Population Effects of Turmeric Consumption on Pediatric Blood Lead Levels

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Prior Evidence

- Identification of Pb chromate, a potential adulterant, at turmeric manufacturing plants in India (source of 97% of US turmeric)
- Recalls of 4 US turmeric brands due to "excessive" Pb levels (Spice Hunter, Archer Farms, Pran, Dr. Clark Supplement)
- Reports of Pb poisoning following spice consumption from 4 health depts. across the US (AZ, CO, CT, CA)
- Identification of spices as the source of Pb exposure in case reports of clinical lead poisoning among children, adults and pregnant women.

Objectives

1. Quantify Pb concentration in turmeric samples purchased in greater Boston
2. Characterize the contribution of turmeric to children's blood lead levels (BLLs)

Methods

Sample Collection: We purchased 64 unique brands of turmeric from 48 stores in the Boston metropolitan area and randomly selected 50% for Pb analysis (n=32).

Chemical Analysis: We analyzed all samples for Pb using ICP-MS and determined *in vitro* Pb bioaccessibility (IVBA) and Pb relative bioavailability (RBA) for a randomly selected subsample (n=10) using a simple bioaccessibility extraction test (SBET).

Exposure Assessment: We estimated a range of Pb intake from turmeric consumption by searching the web for "turmeric recipes" and recording the volume used per serving. We halved the serving size for children 1-4 years.

Exposure Model: We used *@Risk6.0* to fit empirical distribution functions (EDFs) for our Pb (μg/g) & turmeric (g) ingestion data and conducted a one-dimensional Monte Carlo analysis to describe the population distribution of Pb exposure from turmeric consumption.

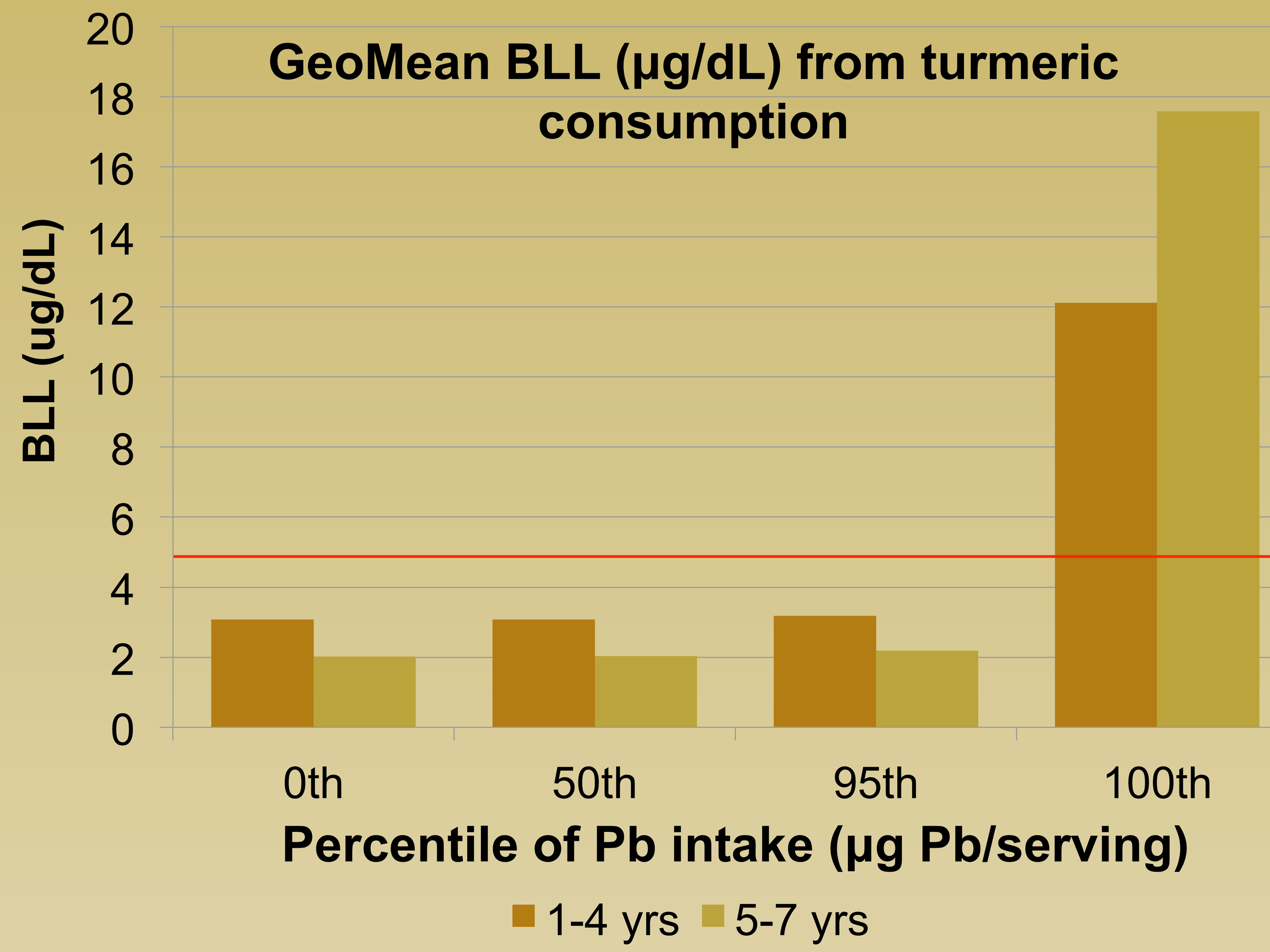
Risk Characterization: We input percentiles of Pb intake estimated from our exposure model into the EPA's Integrated Exposure Uptake Biokinetic Model (IEUBK) to predict changes in children's BLLs. We modified the default bioavailability to reflect our data from the SBET test.

