



Research Article

# A Multistage Public Health Response to Pediatric Lead Exposure: A Case Study on Lead Tainted Turmeric in an Immigrant Family

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## Abstract

Although lead-based paint remains the primary source of childhood lead exposure in the U.S., immigrant children may also be exposed to non-traditional sources of lead in the U.S. This case study represents a local health district's response to an Afghan child with an elevated blood level in Las Vegas, NV from 2019-2021. Testing revealed that the child had an elevated blood lead level from the consumption of lead-tainted turmeric, purchased at a local ethnic market. Through a multistage approach, the child's elevated blood lead level dropped from 48 µg/dL to less than 3.5 µg/dL. This case study highlights the importance of a multidisciplinary and multistage approach in the identification, treatment, and intervention of an elevated blood lead level in children. We highlight key prevention and intervention strategies to reduce the impact of childhood lead poisoning in immigrant and marginalized children.

**Keywords:** Cultural specific exposure; Lead-contaminated spice; Pediatric lead poisoning; Turmeric

## Introduction

Childhood lead poisoning is one of the most preventable environmental health hazards in history. The CDC estimates that over half a million children under six years old in the U.S. have elevated blood-lead levels (EBLLs) [1]. Ample evidence demonstrates that chronic, low-level exposure can have long-lasting physical [2], behavioral [1,2], developmental [2], and cognitive impairments on children [1,2].

The burden of lead exposure falls disproportionately on children from marginalized populations such as racial/ethnic

minorities, immigrants and refugees, and those living in poverty and in older homes [3,4]. Poverty is a strong social determinant of lead exposure [5], as it is correlated with living in older, substandard housing in urban centers, which poses a substantial lead hazard risk [6]. As such, the U.S. Centers for Medicare and Medicaid (CMS) requires Medicaid enrolled children to be tested in accordance with the American Academy of Pediatrics Bright Futures periodicity schedule [7].

Nevada is home to over 220,000 children under six years old and 12.5% of Nevadans live in poverty [8]. Non-Latinx Blacks, who bear the greatest risk of lead exposure, make up 10.3% of Nevada's total population, while Latinxs, who have historically faced high rates of lead exposure, comprise 29.2% of the population

[8]. Immigrants make up 20% of Nevada's residents and 25% of the state's workforce [9].

Immigrant and refugee children may be at higher risk of EBLs than native-born children because of exposure in their country of origin and post-resettlement [10]. Pre-resettlement lead hazards include lead-based paint, improper disposal of lead-acid batteries, leaded gasoline, and various consumer commodities [10]. Some refugees have experienced lead exposure from lead-based paint in their homes post-resettlement in the U.S., as refugees are often relocated to older housing [11,12]. Importantly, some immigrants and refugees have additional risks of lead exposure through the continued use of culturally specific practices and artifacts that include the use of or consumption of lead tainted items [10-13].

A variety of foods, spices, toys, and cultural products have been found to contain lead [14-16], which can increase children's risk of lead exposure. Fruits, vegetables, and spices may be unintentionally contaminated by the presence of lead in air, dust, or soil where food is grown or processed [17-20]. Lead can also be found in folk medicines [21] such as litargirio used for burns and fungal infections in the Dominican Republic [14], greta and azarcon used in Mexico, to treat teething in infants and a variety of digestive ailments in people of all ages [22], or in kohl [23], a cosmetic/medicine widely used across South Asia, North Africa, and the Middle East [13].

Use of any of these culturally specific foods, spices, medicines and cosmetics can increase children's risk of lead exposure. It should be noted that purchasing ingredients in the U.S. does not guarantee that they will be lead-free [17]. In a study of almost 1,500 foods and spices examined in New York City, 30% had excessive lead concentrations [17]. Notably, 40% of the collected samples were spices, with turmeric being the second most common spice [17]. Turmeric, cultivated mainly in Southeast Asia and India, is used as a spice in food and as a traditional medicine for a broad variety of treatments (National Center for Complimentary and Integrative Health and National Institute for Health). Turmeric was found to be the primary source of lead exposure detailed in this case study.

