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ARTICLE

Atypical sources of childhood lead poisoning in the United States: A systematic review from 1966–2006

EMMANUEL C. GOROSPE and SHAWN L. GERSTENBERGER, Ph.D.

University of Nevada Las Vegas, School of Public Health, Department of Environmental & Occupational Health, Las Vegas, Nevada, USA

Background. Lead poisoning from atypical sources, which excludes the well-established lead-based paint ingestions and exposure in occupational settings, are increasingly reported in medical literature. Our objective is to increase awareness on atypical sources of lead exposure and to formulate recommendations for their detection based on actual reported cases. *Methods.* We systematically retrieved and reviewed reports on pediatric lead poisoning in the U.S. from atypical sources by searching Medline, Embase, CINAHL, Academic Search Premier, AltHealth, websites of state lead poisoning prevention programs, and the U.S. Consumer Product Safety Commission database for reports published from January 1966 to December 2006. *Results.* We retrieved 28 published reports that met our inclusion criteria. Of these reports, 20 are case reports and 8 case series, documenting a total of 82 incidents of lead poisoning in children from atypical sources. *Conclusion.* There are varied sources of atypical lead exposure among U.S. children. The sources were grouped in the following categories based on their utility: fashion accessories, folk remedies, imported condiments & candies, pellets & bullets, and lastly, recreational & domestic items. Based on these findings, we have formulated a questionnaire that may assist in the identification of atypical lead sources in the home.

Keywords Lead poisoning; Children; Systematic review; United States

Introduction

Significant improvements in the prevention and treatment of lead toxicity have decreased the incidence of acute lead poisoning among children in the United States (1). However, there are still sporadic cases of lead poisoning in children from both familiar and uncommon sources. The identification of all potential lead sources is paramount in preventing lead's adverse effects on children's growth and development. Acute high doses and chronic low doses of lead exposure have been demonstrated to exert adverse effects on children's behavioral and cognitive functions (2–4).

The Centers for Disease Control and Prevention (CDC) has established ≥10 µg/dL Blood Lead Level (BLL) as the cut-off value for intervention (5). In the 1999–2002 National Health and Nutrition Examination Survey periods, it is estimated that approximately 310,000 children under 6 years are at risk for harmful lead exposure (6). This age group has an increased propensity for hand-to-mouth activity, a greater tendency to exhibit *pica*, increased lead absorption in the gut, and increased sensitivity to neurological damage (7, 8).

Alarmingly, recent population-based studies by Lanphear *et al* (3) and Canfield *et al* (4) report measurable educational and cognitive deficits among children with BLLs below the 10 µg/dL CDC cut-off value. These findings suggest that more U.S. children may be at risk than conservatively estimated. These raise the need for greater surveillance of lead-containing products since the risk of environmental lead appears to have no clearly defined threshold (9).

There have been numerous public health initiatives that have successfully reduced children's exposure to lead. These include the removal of lead from gasoline and paint. Still, approximately 80% of houses built before the 1960s contain lead-based paint (1). It was only in 1978 when lead was banned from domestic paint products (10). Despite these efforts, deteriorating paint chips and lead dusts may contaminate home surfaces (11). These typical exposures are the major sources lead poisoning cases (12). However, there are increasing reports of lead poisoning related to the use of traditional ethnic remedies (13), toys (14), food (15), and fashion accessories (16). With the emergence of global free trade and ease of international travel, we are seeing more unregulated international food items, domestic utensils, and cultural paraphernalia in U.S. markets and households. As a result, the current medical literature contains several cases of confirmed lead poisoning from poorly regulated domestic and foreign products (17, 18).