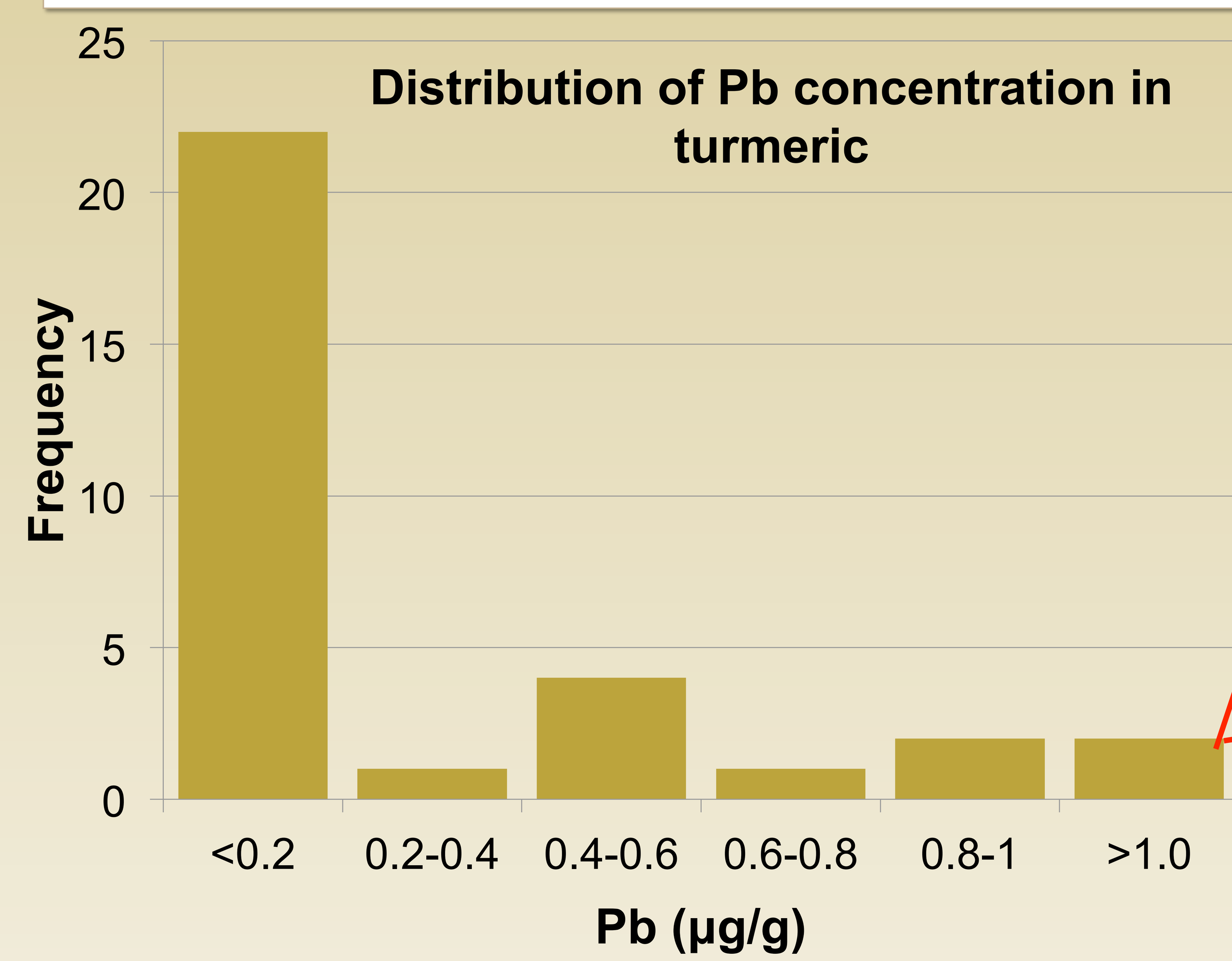
Results

Summary Statistics for Lead Concentration, Turmeric Consumption, and Bioaccessibility Data

	N	Mean (SD)	50th %ile	95th %ile	100th %ile
Pb Conc. (μg/g)	32	4.42 (18.39)	0.12	34.78	99.50
Turmeric Intake (g/serv)					
1-4 yrs	100	0.33 (0.33)	0.22	0.98	1.95
5-7 yrs	100	0.66 (0.67)	0.43	1.95	3.90
Pb Intake (μg/serv)*					
1-4 yrs		0.81 (5.18)	0.03	1.18	122.45
5-7 yrs		1.59 (10.42)	0.05	2.52	349.65
IVBA (%)**	10	69.97 (15.06)	65.75	99.80	99.80

*50,000 iterations was sufficient to achieve model stability.
**To estimate RBA we used the following model: RBA=0.878*IVBA-0.028. To estimate absolute bioavailability (ABA) from RBA we assumed 50% of soluble lead is absorbed in food and water from the child's GI tract





We found two samples with extremely elevated concentrations:
1. ACI Pure: 99.5 μg/g
2. Pran: 34.8 μg/g
Both were imported from Bangladesh where the permissible level is 2.3 ppm. Using our mean intake, we estimate that a single 400g bag of Aci Pure would last for 2 years when consumed by a child on a daily basis.

Conclusion

Use of turmeric for food preparation is unlikely to substantially increase BLLs, however, intentional adulteration of spice samples with high concentrations of Pb warrants further investigation.

Next Steps

Our next steps include investigation of additional pathways of turmeric consumption, such as supplements and beverages, which we have found to contain up to 18.3 g of turmeric.