The Effect of Lead Exposure on Children's Learning in the Developing World: A Meta-Analysis

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ABCDE

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The correlation between lead & IQ is not a new finding

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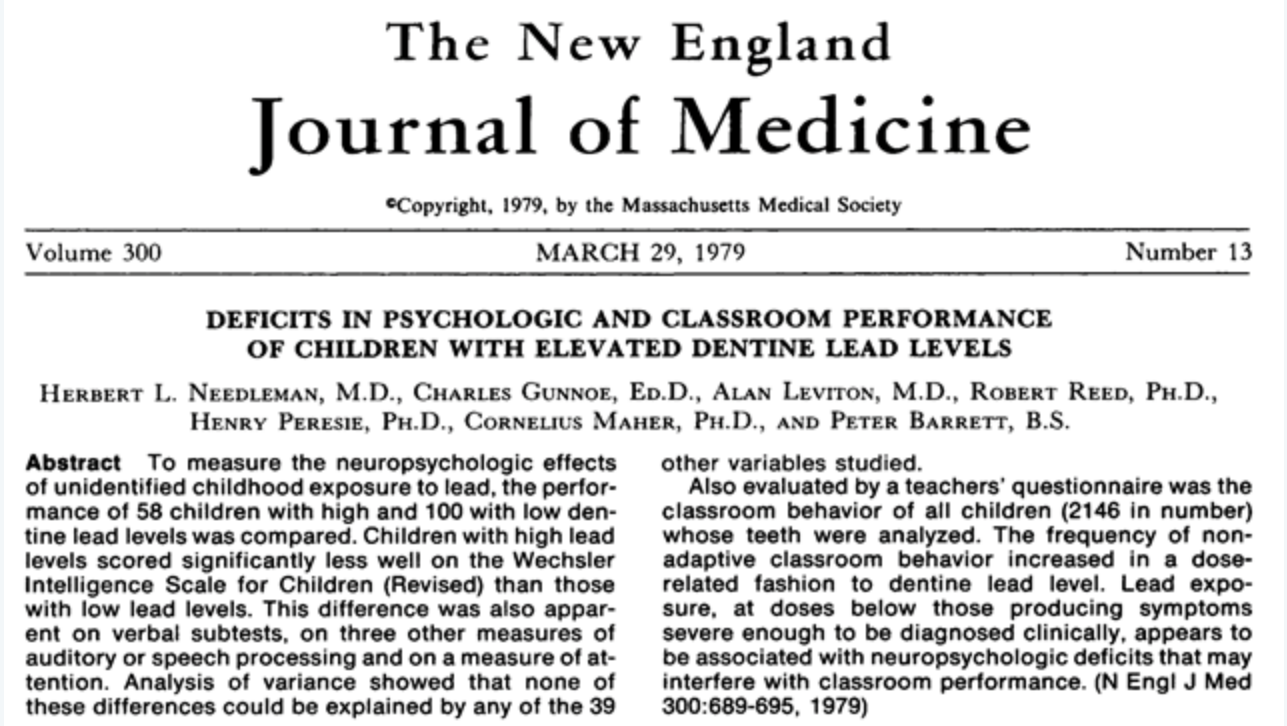

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DEFICITS IN PSYCHOLOGIC AND CLASSROOM PERFORMANCE OF CHILDREN WITH ELEVATED DENTINE LEAD LEVELS

