred age- and sex-matched healthy children served as controls. **Results** The mean blood lead concentration was higher in children with neurological disorders than in controls (113.2 ± 47.5 μg/L vs 84.7 ± 38.0 μg/L; $P < 0.01$). Overall, 44% of children with neurological disorders and 19% of controls were found to have increased blood lead levels, i.e. >100 μg/L. **Conclusions** An increase in blood lead level in children might be related to neurological disorders. The measurement of blood lead level might be included in diagnostic eveluation of children with neurological disorders. [**Chin J Contemp Pediatr**, **2009**, **11** (**11**):**873 – 876**]

Key words: Blood Lead; Neurological disorder; Child

神经系统疾病儿童的血铅水平调查:单中心初步研究

Touran MAHMOUDIAN, Mohamadreza MODARESI, Ali ZAREI, Parinaz POURSAFA, Roya KELISHADI.
伊斯法罕大学医学院小儿神经科, 伊朗伊斯法罕

[**摘　要**] **目的**　儿童铅中毒具有很大的潜在危害。慢性低水平铅暴露会导致学习障碍及行为问题,如腹痛,失眠,多动,生长发育落后,听力损失,上肢无力。该研究旨在调查神经系统疾病儿童的血铅水平,并与健康儿童作比较。**方法**　100 名患有神经系统疾病的 1 ~ 10 岁儿童作为研究对象。100 名年龄和性别匹配的健康儿童作为对照。采用火焰原子吸收光谱法检测血铅含量。**结果**　神经系统疾病组儿童的平均血铅含量显著高于对照组,差异有显著性 (113.2 ± 47.5 μg/L vs 84.7 ± 38.0 μg/L; $P < 0.01$)。神经系统疾病组和对照组分别有 44% 和 19% 的儿童血铅超标(>100 μg/L)。**结论**　儿童血铅水平增高可能与神经系统疾病有关。建议对患神经系统疾病的儿童常规作血铅测定。[**中国当代儿科杂志,2009,11(11):873 – 876**]

[**关　键　词**]　血铅;神经系统疾病;儿童
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Although the burden of lead poisoning has decreased across developed countries, it still remains the most prevalent environmental poison worldwide[1]. Lead poisoning is most commonly seen in children from lower socioeconomic backgrounds, however all children are at risk[2]. Children absorb 50% of the lead they ingest and deposit it in their growing bones, whereas, adults absorb only 10% of the lead ingested[3].

Environmental exposure to lead poses risks of intellectual impairment, poor educational attainment, and lowered lifetime achievement. Air pollution, peeling paint in homes and some widely used toys are identified

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[Biography] Touran MAHMOUDIAN, female, Associate Professor. Specializing in pediatric neurology.
[Correspondence Author] Roya KELISHADI, female, Associate Professor. Department of Pediatric Preventive Cardiology, Isfahan Cardiovascular Research Center, Isfahan University of Medical Sciences, Isfahan, Iran. Email: kroya@aap.net.

as risk factors for elevated blood lead levels in children[4].

There are two types of lead exposure: acute high-level and chronic low-level. Children are considered to have a much greater risk of health effects from lower level exposure to lead than adults; it is documented that even long-term low-level lead exposure might be harmful for neurological development of children[5]. Evidence from a recent cohort study confirmed that children's intellectual functioning at 6 years of age is impaired by blood lead concentrations well below 10 μg/dL[6]. House dust is the most common source of chronic low-level lead exposure for children. In homes where the household members do not routinely remove their shoes, the house dust is loaded with lead. Carpets hold up much higher amount of dust than bare floors and toxins trapped in carpets pose a particular hazard to crawling toddlers. Furthermore, old, lead-based paint, peeling and shedding from walls and ceilings, are other sources of this contamination. Roadside soil might be poisoned with lead and the soil around houses may become contaminated with lead during home construction or reconstruction. In turn, this lead is tracked into the house, elevating lead levels in air and dust. Burning newspapers or magazines can also release lead into the air.

Among children, chronic low-level lead exposure is more common than acute high-level exposure, and can lead to lower IQ scores, learning disabilities, behavior changes such as colic, insomnia, hyperactivity, impaired growth, hearing loss and upper extremity weakness. Chronic exposure also affects the blood, kidneys, and the central nervous system[3,7]. In nearly all cases, lead is ingested either as a component of dust licked off surfaces or in swallowed paint chips[8].

The American Academy of Pediatrics has considered a blood lead level up to 100 μg /L as being acceptable. Although new evidence suggests that even very low blood lead levels less than 100 μg/L can be associated with neurological injury[9]. A screening value at or above 100 μg/L requires repeat testing for a diagnosis and to determine the necessary interventions[3].

The current study was conducted in Isfahan, the second largest city in Iran, in order to compare the blood lead levels of children with neurological problems with healthy controls.

Methods

A total of 100 children aged 1-10 years who suffered from various neurological disorders were randomly enrolled, including 56 cases of seizures disorders, 25 cases of mental retardation and learning disorder, 16 cases of delayed development and cerebral palsy and 3 cases of acute encephalopathy of unknown origin. They all had no history of genetic or prenatal problems. Their metabolic screening, TORCH detection, endocrinology and neuroimaging examinations all were not abnormal. Home assessments and interviews with parents did not reveal a history of pica for paint. One hundred age- and sex-matched children with normal growth and development and who lived in the neighbourhood of the case group served as controls.

