

Supplementary Materials

Who are the “Culprits”: Environmental Health Alert from the Lead Poisoning Incident at a Kindergarten in Tianshui, Gansu, China

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How To Cite: Liu, H.; Qiu, T.; Zhao, L.; et al. Who are the “Culprits”: Environmental Health Alert from the Lead Poisoning Incident at a Kindergarten in Tianshui, Gansu, China. *Glob. Environ. Sci.* **2026**, *2*(1), 38–42. <https://doi.org/10.53941/ges.2026.100003>

1. Text S1

1.1. Quantification of the Contribution Rates of Different Exposure Pathways in This Incident

1.1.1. Calculation of Exposure Doses and Contribution Rates for Each Pathway.

General Formula:

Daily Exposure Dose ($\mu\text{g}/\text{day}$) = $C \times \text{IR} \times \text{CF}$

where:

- C = The concentration of Pb in the environmental medium (the data is derived from the official published results of the investigation into the source: https://paper.people.com.cn/rmrb/pc/content/202507/21/content_30088997.html (accessed on 21 July 2025))
 - IR = Intake or Inhalation Rate (amount of medium contacted per day)
 - CF = Conversion Factor (for unit unification, applied where necessary)
- US EPA Recommended Parameters (for children):
- Drinking Water Intake Rate (IR for water): 0.8 L/day
 - Food Intake Rate (IR for food): 0.15 kg/day (used for estimating specific food consumption in this incident)
 - Soil/Dust Ingestion Rate (IR for soil): 100 mg/day = 0.0001 kg/day
 - Air Inhalation Rate (IR for air): 10 m³/day
 - Object Ingestion Rate (IR for toys and other items): 0.00002 kg/day (20 mg/day)—applicable to hand-to-mouth contact with toys, stationery, etc.

1.1.2. Exposure Dose Calculation for Each Pathway

(1) Dietary Intake Pathway

Pb Concentration in Food (C): (1052 + 1340)/2 = 1196 mg/kg

Calculation:

Dose = 1196 mg/kg \times 0.15 kg/day \times 1000 = 179,400 $\mu\text{g}/\text{day}$

(2) Migration from Children's Products Pathway

Pb Migration Level (C): Using the upper limit of the detection range 4.9 mg/kg (for a conservative assessment)

Calculation:

Dose = 4.9 mg/kg \times 0.00002 kg/day \times 1000 = 0.098 $\mu\text{g}/\text{day}$

(3) Drinking Water Intake Pathway

Pb Concentration in Water (C): 0.92 $\mu\text{g}/\text{L}$

Calculation:

Dose = 0.92 $\mu\text{g}/\text{L} \times$ 0.8 L/day = 0.736 $\mu\text{g}/\text{day}$

(4) Soil and Dust Ingestion Pathway

Pb Concentration in Soil (C): (24.6 + 27.6)/2 = 26.1 mg/kg

Calculation:

Dose = 26.1 mg/kg \times 0.0001 kg/day \times 1000 = 2.61 $\mu\text{g}/\text{day}$

(5) Atmospheric Particulate Matter Inhalation Pathway

Pb Concentration in Air (C): Using the upper limit of the range 26 ng/m³

Calculation:



$$\text{Dose} = 26 \text{ ng/m}^3 \times 10 \text{ m}^3/\text{day} \times 0.001 = 0.26 \text{ } \mu\text{g}/\text{day}$$

(6) Calculation of Contribution Rates and Final Presentation

Total Estimated Exposure Dose:

$$\text{Total Dose} = 179,400 + 0.098 + 0.736 + 2.61 + 0.26 \approx 179,403.7 \text{ } \mu\text{g}/\text{day}$$

1.1.3. Precise Calculation of Contribution Rates

- Dietary Contribution Rate: $179,400/179,403.7 \times 100\% \approx 99.9998\%$

- Product Migration Contribution Rate: $0.098/179,403.7 \times 100\% \approx 0.00005\%$
- Drinking Water Contribution Rate: $0.736/179,403.7 \times 100\% \approx 0.0004\%$
- Soil Contribution Rate: $2.61/179,403.7 \times 100\% \approx 0.0015\%$
- Atmospheric Contribution Rate: $0.26/179,403.7 \times 100\% \approx 0.0001\%$