This case study details the process of treating a child and his family [24] after a March 2019 Blood Lead Level (BLL) test revealed an EBL in the child and subsequently, his family members. The purpose of this paper is to highlight non-traditional lead hazards that can place children at risk and to underscore the necessity of a multidisciplinary approach to preventing, diagnosing, and treating lead exposure.

## Materials and Methods

This study was approved by the Institutional Review Board of the University of Nevada Las Vegas, IRB # UNLV-2022-112.

The Southern Nevada Health District (SNHD) Childhood Lead Poisoning Prevention Program (CLPPP) was established in 2006 with the purpose to prevent lead poisoning and to identify and provide services to children with EBLs. The information that informs this case study was acquired in response to the program's efforts to reduce the impact of lead exposure in children. During this case study, BLL surveillance began at SNHD with the Office of Epidemiology and Disease Surveillance (OEDS), which monitored all BLL results received by the health district. Once the EBL ( $\geq 10$   $\mu\text{g}/\text{dL}$ ) was identified, SNHD deployed a multidisciplinary and multistage approach to respond to the case, which started with OEDS referring the case to Nurse Case Management (NCM) and progressing to Environmental Health (EH).

Children with EBLs described herein received NCM. NCM provided intensive case management including a home visit, review of nutritional and social history, nutritional education, and a plan of care. Nurses administered a lead exposure risk questionnaire to determine possible sources of lead exposure and coordinated an environmental assessment. Furthermore, NCM monitored BLL results until EBLs were below the reference value.

In addition, families received an environmental assessment managed by SNHD's Division of Environmental Health. An EPA-certified lead risk assessor used a calibrated Niton XL3t-700 and calibrated Niton XL3p-303A-Ray Fluorescence (XRF) to examine lead-painted sources in interior and exterior of the home (e.g., paint, windows) and non-painted sources (e.g., imported candy, toys or jewelry). Samples from a local ethnic market were purchased for additional analysis. An environmental laboratory accredited by the National Lead Laboratory Accreditation Program (NLLAP) tested soil, dust, water, and food samples using Atomic Absorption Spectroscopy (AAS).

## Results

In March 2019, a pediatrician found that Child A had an EBL of 48  $\mu\text{g}/\text{dL}$ , well in excess of the CDC BLL reference value of 5  $\mu\text{g}/\text{dL}$ , following his well-child visit. This triggered a family-wide investigation that helped identify and treat two other children with EBLs (Child B and C). Child B's EBL had been discovered the month prior (February 2019), but the EBL was not high enough at the time to warrant intensive nurse case management and an environmental investigation. This case study details how SNHD's response helped reduce the children's EBLs. During the course of SNHD's response, it was revealed that all three children were related but lived in two separate households. They had parents who had emigrated from Afghanistan, and all consumed a culturally-specific source of lead tainted turmeric.

### Child A

Child A, a two-year-old male, presented with no signs of developmental delays and had a venous BLL of 48  $\mu\text{g}/\text{dL}$ . The

pediatrician reported the child's BLL to the SNHD OEDS, where he subsequently received guidance on chelation therapy to reduce the BLL. Based on the initial information, Child A was referred to a local emergency department for further laboratory workup, abdominal radiographs, and determination of inpatient hospitalization.

Child A was admitted to a local hospital for a 2-day inpatient work-up and treatment. Child A's complete blood count demonstrated a hemoglobin of 12.3 g/dL (reference range 11.0-12.8 g/dL), with a mean corpuscular volume of 72.5 fL (reference range 76.8-83.3 fL). Mean corpuscular hemoglobin concentration measured 32.3 g/dL (reference range 34.2-35.7 g/dL). The Poison Control Center recommended oral chelation therapy with succimer (Trade name: Chemet). Succimer is recommended for children with moderate lead poisoning (45-69 µg/l), who can be protected from further lead exposure [25]. Because there was no succimer available at the hospital nor the local pharmacy at the time Child A was evaluated, the medicine had to be ordered from a neighboring state. Once received, Child A's parents administered chelation therapy with succimer at 10 mg per kg body weight twice daily for 14 days.