Written consent was obtained from parents. The child's forearm was washed carefully, and 3 mL of venous blood was drawn. The blood lead concentrations were measured by flameless atomic absorption spectrometry (Philips Analytical Company, England). Data were stored in a computer database and analyzed with SPSS software package for Windows (SPSS, Inc. Chicago, IL).

Results

The mean blood lead concentrations were significantly higher in children with neurological disorders than in controls (113.2 ± 47.5 μg/L vs 84.7 ± 38.0 μg/L; $P < 0.01$).

In the case group, the mean blood lead concentrations in children at ages of less than 2 years ($n = 15$), of 2-5 years ($n = 22$) and of 5-10 years ($n = 63$) were 102.7 ± 37.4, 112.8 ± 35.9 and 117.1 ± 53.0 μg/L, respectively.

Overall, 44% of children who had neurological disorders and 19% of the controls were found to have blood lead concentrations of > 100 μg/L (Table 1).

Table 1 Number of children with high blood lead levels

	Cases	Cases with high blood lead levels	%
Control	100	19	19
Patient	100	44	44
Seizures disorders	56	24	43
Mental retardation and learning disorder	25	12	48
Delayed development and cerebral palsy	16	6	38
Acute encephalopathy of unknown origin	3	2	67

Discussion

This study found that blood lead concentrations were significantly higher in children with various neurological disorders than those in the control group. The children of the control group who had high blood lead level had no clinical neurological signs and symptoms, and this might be because some hazards of lead poisoning might be minor or asymptomatic. The finding of this study should be confirmed in longitudinal studies with long-term follow up.

Lead poisoning is a common and potentially devastating affliction particularly among young children. Despite advances in understanding and controlling such poisoning, including substantial reductions of lead in paints, food, water, air and gasoline, lead poisoning continues. The major remaining sources are lead-based paint in older, dilapidated housing, lead in soil and drinking water and occupational exposure. In the US, more than 6 million children and 400 000 pregnant women are estimated to have lead blood levels of greater than 100 μg/L which is the maximum level now set as safe by the centers for disease control & prevention[10,11].

Blood lead levels in excess of 100 μg /L can cause learning and behavioral disorders in children, impair central nervous system development in fetuses and raise the blood pressure of pregnant women[11].

A study in Taiwan revealed that air and soil outside a lead-recycling plant were seriously contaminated by lead, which was associated with lowered intelligence quotients of 32 children who attended a nearby kindergarten[12]. It is shown that lifetime low-level exposure to environment lead might impair children's emotional and behavioral development at ages of 11-13 years[13].

The findings of this study are consistent with a study on 82 Indian children suffering from various neurological disorders and 28 healthy children, aged 1 to 12 years, which showed that the mean blood lead level in the case group was higher than in the control group (193.0 ± 176.5 μg/L vs 119.6 ± 109.7 μg/L)[14].

In some countries, the most important source of the lead exposure is the paint in older housing and recovery of lead from old automobile batteries and even a quite small lead smelter can contaminate a significant area[15]. Most houses are newly built in Isfahan, hence in this area childhood lead poisoning may arise from exposure to non-paint sources of lead. Isfahan is an industrial city with a population of nearly 2 millions, located in the center of Iranian plateau, with an average altitude of 1 500 m above sea level and is bounded by NW-SE mountain range of 3 000 m. However, it is facing significant atmospheric pollution arising from the rapid urbanization, and industrial development, and heavy traffic of motor vehicles (approximately 450 new cars/day). It is shown that most daily air pollution time series in this city have high persistence of air pollution conditions through time[16]. Our previous study showed that in Isfahan the Pollutant Standard Index (PSI) value corresponded to a moderate air quality in 2004-2005 and that in 171 days a year, this level indicated unhealthy air quality for sensitive groups including children. In that study, we documented the independent association of air pollutants with markers of insulin resistance, inflammation and oxidation among youths[17].

We suggest that the air pollution might be the most important source of the lead exposure. However considering that the patient and control groups in this study were from the same area, it may be presumed that exposure to some widely used instruments at home and or children's toys might be the most probable risk factor for elevated blood lead levels in children with neurological disorders. This needs further study to confirm it.

The main limitation of this study is its cross-sectional nature, and longitudinal studies with long follow-up are necessary to confirm the findings of the current study. In addition, the study included a heterogeneous group of children with a wide age range, and it did not determine the indoor pollutants and life habits that might play a role in lead exposure of the children.

Because chronic low level exposure is more commonly seen with multiple effects, primary and secondary prevention of lead exposure among children can significantly reduce the number of children affected by its serious health hazards. Health care providers need to emphasize their vigilant efforts to educate families about the dangers of lead exposure. Environmental interventions, including increasing national awareness, can reduce the immediate and future dangers of lead poisoning. Measurement of blood lead level might be included in the diagnostic evaluation of children with neurological disorders.

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·消息·

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