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Address correspondence to Dr. Shawn L. Gerstenberger Ph.D. University of Nevada Las Vegas, School of Public Health, Department of Environmental & Occupational Health, 4505 Maryland Parkway, P.O. Box 453064, Las Vegas, NV 89154-3064. E-mail: shawn.gerstenberger@unlv.edu

This systematic review aims to summarize published reports on acute lead poisoning and elevated BLLs from atypical sources. It excludes reports from the common lead-based paint ingestions, exposure to leaded gasoline, lead-soldered pipes, and occupational exposure. Our objective is to increase awareness regarding uncommon sources of lead exposure and to formulate recommendations for the identification and removal of atypical lead sources based on reported cases of lead poisoning. This review can also serve as guide for public health professionals who are confronted with the task of identifying and isolating obscure and foreign sources of environmental lead exposures.

Methods

Data sources

We searched Medline, Embase, CINAHL, Academic Search Premier, and AltHealth for articles published from January 1966 to December 2006, using combinations of the following medical subject heading (MeSH) search terms: *lead poisoning, heavy metal, blood lead levels, children, case reports, case series*; as per the Cochrane Collaboration recommended search strategy. In addition, the authors' files and bibliographies of retrieved papers were subsequently searched for further relevant published reports. Lastly, the authors visited the websites of state lead poisoning prevention programs, and the U.S. Consumer Product Safety Commission (CPSC) database for online case reports and products recalled due to lead poisoning in children.

Selection criteria

We included clinical case reports, case series, and other epidemiologic studies in the U.S. which presented cases of acute lead poisoning and elevated BLLs (≥10 μg/dL) in children ages 6 years old and below. Selected articles must contain original data of the actual case, indicating age of the child, measured BLLs, and source of lead exposure. The BLL must be reported and preferably measured by standard graphite furnace atomic absorption spectrophotometry or other approved methodology (e.g. inductively coupled plasma mass spectrometry). The identified source of lead poisoning must be other than the typical lead-paint chips or dust ingestion and exposure from occupational or industrial settings. The strength of the causal relationship between the case and the atypical source was assessed by the authors based on the detailed description of the published report. Reports that had unclear causes or without any confirmed source of lead exposure were rejected. Whenever a case is reported twice such as a citation in the CDC Mortality and Morbidity Weekly Reports, we opt to select the primary report from the original investigators.

For the cases meeting our selection criteria, we extracted information on the patient's age, sex, source of lead poisoning, lead content, highest reported BLL, presenting symptoms, intervention, and case outcome. Other family members such as siblings, diagnosed to have elevated BLLs and aged 6 years old and below, who are coincidentally discovered during the investigation of the original case and lacking sufficient details will be cited but not counted as part of the review. Disagreements in the selection of cases and extraction of data were resolved by discussion and repeated assessment of the articles.

Results

We retrieved 28 published reports that met our inclusion criteria. Of these reports, 20 are individual case reports and 8 case series, documenting a total of 82 incidents of lead poisoning in children from atypical sources. The different sources were grouped by the authors into the following categories based on the items' utility: *fashion accessories, folk remedies, imported condiments & candies, recreational items, domestic items* and lastly, the miscellaneous group of *pellets and bullets*.

There are 13 reported cases resulting from unintentional ingestion of leaded fashion accessories (16, 19–21), recreational items (14, 22, 23), curtain weights (24), bullets, and pellets (25–28). There is only a single case (29) of lead poisoning from retained bullet fragments. *Cosmetic plumbism* or lead poisoning from use of lead-tainted ethnic cosmetics accounts for 8 individual cases (30). There are 9 cases of elevated BLLs from imported condiments (31–33) and candies (15–33). Other domestic items such as lead-tainted ceramic dinnerware (34), imported urns (35), lead-glazed pitchers (36), and miniblinds (37) account for 4 cases. The most number of recorded cases are from folk remedies. There are 47 children reported to have elevated BLLs from folk remedies. Of these, *azarcon* and *greta* are the leading sources.

There are 22 cases which are asymptomatic and diagnosed only to have elevated BLLs on routine screening. In this review, children with elevated BLLs from imported condiments and candies do not present any symptoms and are only identified on routine blood lead screening. Among those that have presenting symptoms that prompted medical attention, the most common complaints are abdominal pain, vomiting, and irritability.