### Child B

In February 2019, OEDS received record of a venous BLL of 9 µg/dL for Child B through electronic laboratory reporting-high enough for OEDS to respond ( $\geq 5$  µg/dL), but not high enough for NCM and EH to respond ( $\geq 10$  µg/dL). OEDS conducted the initial

interview with the family of Child B via phone in February 2019. A lead risk hazard questionnaire was completed, and no obvious environmental lead hazards or potential household sources of lead exposure were identified. Child B lived in a single-family home built in 2005 and no occupational sources or hobbies with lead hazards were identified. During the interview following Child B's first EBLL, the family of Child B indicated that they only use products from the U.S. and do not use imported spices. During this time, no additional family members were tested for lead exposure and the investigation on Child B was considered an isolated event. However, in March, Child B was tested again and had an EBLL of 11 µg/dL, triggering a response from NCM and EH.

### Family-Wide Assessments and Follow Up

The connection between Child A and Child B resulted in a referral of additional family members for blood lead screening. Table 1 provides a summary of all the family members tested. This includes Child A's father, a 34-year-old male (Adult A), who had a BLL of 49 µg/dL, Child A's mother, a 28-year-old female (Adult B) who had a BLL of 20 µg/dL, and Child B's two-year-old sister (Child C), who was tested in March 2019 and was found to have a venous EBLL of 13 µg/dL. The pediatrician noted that Child B and Child C presented with no signs of developmental delays or behavioral problems.

		Age	Gender	Year Housing Built	Feb 2019 BLL	Mar 2019 BLL	Apr 2019 BLL	May 2019 BLL	Aug 2019 BLL	Sep 2019 BLL	Dec 2019 BLL	Jun 2020 BLL	Aug 2020 BLL	Oct 2020 BLL	Jan 2021 BLL
<b>Fam. A</b>	Child A	2 yrs.	M	2013	-	48 µg/dL, 48 µg/dL	18 µg/dL, 17 µg/dL	19 µg/dL	-	14 µg/dL	9 µg/dL	7 µg/dL	-	6 µg/dL	-
	Adult A	34 yrs.	M	2013	-	49 µg/dL	42 µg/dL	-	15 µg/dL	-	-	-	4 µg/dL	-	-
	Adult B	28 yrs.	F	2013	-	-	-	20 µg/dL	-	5 µg/dL	-	2 µg/dL	-	-	-
<b>Fam. B</b>	Child B	9 mos.	F	2005	9 µg/dL	11 µg/dL	8 µg/dL	-	-	3 µg/dL	-	-	-	-	<1 µg/dL
	Child C	2 yrs.	F	2005	-	13 µg/dL	-	-	-	3 µg/dL	-	-	-	-	1 µg/dL

**Table 1:** Decreases in Elevated Blood Lead Levels after Public Health Intervention.

The three children were referred for intensive case management and for an environmental assessment to be conducted of the two separate homes. Prior to the environmental assessment of Child A's home, the following lead risk factors were identified from the completion of the NCM lead questionnaire - Child A had eaten non-food items (paint from daycare) and had chewed on the zipper of his jacket. The environmental assessment at Child A's home was conducted 7 days after the EBLL was first identified. Child A lived in an apartment built in 2013. Both the interior and exterior of the building were inspected for lead risk hazards and no lead-based paint hazards were identified. However, analysis of non-painted items identified the following lead hazards - dishware, a meat grinder, crystal items, turmeric spice, and rice seasoning. The turmeric sample was confirmed by laboratory testing to have lead levels of 2,000 mg/kg while the rice seasoning had 0.6 mg/kg of lead (Table 2). Five dust samples from the floor tile and one water sample were collected and submitted for further analysis-none of the results exceeded the EPA's lead standards.