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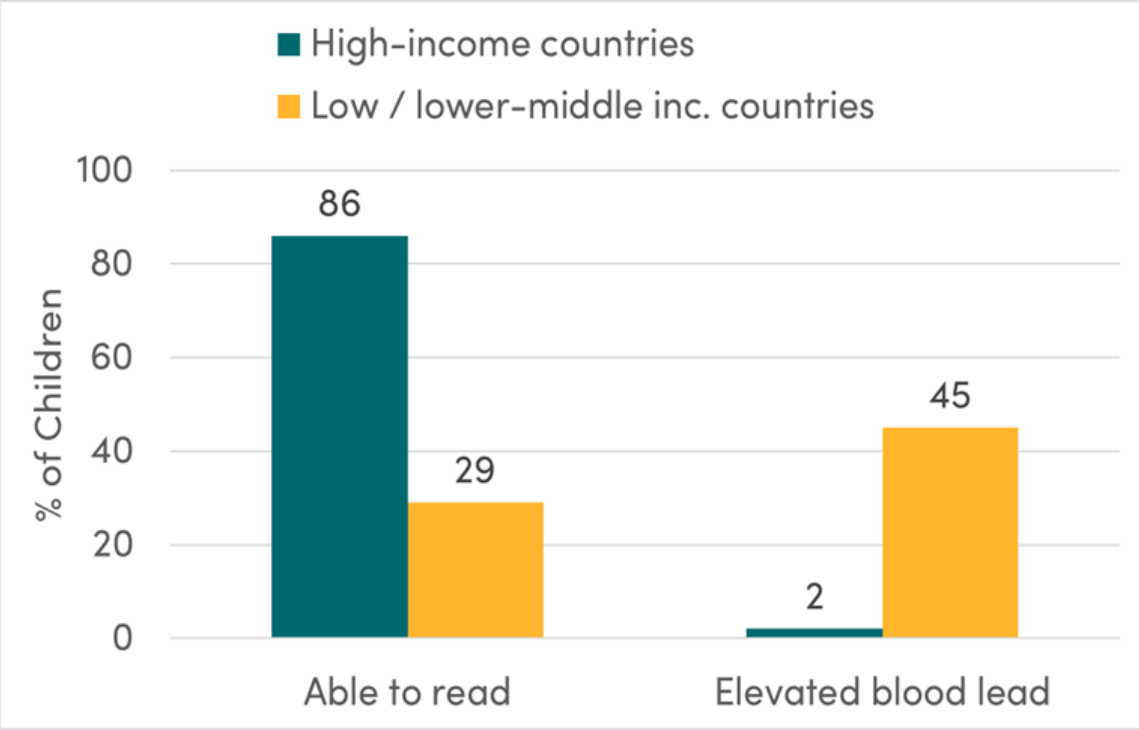
Abstract To measure the neuropsychologic effects of unidentified childhood exposure to lead, the performance of 58 children with high and 100 with low dentine lead levels was compared. Children with high lead levels scored significantly less well on the Wechsler Intelligence Scale for Children (Revised) than those with low lead levels. This difference was also apparent on verbal subtests, on three other measures of auditory or speech processing and on a measure of attention. Analysis of variance showed that none of these differences could be explained by any of the 39 other variables studied.

Also evaluated by a teachers' questionnaire was the classroom behavior of all children (2146 in number) whose teeth were analyzed. The frequency of nonadaptive classroom behavior increased in a dose-related fashion to dentine lead level. Lead exposure, at doses below those producing symptoms severe enough to be diagnosed clinically, appears to be associated with neuropsychologic deficits that may interfere with classroom performance. (N Engl J Med 300:689-695, 1979)

But how big is the effect, in the context of the global learning crisis?



- Extensive literature links childhood lead exposure to cognitive and learning deficits
- Is lead exposure a substantial driver of observed lower education attainment in LMICs?
- If so, to what extent can it explain observed learning gaps?

Note: The share of children able to read is the World Bank estimate for minimum reading proficiency at the end of primary school. The share of children lead poisoned is calculated from the numerator in the IHME/UNICEF "Toxic Truth" report and the denominator in UN population estimates.

