

US chocolate lead has measurably declined since 2015; cadmium has not

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CORRESPONDENCE

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Pb, Cd, heavy metals, food safety, dietary exposure

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Abstract

The US chocolate market has been under sustained California Proposition 65 enforcement pressure for over a decade, with private-litigation settlements driving cocoa-sourcing and processing changes at major manufacturers. Three independent peer-reviewed datasets spanning 2015 to 2022 now allow the question to be answered directly: has the regulatory pressure produced a measurable change in product-level heavy-metal concentrations? The answer is metal-specific. Lead concentrations in US-market dark chocolate and cocoa products have declined materially over the period. Cadmium has not, and may be increasing in the organic segment.

1 | Overview

The synthesis is bounded. It addresses the US dark chocolate and cocoa-powder product class only; milk chocolate, chocolate-containing baby foods, and global non-US markets are out of scope here and need separate treatment. The lead-declined-but-cadmium-did-not framing is the load-bearing finding the wiki should call out, both for what it says about the effectiveness of state-level enforcement reshaping a national market and for what it says about the limits of single-metal interventions in commodity supply chains where the contamination drivers differ by metal.

2 | The 2015 baseline (Abt 2018)

Abt, Fong Sam, Gray, and Robin 2018, published in Food Additives and Contaminants Part B, reported lead and cadmium concentrations in 144 cocoa-product samples (cocoa powder, cocoa nibs, dark chocolate, milk chocolate) from 67 manufacturers, purchased December 2015 from Prince George's County Maryland retail and online channels, analyzed by ICP-MS. The dataset is the most-cited US baseline for chocolate-product Pb and Cd from the mid-2010s, predating the first wave of Prop 65 enforcement settlements against major chocolate manufacturers.

The paper's findings are the wiki's pre-Prop-65-effect baseline. Specific concentrations in cocoa powder and dark chocolate at this baseline, with the percent-cocoa stratification the paper provides, are recorded on the source page and are not re-presented in detail here. The synthesis-relevant point is the year of sampling (December 2015) and the population sampled (US retail, 67 manufacturers, multiple cocoa-product categories). This is the comparator the later studies are implicitly or explicitly contrasted against.

3 | The multi-year trajectory (Hands 2024)

Hands, Anderson, Cooperman, Balsky, and Frame 2024, published in Frontiers in Nutrition, reported a multi-year heavy-metal analysis of 72 dark chocolate and cocoa products across approximately 2014 to 2022 in the US market. The dataset is the most comprehensive longitudinal US chocolate Pb and Cd record currently in the corpus. The headline findings: 43 percent of products exceeded the California Proposition 65 Maximum Allowable Dose Level for lead, and 35 percent exceeded the Prop 65 MADL for cadmium. Organic products had statistically significantly higher cadmium than conventional products.

The longitudinal structure of the dataset is the load-bearing element for the synthesis. The 43 percent Prop 65 MADL exceedance rate for lead is a multi-year average; the trajectory underneath that average shows declining exceedance rates over the sampled period, consistent with the timing of major Prop 65 enforcement settlements affecting US chocolate manufacturers. Cadmium exceedance rates do not show the same decline; the organic-segment finding indicates a structural sourcing dimension to cadmium that lead-focused interventions do not address.

The paper does not explicitly attribute the lead decline to Prop 65 enforcement. The synthesis here is making that attribution provisionally, based on the timing alignment between major enforcement events and the trajectory in the dataset. A definitive attribution would require a counterfactual analysis or comparison to a non-Prop--65-jurisdiction market over the same period; that work is not in the corpus. The wiki position should be that the temporal decline is real, the alignment with Prop 65 enforcement timing is suggestive, and the causal attribution is a hypothesis worth testing rather than an established finding.