With our standard cut-off of 6 years old, the weighted median age of children with elevated BLLs is 2 years and 3 months old. The youngest is 3 months old from cosmetic plumbism. Overall, the weighted median BLL is 46 μg/dL, ranging from 10 to 238 μg/dL. The highest recorded BLL of 238 μg/dL is from a 2-year-old child who subsequently died of severe encephalopathy from the lead toxicity (24). A summary of pediatric lead poisoning cases in the U.S. from atypical sources can be seen on Tables 1 to 6.

Discussion

Preventing unnecessary exposure to lead and isolating its sources are the tenets of current lead poisoning prevention programs. These programs work by informing the public

Table 1. Cases of elevated BLLs from fashion accessories

Reference	Age/ Sex	Lead source	Lead content (mg/kg)	BLL (μg/dL)	Presenting symptoms	Intervention	Outcome
Berkowitz, 2006	4/M	Ingested metallic charm	990,000	180	Abdominal pain, intractable vomiting	Lead toxicity diagnosed postmortem	Lead encephalopathy resulting to death
Jones, 1999	2/M	Ingested necklace bead from China	20,200	43	Diagnosed on routine screening	Necklace removed from child	BLL dropped to 24 μg/dL after 3 weeks
Esernio-Jenssen, 1996	3/F	Ingested metallic clothing accessory from Singapore	940,000	150	Abdominal pain, pallor, irritability	Endoscopic removal, Chelation therapy	BLL dropped to 56.5 μg/dL on hospital discharge
J. Sprinkle, 1995	1/F	Ingested metallic locket	None reported	44	None reported	Endoscopic removal	BLL dropped to unspecified level
R. Sprinkle, 1995	1	Leaded eye cosmetics from Pakistan	None reported	10	None reported	None reported	None reported
	3			10			
Cases from a chart review in a California county hospital	1			13			
	2			13			
	1			15			
	1			17			
	1			22			
	3mos.			24			

Table 2. Cases of elevated BLLs from folk remedies

Reference	Age/ Sex	Lead source	Lead content (mg/kg)	BLL(µg/dL)	Presenting symptoms	Intervention	Outcome
CDC, 2005	5/F ¶-1	*Litargirio* [1]	790,000	29	Diagnosed on routine screening	*Litargirio* application discontinued and removed from house	BLL dropped to 7 µg/dL after 9 months
	1/F ¶-1			44			BLL dropped to 16 µg/dL after 9 months
CDC,2002	4 /M ¶-2	*Greta* [2]	770,000	88	Diagnosed on routine screening	Chelation	None reported
	6/F ¶-2			69		Chelation	None reported
	2/M			26		None reported	None reported
Moore, 2000	5/M	Tibetan herbal supplement	Report estimates that child may have consumed 63g of Pb	86	Persistent anemia	Chelation therapy	BLL dropped to 24.5 µg/dL after 4 years
Jones, 1999	11mos.	*Surma* [3]	252,000	43	Diagnosed on routine screening	*Surma* application discontinued	BLL dropped to 23 µg/dL after 8 weeks
CDC, 1993 *Case series reported in California 1991–1992*	22 cases Median age: 2 yrs. Age range: 8 mos. to 5 yrs	*Azarcon* [4]	760,000 –860,000	Median:33 Range: 21–64	5 cases had symptoms of irritability, diarrhea, abdominal pain, vomiting	None reported	None reported
	14 cases Median age: 2 yrs. Age range: 1 to 5 yrs	*Greta* [2]	40,000–900,000	Median:33 Range:20–83	6 cases had symptoms of irritability, loss of appetite, abdominal pain, headache, muscle soreness	None reported	None reported
CDC, 1984	9 mos./M	*Ghasard* [5]	16,000	214	Seizures, Brain herniation	Lead toxicity diagnosed postmortem	Lead encephalo-pathy resulting to death
CDC, 1983	2	*Azarcon* [4]	None reported	124	Diarrhea	None reported	None reported
Bose, 1983	4 mos./M	*Azarcon* [4]	860,000	45	Vomiting, Diarrhea	Application discontinued	None reported
	2/F		None reported	137	Diagnosed on routine screening	None reported	None reported