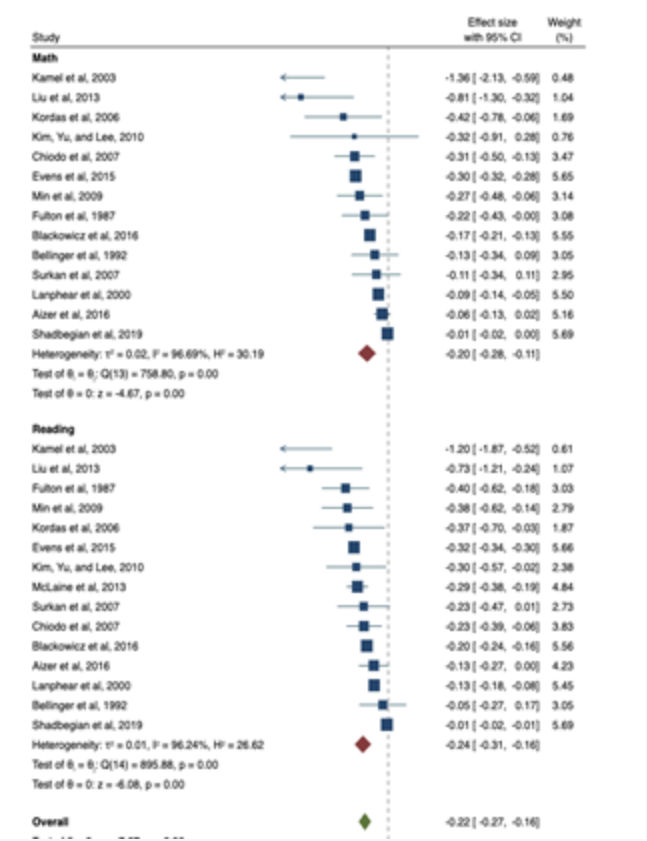
Our Approach

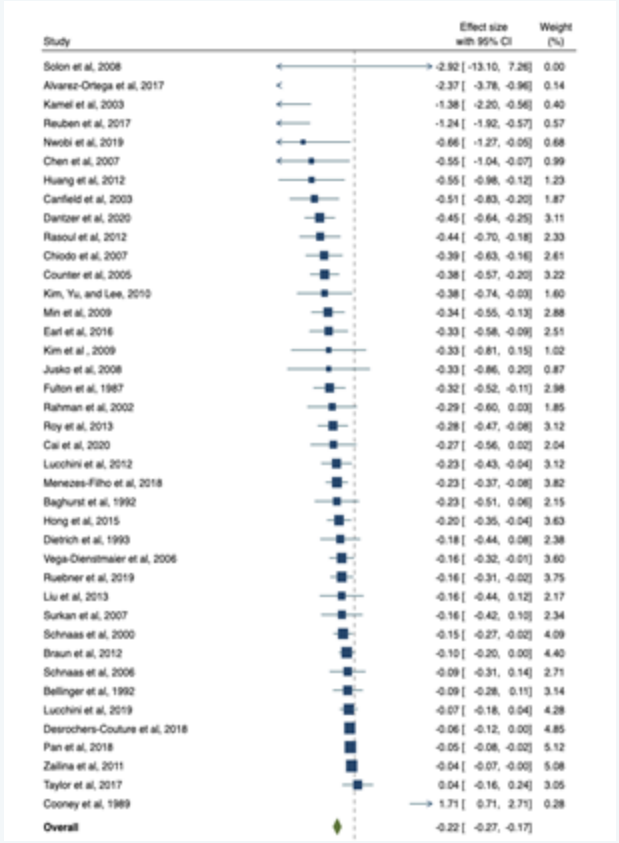
1. Systematic review and meta-analysis of observational studies on the relationship between lead exposure and learning outcomes

2. Adjustments for likely magnitude of unobserved confounding and publication bias

3. Simulation: What is predicted learning gain if blood lead levels (BLLs) in low- and middle-income countries (LMICs) are reduced to US levels?