	Sample	XRF Readings	Sample Area / Air Volume	Analyte	Result	Results Units	Reporting Limit
Child A's Home	Yogurt Sample #1	NA	7 oz	Pb	< 0.5	mg/kg	0.5
	Yogurt Sample #2	NA	7 oz	Pb	< 0.5	mg/kg	0.5
	Water Sample	NA	8 oz	Pb	< 5	ppb	5
Child B's Home	Turmeric Spice (local market)	1711 ppm +/- 141	1 oz	Pb	2,000	mg/kg	1,000
	Rice Seasoning	ND	1 oz	Pb	0.6	mg/kg	0.5
	Anise Seed	NA	0.5 oz	Pb	< 0.5	mg/kg	0.5
	Unknown (Type of Flower)	NA	.25 oz	Pb	< 0.5	mg/kg	0.5
	Cardamom	NA	.25 oz	Pb	< 0.5	mg/kg	0.5
	Turmeric Spice (local market)	1,618 ppm +/- 243	1 oz	Pb	3,000	mg/kg	3,000
	Turmeric Spice (Afghanistan)	11,000 ppm +/- 1	1 oz	Pb	15,000	mg/kg	8,000
	Spice for Chicken	ND +/- 68	1 oz	Pb	< 2	mg/kg	2
	Paprika	NA	0.5 oz	Pb	< 2	mg/kg	2
	Ginger	NA	0.5 oz	Pb	< 2	mg/kg	2
	Paprika (local market)	NA	0.5 oz	Pb	< 2	mg/kg	2
	Organic Turmeric	NA	0.5 oz	Pb	< 2	mg/kg	2
	Water Sample	NA	8 oz	Pb	< 2	ppb	2

**Table 2:** Environmental Samples Sent for Laboratory Analysis.

Completion of the lead questionnaire in Child B's home identified two potential lead hazards-minor remodeling done in the home and chalk from a billiards table. The environmental assessments for Child B were conducted 9 days after Child A's EBLL was identified. In Child B's home, analysis identified dishware, car keys, and two types of turmeric spice-one imported from Afghanistan and the other purchased from the same local ethnic market as that found in Child A's home. The lead risk assessment revealed no lead-based paint hazards in the home. Analysis demonstrated lead levels of 15,000 mg/kg in the turmeric from Afghanistan and 3,000 mg/kg in the turmeric from the local ethnic market. None of the dust samples from the floor tile (average of 0.50 µg per square foot) in Child B's home exceeded the EPA lead standard of 10 ug/ft [2,26].

The parents of Children A, B, and C emigrated from Afghanistan (Children B and C are siblings) and all three children were born in the U.S. Neither family A nor B indicated the use of culturally specific lead hazards such as kohl, surma, or kajal. The environmental assessors recommended that identified lead hazards be removed from the home. Interviews with both families indicated

that the family of Child A consumed more food containing turmeric than did the family of Children B and C. EBLLs demonstrated higher lead in Family A compared to those in Family B.

Additional follow-up with the families revealed that they removed all the lead-identified items from the household. SNHD intervention contributed to a decline of the BLLs among all family members (Table 1). After initiation of chelation therapy, Child A's BLL was reduced from 18 µg/dL to 6 µg/dL by October 2020. By January 2021, Children B and C's BLL dropped to <1 µg/dL.

#### **Analysis for Lead in Spices from the Local Ethnic Market**

As a result of two families utilizing locally sold turmeric tainted with lead, SNHD's EH obtained additional turmeric samples from the market where it was purchased. A total of 5 samples of turmeric were tested. The packing labels indicated that samples were products of India and manufactured/distributed in the U.S. Since the turmeric spice purchased locally was not in its original packaging and no lot information was available, multiple turmeric spices were purchased. One sample of turmeric collected resembled the description of the packaging described by the

family. Additional samples were collected to cast a net for potential samples of lead-contaminated turmeric. AAS analysis (Table 3) indicated no lead in the acquired samples.