¶-1, ¶-2siblings (same number denotes siblings from one family).
[1]*Litargirio*- yellow colored lead monoxide powder used as antiperspirant in the Hispanic community.
[2]*Greta*- yellow lead monoxide powder used for stomachache.
[3]*Surma*- Indian/Middle Eastern lead sulfide remedy.
[4]*Azarcon*- powdered lead tetraoxide compound, used for stomachache.
[5]*Ghasard*- leaded brown powder from India, given as a tonic.

Table 3. Cases of elevated BLLs from imported condiments & candies

Reference	Age / Sex	Lead Source	Lead content (mg/kg)	BLL (µg/dL)	Presenting symptoms	Intervention	Reported outcome
Vassilev, 2005	1/M	*Sindoor*[1]	580,000	57	Diagnosed on routine screening	*Sindoor* used discontinued	None reported
Woolf, 2005	2/M	*Kozhambu*[2]	1,000	31	Diagnosed on routine screening	Chelation therapy	BLL dropped to 15 µg/dL after 12 weeks
	2 ¶-1	*Swanuri & Kharchos*[3]	23,100	37	Diagnosed on routine screening	Chelation therapy	BLL dropped to 15 µg/dL after 4 weeks
	4 ¶-1			31		Chelation therapy	BLL dropped to 15 µg/dL after 4 weeks
CDC, 2002	4/M ¶-2	Imported Mexican candies	None reported	26	Diagnosed on routine screening	Discontinued candy consumption	BLL dropped to 13.2 µg/dL after two years
	4/M ¶-2			22			BLL dropped to 11 µg/dL after one years
CDC, 1998	6 /M	Mexican tamarind candy	None reported	59	Diagnosed on routine screening	Chelation therapy	None reported
	3/M ¶-3	*Lozeena*[4]	78,000–89,000	27		*Lozeena* discontinued	None reported
	2/M ¶-3			36			None reported

¶-1, ¶-2, ¶-3siblings (same number denotes siblings from one family).
[1]*Sindoor*- orange colored powder, used as dye.
[2]*Kozhambu*- imported spices from India.
[3]*Swanuri & Kharchos*- imported spices from Republic of Georgia.
[4]*Lozeena*- imported spices from Iraq.

Table 4. Cases of elevated BLLs from recreational items

Reference	Age / Sex	Lead source	Lead content (mg/kg)	BLL (µg/dL)	Presenting symptoms	Intervention	Outcome
VanArsdale, 2004	4/M	Ingested toy medallion	338,000	123	Abdominal pain	Endoscopic removal, Chelation therapy	BLL levels dropped to 40 µg/dL after treatment
Miller, 1996	2/ F	Ingested pool	7,000	22	Diagnosed on	Removal of	None reported
	2/M	cue chalk	4,030	26	routine screening	pool cue chalk from child	None reported
Arreola, 1996	11 mos.	Ingested crayons made in China	800	48	Diagnosed on routine screening	Crayons banned, Chelation therapy	None reported

about the hazards and common sources of lead (38). Lead is particularly hazardous to children due to its toxic effects on the developing nervous system. Children's hand-to-mouth behavior and lesser concern for bodily hygiene predispose them to ingestion of toxic substances such as lead-tainted products (39). The four cases (25–28) of elevated BLLs from ingestion of pellets and bullets reflect children's propensity to place things in their mouths even for objects that are blatantly metallic and non-edible in appearance. This review supports the findings of Wiley *et al*. (40) which suggest that children prone to foreign body ingestion have an increased risk for lead poisoning.