Unadjusted effects are near identical for IQ and reading or math





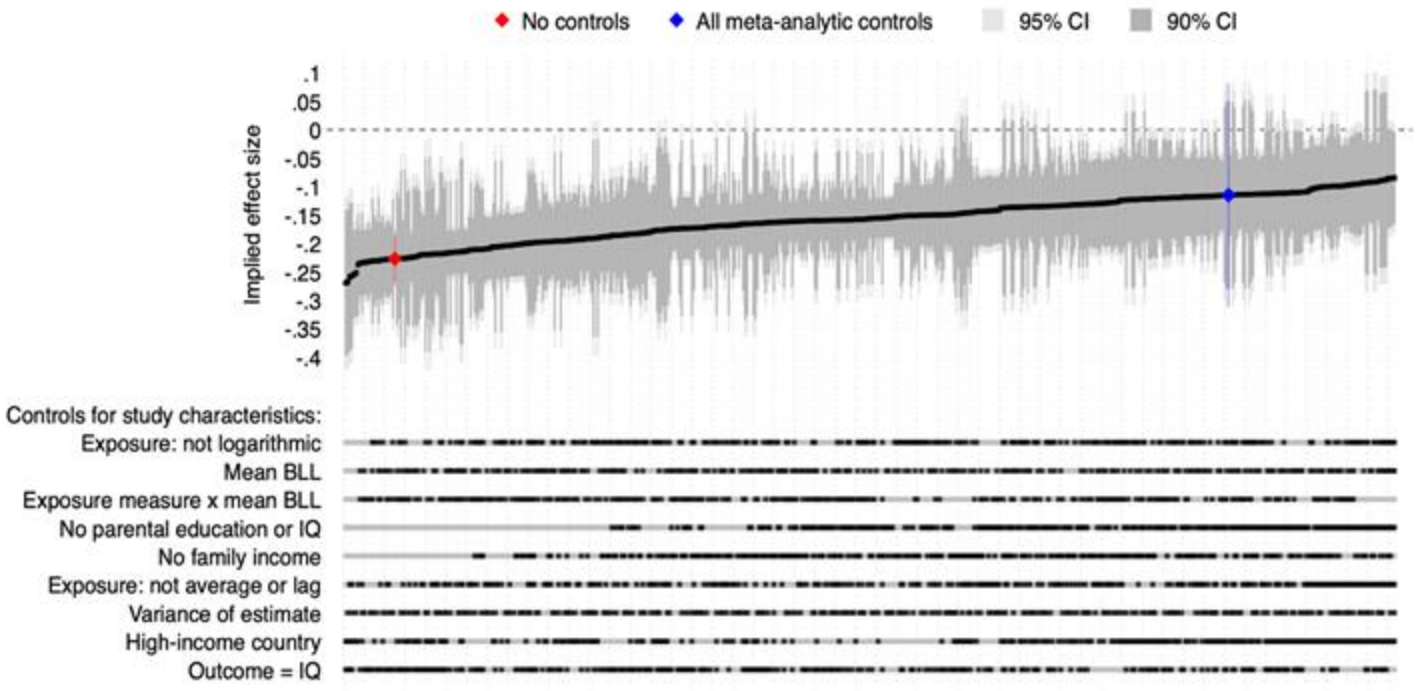
- All studies with a correlation between blood lead & IQ, reading, or math test scores -> 286 estimates from 47 studies

- 40 studies on IQ (0.22 SD)

- 15 studies on reading (0.22 SD)

- 14 studies on math (0.20 SD)

We just ran two million regressions



Corrected for publication bias and study characteristics: **Doubling of BLL (1 natural log unit increase) implies a 0.12 standard deviation reduction in learning.**

But are these correlations causal?

1. Correlational studies robust to variety of observed and unobserved controls

2. Clear theory of change with well-understood biological mechanisms

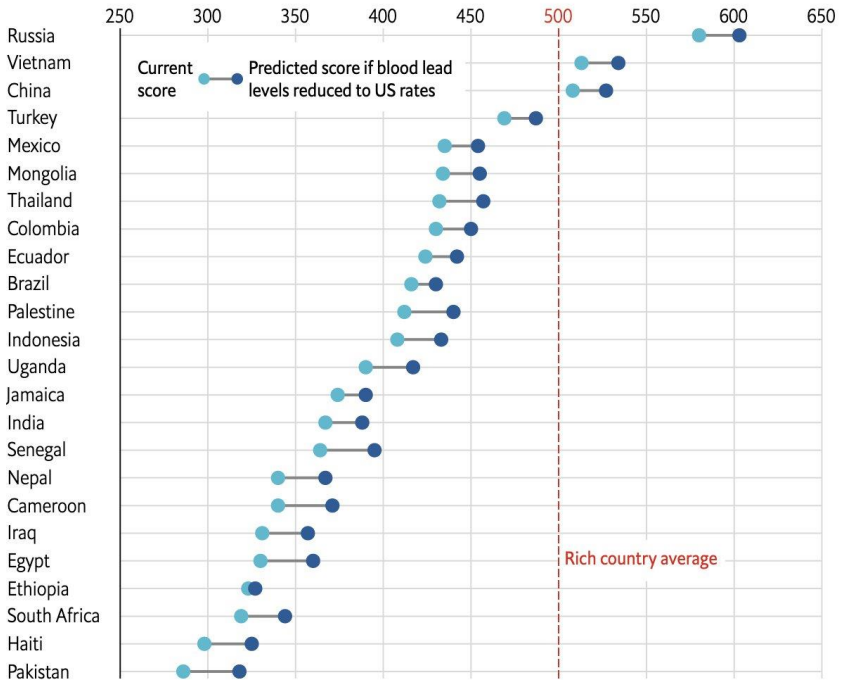
3. Natural experiments find similar effects to correlational studies