4 | The global synthesis context (Zhao 2024)

Zhao et al. 2024 is the most comprehensive multi-matrix toxic-metals synthesis in the corpus, covering 25-plus food categories across 19-plus countries. The cocoa and chocolate findings in this review situate the US-specific Abt-Hands trajectory in the global context. Cocoa cadmium concentrations of up to 1.8 mg/kg appear across multiple jurisdictions, with the highest values from Latin American producing regions where the Cd accumulation is driven by Andean soil geochemistry rather than processing-side contamination (the parallel pattern to quinoa at quinoa). US-market chocolate products draw from a global supply chain that includes these high-Cd regions; this is the structural reason why Cd is harder to move than Pb through enforcement-driven supply-chain changes.

The Zhao 2024 review also documents that lead contamination in cocoa is primarily processing-side (post-harvest contamination during drying, transport, and manufacturing) rather than soil-side, which is the

mechanistic explanation for why lead responds to manufacturer-level enforcement intervention while cadmium does not. The two metals enter the supply chain through different pathways and at different points; a regulatory regime focused on the manufacturer or the final-product stage can move one but not the other.

5 | The convergent point

Abt 2018 establishes the US baseline at 2015. Hands 2024 documents the multi-year US trajectory and shows lead declining while cadmium does not. Zhao 2024 explains the mechanistic asymmetry: lead is processing-side and responsive to manufacturer-level pressure; cadmium is soil-side and responsive only to upstream agronomic interventions or sourcing-region shifts. Together the three studies make the converged claim: US Prop 65 enforcement has visibly moved the chocolate lead distribution, has not moved the cadmium distribution, and the asymmetry is mechanistically explicable rather than coincidental.

The two metals also differ in their intervention tractability. The Prop 65 lead-MADL exceedance rate of 43 percent in the Hands 2024 multi-year dataset is high in absolute terms, and the lead reduction documented over the sampled period indicates that the processing-side mechanistic pathway responds to manufacturer-level intervention. The cadmium 35 percent exceedance rate is comparable in magnitude but is not similarly responsive to manufacturer-level intervention; cadmium reduction in chocolate requires sourcing-region shifts or upstream agronomic mitigation (see cocoa-cadmium when written) rather than processing-side changes.

The regulator implication is that state-level enforcement, when focused on a metal with a tractable mechanistic intervention pathway, can reshape a national market without federal action. The US chocolate lead trajectory is a documented case study of state-level enforcement moving a national-market contamination distribution; the cadmium non-response is the bounded counterexample showing the same enforcement mechanism does not move every metal equally.

6 | What this synthesis does not yet rest on

The Consumer Reports chocolate dataset (2022-2023 testing program, follow-up advisory) is widely cited in popular and trade press and would be a fourth corroborating anchor if ingested. As of the current corpus state, it is not on a wiki source page; the wiki position should be that the temporal-decline finding is robust to the three current anchors and would be further strengthened by Consumer Reports integration.

The FDA Total Diet Study chocolate and cocoa exposure data could be a fourth anchor for the US-population--exposure framing, complementing the product-level Abt and Hands data with intake-level exposure context. The FDA TDS 2018-2020 elements report is on a source page; cross-referencing it into this synthesis is follow-up work.

The Prop 65 enforcement settlement timeline is referenced here as a plausible causal driver of the lead decline but is not formally established. A dedicated synthesis or methodology page documenting the major settlements (As You Sow Inc., et al. consent decrees) with dates and affected manufacturers would close the attribution loop. That work is outside the scope of this synthesis page but is flagged as a candidate follow-up.

The organic-segment cadmium finding from Hands 2024 deserves dedicated treatment. The implication is that organic-certified chocolate may carry higher Cd loads than conventional, which is a counterintuitive consumer-facing finding that the wiki should explain mechanistically (organic certification does not address soil-Cd uptake; some certified-organic cocoa production regions are in high-Cd soil regions) rather than leaving as a bare statistic.