Sample	Sample Area / Air Volume	Analyte	Result	Results Units	Reporting Limit
Turmeric Spice #1	0.5 oz	Pb	< 1	mg/kg	1
Turmeric Spice #2	0.5 oz	Pb	< 0.5	mg/kg	0.5
Turmeric Spice #3	0.5 oz	Pb	< 0.5	mg/kg	0.5
Turmeric Spice #4	0.5 oz	Pb	< 0.5	mg/kg	0.5
Turmeric Spice #5	0.5 oz	Pb	< 0.5	mg/kg	0.5

**Table 3:** Samples of Turmeric Spices Obtained from the Local Ethnic Market.

## Discussion

This case study highlights the importance of a multidisciplinary and multistage approach to identify, treat, and intervene in childhood lead poisoning cases. These findings also support existing reports of lead-contaminated turmeric in the U.S. and suggest that immigrants and refugees face risk of lead poisoning through consumption of culturally specific spices [17,18,25]. This case study also highlights key areas that can be strengthened to improve primary, secondary, and tertiary prevention efforts in childhood lead poisoning.

To prevent initial lead exposure in children, we recommend two primary prevention efforts. First, continued efforts are needed to provide education and outreach about traditional and non-traditional sources of lead exposure to stakeholders including community members, community leaders, and medical practitioners. This entails helping stakeholders understand that lead hazards exist in many pre-1978 housing units [27]. Additionally, because some lead hazards may be culturally specific, a one-size fits all model of health communications does not suffice for all communities. Therefore, we argue for the use of a community-engaged approach to lead exposure prevention. This approach enhances community reach, providing an opportunity to develop culturally and linguistically appropriate materials, and most importantly, help community members build a sense of trust in public health organizations. Engagement in historically marginalized communities requires us to be sensitive to deep-rooted cultural practices. The importance of crafting meaningful messages and respect for culture cannot be overstated. As non-traditional lead hazards persist or emerge in our communities, targeted efforts need to be developed to inform stakeholders. Considerable efforts still need to be made to educate our partners about both traditional sources of lead exposure and non-traditional sources that may be embedded in cultural practices.

Policies also serve as a primary prevention strategy to reduce lead exposure. For instance, the 2011 Food Safety Modernization Act (FSMA) gave the U.S. Food and Drug Administration (FDA) regulatory powers over the nation’s food supply. This has supported efforts to reduce contamination in food from lead and other impurities by providing the authority to (1) establish prevention measures, (2) ensure compliance, (3) develop responses such as mandatory recalls, and (4) develop methods to better ensure imported products meet U.S. standards (Food and Drug Administration (FDA), “Food Safety Modernization Act (FSMA)”). Furthermore, it is encouraging that FDA’s Closer to Zero Plan aims “to reduce exposure to elements from foods eaten by babies and young children” particularly in baby food (Food and Drug Administration (FDA), “Closer to Zero: Action Plan for Baby Foods”) [28,29].

Although the U.S. has been at the forefront of effective policies to reduce lead exposure in children, we still lack federal policies to limit the amount in some foods. Therefore, similar to the FDA’s regulation stating that lead in bottled water cannot exceed 5 parts per billion, the FDA should establish a maximum allowable limit of lead in spices, and enforce it. Furthermore, the FDA should regularly test and report on heavy metals in spices. This could help quantify adulterated turmeric consumption and its impacts as well as prevent future consumption [30,31]. For instance, the FDA’s Total Diet Study monitors levels of nutrients and contaminants in foods commonly eaten by people in the U.S.—however; it does not include spices (Food and Drug Administration (FDA), Total Diet Study; Food and Drug Administration (FDA), Total Diet Study Food/Analyte Matrix). Spices should be accounted for in future FDA analyses because lead-contaminated spices can harm children and disproportionately impact vulnerable communities. Another key approach includes standardizing package labeling to require brand, lot number, country of origin, and whether the spices meet safety standards. Proper package labeling can support tracing of adulterated spices to prevent their consumption.

Policy development should extend beyond the U.S. It is recommended that the FDA work collaboratively with other countries to develop maximum allowable limits of lead in spices, especially in countries that export the largest amounts of spices to the U.S. Regular testing and enforcement of these standards abroad are critical to ensure that spices do not contain dangerously high levels of lead for local populations or international populations when the spices are exported [32].