The diagnosis of lead poisoning is challenging due to its vague symptoms. Only in high dose lead poisoning can severe abdominal pain, irritability, decreased consciousness, motor, and sensory deficits raise enough diagnostic suspicion of lead toxicity. Chronic low dose exposure may manifest with non-specific gastrointestinal disturbances, subtle neurologic, and subclinical cognitive deficits (1). Moreover, overt poisoning with high doses of lead is now rare in the U.S. This

Table 5. Cases of elevated BLLs from domestic items

Reference	Age / Sex	Lead source	Lead content (mg/kg)	BLL (µg/dL)	Presenting symptoms	Intervention	Outcome
CDC, 2004	1/ M	Ceramic dinnerware	Plate leaches 29.6 µg/ml Pb	23	Diagnosed on routine screening	Discontinued dinnerware use	BLL dropped to 8 µg/dL after 8 months
Schaller, 1999	10mos/M	Dust from imported miniblinds	Dust wipes yielded 1,021 µg/ft^2 Pb	20.2	None reported	Removal of miniblinds, Chelation therapy	BLL dropped to 16 µg/dL after intervention
Shannon, 1998	4mos./M	Lead soldered *Samovar* urn from Iran (used for boiling water)	None reported	46	None reported	Discontinued urn use, Chelation therapy	BLL dropped to 8 µg/dL in 9 mos. Patient with residual speech delay
Blank, 1983	2/F	Ingested Curtain weights	None reported	238	Vomiting, Irritability, Cerebral edema	Lead toxicity diagnosed postmortem	Lead encephalopathy resulting to death
Sitarz, 1975	4mos.	Lead-glazed pitcher	None reported	80	Seizures, Irritability, Poor head control	Chelation therapy	BLL dropped to 60µg/dL. Further follow-up continued

Table 6. Cases of Elevated BLLs from pellets and bullets

Reference	Age /Sex	Lead source	Lead content (mg/kg)	BLL (µg/dL)	Presenting symptoms	Intervention	Outcome
McKinney, 2000	5 /F	Ingested pellets from ankle weight	Approx. pure lead	57	Vomiting, Abdominal pain	Whole bowel irrigation, Chelation therapy	BLL dropped to 14.3 µg/dL by end of chelation
Roberts, 1998	6/F	Ingested pellets from toy gun	Approx. pure lead	34	Diagnosed on routine screening	Bullet passed on stools	BLL decreased steadily to 15 µg/dL
Lyons, 1994	4/M	Ingested pellets	Approx. pure lead	23	Vomiting, Abdominal pain, Diarrhea, Headache	Surgical removal of pellets	Patient recovered, Resolution of symptoms
Gellert, 1993	5/M	Accidental ingestion of a bullet	Approx. pure lead	27	Child reported accidental Ingestion to parents	Bullet passed on stools	BLL decreased to 9 µg/dL in 1 month
Kikano, 1992	4/M	Retained lead pellets from accidental gun shot injury	Approx. pure lead	45(1 year after gunshot injury)	Routine follow-up	Chelation therapy	BLL decreased steadily to 22 µg/dL in 2 years

may have reduced the knowledge and clinical acumen of clinicians in diagnosing lead toxicity. In this review, the case reported by Berkowitz and Tarrago (16) is an example of a missed diagnosis of an ingested leaded foreign body that resulted in a fatality.

Complexities in the problem of identifying the sources of lead poisoning are due to lead's ubiquity and more recently, the influx of uncommon materials such as unregulated imports, ethnic accessories, poorly-controlled nutritional supplements, and other seemingly innocuous products such as imported toys and domestic utensils. Starting in the 1990's, there have been revived interests in complementary and alternative medicine in the U.S. (41). In 2003 alone, it is estimated that at least 40% of Americans use some form of folk remedies and other alternative medicine practices (42). The poorly regulated field of herbal medicines and nutritional supplements is an avenue for substandard and even unsafe medicinal preparations. More alarmingly, there are reports in popular media regarding the practices of some Americans and other foreign residents seeking alternative healthcare outside the U.S. On their return, they bring with them an array of products whose potential hazards are mostly unknown to U.S. regulatory agencies.