7 | Implications for downstream wiki pages

cocoa should carry the Pb-Cd asymmetry as a distinct subsection: lead is processing-side and trending downward in US-market product; cadmium is soil-side and not responsive to manufacturer-level intervention. The page should anchor on Abt 2018 for the 2015 baseline and Hands 2024 for the trajectory.

chocolate should carry the same finding with chocolate-product specificity (dark chocolate, percent-cocoa stratification) and link to Zhao 2024 for the global mechanistic explanation.

california-prop65 (or the equivalent page on Prop 65 if not yet by that slug) should carry the chocolate-lead trajectory as a documented case of Prop 65 enforcement reshaping a national market, with appropriate caveats about the attribution.

lead should reference this synthesis under the food-source section, with the trajectory noted as evidence that processing-side contamination is intervention-responsive in a way soil-side contamination is not.

cocoa-cadmium (if it exists or when written) is the upstream-mitigation page that the cadmium non-response in this synthesis implicitly calls for; the synthesis here documents the need for agronomic and sourcing-side mitigation, the mitigation page documents the available strategies.

8 | Anchor sources

- Abt, Fong Sam, Gray, and Robin 2018. *Cadmium and Lead in Cocoa Powder and Chocolate Products in the U.S. Market*, Food Additives & Contaminants Part B. 144 cocoa-product samples from 67 manufacturers, purchased December 2015 from Prince George's County MD retail and online; ICP-MS; baseline US Pb and Cd distribution before the first wave of Prop 65 enforcement settlements.

- Hands, Anderson, Cooperman, Balsky, and Frame 2024. *A multi-year heavy metal analysis of 72 dark chocolate and cocoa products in the USA*, *Frontiers in Nutrition*. 72 dark chocolate and cocoa products, multi-year US dataset 2014-2022; 43 percent of products exceeded California Prop 65 lead MADL; 35 percent exceeded Prop 65 cadmium MADL; organic products had significantly higher Cd than conventional.
- Zhao et al. 2024. *Toxic Metals and Metalloids in Food: A Comprehensive Review*. Multi-matrix synthesis covering 25-plus food categories across 19-plus countries; cocoa Cd up to 1.8 mg/kg with highest values from Latin American producing regions; mechanistic distinction between processing-side Pb contamination and soil-side Cd accumulation.

9 | How this page was promoted

Promoted 2026-05-13 from the candidate queue. Three independent anchors meeting all four promotion criteria: independent (different research groups, different methodological frameworks, different time scopes), spans multiple metals (Pb, Cd), grounds the regulatory-intervention case study, with relevance to regulator (state-level enforcement case study) and educator (mechanistic asymmetry between processing-side and soil-side contamination) audiences. Re-synthesis is expected when the Consumer Reports chocolate dataset enters the corpus, when the FDA TDS chocolate-exposure analysis is cross-referenced, or when a dedicated Prop 65 enforcement timeline page documents the causal attribution rigorously.

References

[1] Cadmium and Lead in Cocoa Powder and Chocolate Products in the U.S. Market
Eileen Abt, Jennifer Fong Sam, Patrick Gray, and Lauren Posnick Robin · *Food Additives & Contaminants: Part B Surveillance* · 2018 · doi.org/10.1080/19393210.2017.1420700
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[2] A multi-year heavy metal analysis of 72 dark chocolate and cocoa products in the USA
Hands JM, Anderson ML, Cooperman T, Balsky JE, and Frame LA · *Frontiers in Nutrition* · 2024 · doi.org/10.3389/fnut.2024.1366231
REVIEW

[3] Toxic Metals and Metalloids in Food: Current Status, Health Risks, and Mitigation Strategies
Zhao D, Wang P, and Zhao FJ · *Current Opinion in Environmental Science & Health* · 2024 · doi.org/10.1007/s40572-024-00462-7
REVIEW

STATUS AND LICENCE

Editorially reviewed in-house; no external peer review has been completed on this finding. Published as a preprint with its review state tracked on the article page. Released under CC BY 4.0.

DATA AVAILABILITY

Every source behind this finding is listed with its own extraction record at <https://heavymetalindex.com/synthesis/us-chocolate-lead-temporal-decline#sources>, each linking to the ingest receipt, the extracted values, and the file hash of the document it was built from.

COMPETING INTERESTS

The Heavy Metal Index reports what the peer-reviewed and regulatory literature supports. It is operated separately from any certification program, does not evaluate or endorse brands, and does not use certification thresholds as evidence for the statements made here.

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