The main form of secondary lead poisoning prevention is to screen children for elevated blood lead levels in order to identify exposures early and reduce any associated negative impacts. Medical practitioners play a pivotal role in the identification of children with EBLLs. This case study demonstrated how a physician's identification of a child with an EBLL and proactive role in connecting that child to services resulted in ongoing nurse case management and BLL monitoring to ensure BLLs continued to decrease. However, some states, like Nevada, are challenged with low screening rates. Therefore, continued efforts and strategies need to be developed to enhance the identification of children with EBLLs. This paper shows that childhood lead poisoning prevention programs need to include case management, environmental assessments to identify lead hazards, and ongoing BLL monitoring to ensure the best possible outcomes in children with EBLLs [33,34].

Finally, this case study elucidated the need for tertiary lead poisoning prevention efforts to mitigate the long-term impacts of EBLLs. As part of a comprehensive public health response, states need to be prepared to develop timely responses to address EBLL cases. As presented in this case study, neither the hospital where the child was being treated nor the local pharmacy had succimer in stock, which delayed treatment, since an out-of-state supplier had to be contacted. To prevent future delayed lead poisoning treatment, we recommend hospitals that serve immigrant and low-income populations of children, located in and around zip codes with high lead exposure risk maintain a stock of succimer.

## Conclusion

This case study makes apparent that a robust public health response is needed to successfully address childhood EBLLs in order to identify and mitigate the impacts of lead exposure, especially in medically underserved immigrant communities. Such public health response requires coordination and collaboration with multiple agencies including medical providers, local health authorities and their various teams, hospitals, pharmacies, and childhood lead poisoning prevention programs. Our findings lend support to the notion that lead contamination is a global issue that will not be eradicated by local interventions alone. In addition, we delineate the need for strategic partnerships, the incorporation of culturally and linguistically appropriate outreach and educational approaches, and the need for policy change to reduce lead in spices.

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## References

1. Council on Environmental Health (2016) Prevention of Childhood Lead Toxicity. *Pediatrics* 138: e20161493.
2. Centers for Disease Control and Prevention (CDC) (2021) CDC Updates Blood Lead Reference Value for Children. *CDC Newsroom*.
3. Kim DY, Staley F, Curtis G, Buchanan S (2002) Relation between housing age, housing value, and childhood blood lead levels in children in Jefferson County, Ky. *Am J Public Health* 92: 769-770.
4. Centers for Disease Control and Prevention (2013) Blood lead levels in children aged 1-5 years - United States, 1999-2010. *MMWR Morb Mortal Wkly Rep* 62: 245-248.
5. Sampson RJ, Winter AS (2016) The Racial Ecology of Lead Poisoning: Toxic Inequality in Chicago Neighborhoods, 1995-2013. *Du Bois Review* 13: 261-283.
6. Centers for Disease Control and Prevention (1997) Screening Young Children for Lead Poisoning: Guidance for State and Local Public Health Officials.
7. Medicaid (2022) Lead Screening.
8. U.S. Census Bureau (2021) U.S. Census Bureau QuickFacts: Nevada.
9. American Immigration Council (2016) Immigrants in Nevada.
10. Shakya S, Bhatta MP (2019) Elevated blood lead levels among resettled refugee children in Ohio, 2009-2016. *Am J Public Health* 109: 912-920.
11. Lupone CD, Daniels D, Lammert D, Borsuk R, Hobart T, et al. (2020) Lead Exposure in Newly Resettled Pediatric Refugees in Syracuse, NY. *Journal of Immigrant and Minority Health* 22: 34-43.
12. Eisenberg KW, van Wijngaarden E, Fisher SG, Korfmacher KS, Campbell JR, et al. (2011) Blood lead levels of refugee children resettled in Massachusetts, 2000 to 2007. *Am J Public Health* 101: 48-54.
13. Centers for Disease Control and Prevention (CDC) (2012) Infant lead poisoning associated with use of tiro, an eye cosmetic from Nigeria--Boston, Massachusetts, 2011. *MMWR Morb Mortal Wkly Rep* 61: 574-576.
14. Centers for Disease Control and Prevention (2005) Lead poisoning associated with use of litargirio--Rhode Island, 2003. *MMWR Morb Mortal Wkly Rep* 54: 227-229.