4. Direct experiments with animals demonstrate causal effects

Take a weight off their minds

Effect of blood lead levels on learning outcomes, 2023

Selected countries, Harmonised Learning Outcomes (HLO) score



Source: "How much would reducing lead exposure improve children's learning in the developing world?", by Lee Crawfurd et al., Centre for Global Development working paper, July 2023

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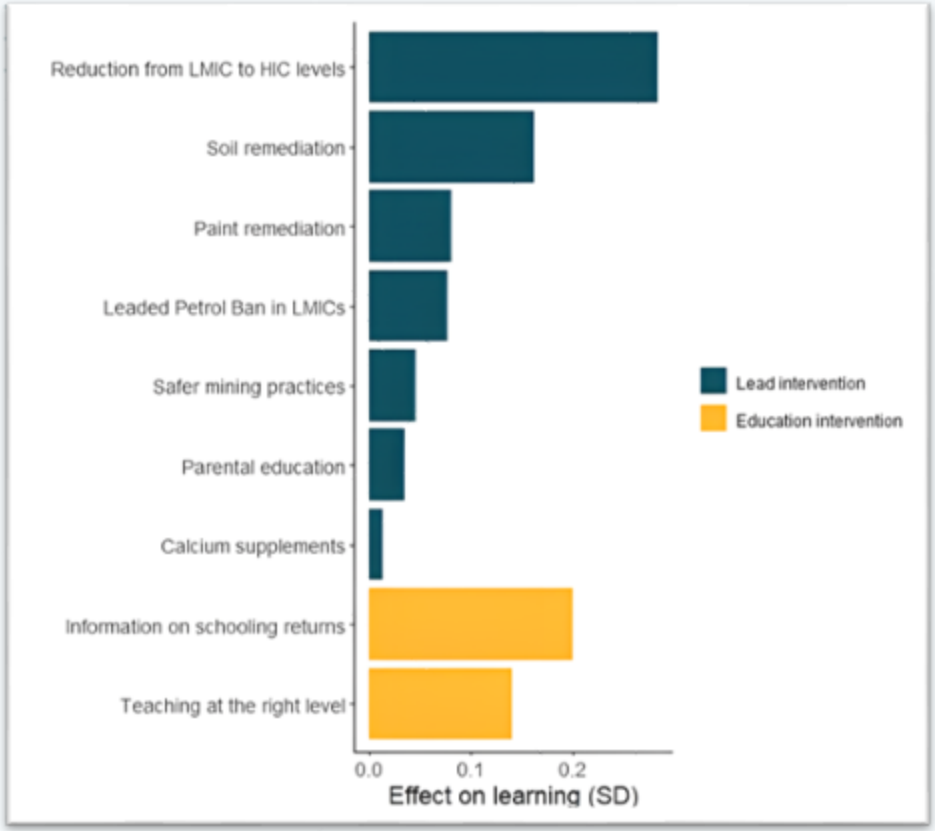
Reducing lead exposure to US levels could close 21% of learning gap between rich countries and LMICS

Note: This figure shows the simulated effect on Harmonized Learning Outcomes for each country of reducing average blood lead levels to US levels (0.5 mcg/dl).

Lead compares well with leading education programs



Note: Where we have more than one study for an intervention category, this figure shows the median of effect sizes for those studies.

Conclusion

- Lead exposure could explain 1/5th of the learning gap between rich & poor countries
- The issue remains massively neglected, with big consequences for both health and education
- Priority actions include
  - Low-hanging regulation (e.g. lead paint bans)
  - National surveys drive action
  - Prioritization of largest sources