Calculating Change in Lifetime Earnings Based on Change in a Typical Child's Blood Lead Level

From EPA's Economic Analysis for the Final Lead and Copper Rule Improvements, EPA 810-R-24-005
Sections 5.5.1 Concentration-Response Functions for Lead and IQ & 5.5.2 Valuation of Avoided IQ Loss
https://www.epa.gov/system/files/documents/2024-10/508_lcri_final_ea_10-21-2024.pdf

Instructions:
1. Use EPA's All Ages Lead Model to Estimate Pre-Rule and Post-Rule Blood Lead Levels for Typical Child
2. Enter Pre-Rule and Post-Lead Blood Lead Levels in Yellow Highlighted Cell
3. Adjust β Based on Exhibit 5-24 (below) - Default is 3.25
4. Enter Value of an IQ Point from Exhibit 5-25 (below) in Magenta Highlighted Cell
5. See Low-End and High-End Estimated Changes in Lifetime Earnings in Blue Highlighted Box.

Note: Assuming the post-rule blood lead level estimates are lower, these equations estimate the avoided population average IQ loss.

Variable	Value	Description
PbB_1	2.75	Pre-Rule Blood Lead Level in µg/dL
PbB_2	1.22	Post-Rule Blood Lead Level in µg/dL

Equation 9 - LCRI High Benefits Calculation based on corrected Lanphear et al (2005, erratum 2019)

(PbB1)/(PbB2)	2.254098361	-2.64
β =	-3.25	See Exhibit 5-24 below.

Change in lifetime earnings from IQ point change discounted at 2% to age 7

Value of IQ Point - Exhibit 5-25 Row 6	$42,226	$	111,537	Average Societal Benefits Per Child

$$IQ\ Loss = \beta \times \ln\left(\frac{PbB_1}{PbB_2}\right) \quad \text{(Equation 9)}$$

Where:
- β = Corrected lifetime beta estimate from Lanphear et al. (-3.25)
- PbB_1 = Pre-rule BLL
- PbB_2 = Post-rule BLL

Equation 10 - LCRI Low Benefits Calculation based on Crump et al. (2013)

(PbB1+1)/(PbB2+1)	1.69	-1.70
β =	-3.25	See Exhibit 5-24 below.

Change in lifetime earnings from IQ point change discounted at 2% to age 7

Value of IQ Point - Exhibit 5-25 Row 6	$42,226	$	71,945	Average Societal Benefits Per Child

$$IQ\ Loss = \beta \times \ln\left(\frac{PbB_1 + 1}{PbB_2 + 1}\right) \quad \text{(Equation 10)}$$

Where:
- β = Lifetime beta estimate from Crump et al. (2013) independent analysis (-3.25)
- PbB_1 = Pre-rule BLL
- PbB_2 = Post-rule BLL

Exhibit 5-24: Comparison of Adjusted Coefficients from Lanphear et al. Erratum (2019) with Those Obtained in the Kirrane and Patel (2014), and the Reanalysis and Independent Analysis of Lanphear et al. (2005) by Crump et al. (2013)

BLL Variable	Kirrane and Patel (2014) β (95% CI)	Kirrane and Patel (2014) R^2	Lanphear et al. Erratum (2019) β (95% CI)	Lanphear et al. Erratum (2019) R^{2a}	Crump et al. (2013) Reanalysis ln(BLL) β (95% CI)	Crump et al. (2013) Reanalysis ln(BLL) R^2	Crump et al. (2013) Independent Analysis ln(BLL + 1) β (95% CI)	Crump et al. (2013) Independent Analysis ln(BLL + 1) R^2
Early	-2.21 (-3.38, -1.04)	0.643	-2.21 (-3.38, -1.04)	n/a	-2.21 (-3.38, -1.03)	0.643	-2.46 (-3.82, -1.10)	0.659
Peak	-2.86 (-4.10, -1.61)	0.640	-2.86 (-4.10, -1.61)	n/a	-2.86 (-4.10, -1.61)	0.640	-2.48 (-3.83, -1.14)	0.656
Lifetime	-3.14 (-4.39, -1.88)	0.641	-3.25 (-4.51, -1.99)	n/a	-3.19 (-4.45, -1.94)	0.641	-3.25 (-4.66, -1.83)	0.659
Concurrent	-2.65 (-3.69, -1.61)	0.641	-2.65 (-3.69, -1.61)	n/a	-2.65 (-3.69, -1.61)	0.641	-3.32 (-4.55, -2.08)	0.658

Sources: Crump et al. (2013, Table 2 and Table 5), Kirrane and Patel (2014, Table 1), Lanphear et al. erratum (2019, Table 4).
[a] R^2 not reported in Lanphear et al. erratum (2019); however, the paper reported that the concurrent BLL was the largest R^2.
Notes: This table displays regression coefficients and R^2 values for the Lanphear et al. erratum (2019) analysis, the Crump et al. (2013) and Kirrane and Patel (2014) reanalysis of Lanphear et al. (2005), and the Crump et al. (2013) independent analysis of Lanphear et al. (2005). This table summarizes the relationship between BLL and IQ loss across various blood lead metrics.

Exhibit 5-25 Updated Estimates for Lifetime Earnings, Additional Education Costs, and Lost Earnings from Additional Education (2022 USD), discounted at 2 percent to age 7

Estimate	Updated Salkever Estimates		
	Male	Female	Male and Female Combined
1. Lifetime Earnings	$2,174,849	$1,424,497	-
2. IQ Effect	1.87%	3.41%	-
3. IQ Effect*Lifetime Earnings	$40,700	$48,559	$44,551
4. Additional Education Costs	$1,702	$1,940	$1,819
5. Lost Earnings (from additional education)	$594	$415	$506
6. Value of an IQ Point (3 - (4+5))	**$38,404**	**$46,204**	**$42,226**

Note: The EPA uses of the term "2 percent discount rate" with regard to the calculation of the IQ point high and low estimates is shorthand for a declining discount rate which begins with a 2 percent discount rate for the years 2024-2079, a 1.9 percent discount rate used for the years 2080-2096, and a 1.8 percent discount rate used in years 2095-2102. This declining rate structure was implemented to comply with updates to OMB Circular A-4 guidance.