15. Greenway JA, Gerstenberger S (2010) An evaluation of lead contamination in plastic toys collected from day care centers in the Las Vegas Valley, Nevada, USA. *Bull Environ Contam Toxicol* 85: 363-366.
16. Diaz-Ruiz A, Tristan-Lopez LA, Medrano-Gomez KI, Torres-Dominguez JA, Rios C, et al. (2017) Glazed clay pottery and lead exposure in Mexico: Current experimental evidence. *Nutritional Neuroscience* 20: 513-518.
17. Hore P, Alex-Oni K, Sedlar S, Nagin D (2019) A Spoonful of Lead: A 10-Year Look at Spices as a Potential Source of Lead Exposure. *J Public Health Manag Pract* 25: S63-S70.
18. Angelon-Gaetz KA, Klaus C, Chaudhry EA, Bean DK (2018) Lead in Spices, Herbal Remedies, and Ceremonial Powders Sampled from Home Investigations for Children with Elevated Blood Lead Levels-North Carolina, 2011-2018. *MMWR Morb Mortal Wkly Rep* 67: 1290-1294.
19. Ud Din A, Abdel-Reheem MAT, Ullah H, Ahmad I, Waseem A, et al. (2013) Assessment of heavy metals in onion and potato in imported and local variety of Pakistan and Afghanistan. *Life Sci J* 10: 198-204.
20. Zikrullah S, Buerkert A (2011) Heavy Metal and Microbial Loads in Sewage Irrigated Vegetables of Kabul, Afghanistan. *Journal of Agriculture and Rural Development in the Tropics and Subtropics* 112: 29-36.
21. Mamtani R, Stern P, Dawood I, Cheema S (2011) Metals and disease: a global primary health care perspective. *J Toxicol* 2011: 319136.
22. Centers for Disease Control and Prevention (CDC) (2002) Childhood lead poisoning associated with tamarind candy and folk remedies-California, 1999-2000. *MMWR Morb Mortal Wkly Rep* 51: 684-686.
23. Jallad KN, Hedderich HG (2005) Characterization of a hazardous eyeliner (kohl) by confocal Raman microscopy. *J Hazard Mater* 124: 236-240.
24. Kappel M, Kraushaar V, Mehretu A, Slater W, Marquez E (2021) Notes from the Field: Childhood Lead Poisoning Associated with Turmeric Spices - Las Vegas, 2019. *MMWR Morb Mortal Wkly Rep* 70: 1584-1585.
25. Cowell W, Ireland T, Vorhees D, Heiger-Bernays W (2017) Ground Turmeric as a Source of Lead Exposure in the United States. *Public Health Rep* 132: 289-293.
26. United States Environmental Protection Agency (2022) Hazard Standards and Clearance Levels for Lead in Paint, Dust and Soil (TSCA Sections 402 and 403).
27. Jacobs DE, Clickner RP, Zhou JY, Viet SM, Marker DA, et al. (2002) The prevalence of lead-based paint hazards in U.S. housing. *Environ Health Perspect* 110: A599-A606.
28. Food and Drug Administration (FDA) (2021) Closer to Zero: Action Plan for Baby Foods.
29. Frestedt JL (2017) Chapter 7: Food Safety Modernization Act (FSMA). *FDA Warning Letters about Food Products* pp: 207-231.
30. US FDA (2021) Total Diet Study.
31. US FDA (2021) Total Diet Study Food/Analyte Matrix. Pp: 1-7.
32. Marshall AT, Betts S, Kan EC, McConnell R, Lanphear BP, et al. (2020) Association of lead-exposure risk and family income with childhood brain outcomes. *Nat Med* 26: 91-97.
33. National Center for Complimentary and Integrative Health and National Institute for Health (2020) Turmeric.
34. Tehranifar P, Leighton J, Auchincloss AH, Faciano A, Alper H, et al. (2008) Immigration and risk of childhood lead poisoning: findings from a case-control study of New York City children. *Am J Public Health* 98: 92-97.