The actual incidence of lead poisoning from folk remedies or unregulated alternative medicine is not known, but it is disturbing to know that at least 64% of herbal medicines sampled from India contain lead (43). Lead is a regular constituent in Indian herbal medicine. It accounts for the most number of documented heavy metal poisoning from Indian herbal drugs (17). In this review, the case (13) of lead poisoning implicating an alleged Tibetan herbal supplement was actually manufactured in India.

Azarcon and *greta* account for the most number of incidents of lead poisoning from folk remedies based on the literature gathered in this review. Both remedies are commonly distributed in powdered form as treatment for abdominal symptoms which are collectively called as *empacho* in the Hispanic community. *Azarcon* consists of lead tetraoxide (44). It is mixed with oil, milk, or sugar and incorporated in a child's milk or tortilla meal (18). *Greta* is a yellow-orange powder of lead monoxide that is given for *empacho* and administered in the same manner as *azarcon* (18).

In terms of home lead poisoning investigation, we found cases (26, 34, 37) that had to be examined more than once for failure to isolate the source for the lead poisoning. Based on the cases presented in this systematic review, we have come up with five recommendations which may assist lead poisoning prevention programs to identify and isolate atypical sources of lead affecting children. These recommendations may be useful in cases where the source is not obvious and immediately identifiable. In addition, we have formulated a list of questions (see Table 7) which can be used in investigating pediatric cases of lead poisoning with obscure lead sources based on the results of this review and from our previous experience in home lead poisoning investigations.

1. *Examine other family members' blood lead levels*. An elevated BLL among other family members may identify a common source shared with the child. In this review, the case (31) of lead poisoning from *sindoor* was narrowed to a source related to food preparation after confirming elevated BLLs on both parents. Similarly, the lead-soldered boiling urn, *samovar*, was also discovered after diagnosing the mother with elevated BLL and documenting her practice of preparing tea in the same urn which she used to prepare the same formula milk for her child (35).
2. *Trace the child's habitual and recreational activities.* When the source can not be easily isolated, try tracing the child's habitual and recreational activities while mapping out the location and the possible materials the child can reach during those times. The case (37) involving the miniblinds only became clear when it was recognized that the child had the habit of standing by the window while placing his mouth on the lead-tainted miniblinds. Also, the two cases (14) involving pool cue chalk were resolved after discovering the children's habit of putting chalk pieces in their mouths during their recreational time.
3. *Get a detailed past medical and dietary history.* When no obvious environmental lead source could be identified, it may be helpful to obtain a detailed medical and dietary history, noting for previous gun shot wounds which may have retained bullet fragments (29) or a history of *pica* involving metallic objects that may lodge in the gastrointestinal tract (16, 21, 26, 28).
4. *Document all medications including herbal supplements or other traditional medicine practices*. Clinicians and other professionals in home-lead investigation should encourage parents and caregivers to disclose the use of any herbal supplements, complementary and alternative medicine, and other folk medicine practices. Surveys on attitudes and practices of consumers of folk and alternative medicines show that they do not usually disclose their non-mainstream medicine practices to their healthcare providers (41). At times, it may be difficult for some parents and caregivers to be open about their folk medicine practices (13, 18) for fear of prejudice. The reluctance to report use of folk remedies may reflect parents' uncertainty about the legitimacy of using such products and their responsibility for their child's lead poisoning (18). Their concerns should be allayed by showing sensitivity to the family's cultural practices while expressing genuine concern for the safety of their child.
5. *Document any food, cooking utensil, cosmetic or other imported products that were brought from a foreign country or purchased from a local ethnic store.* In this review, the cases involving *surma* (19) and *litargirio* (45) were actually brought by visiting grandmothers from the family's country of origin. The lead-tainted candies (15, 33) were purchased from local Hispanic stores or brought by visiting relatives. While recognizing that the kin's intentions are mostly good in bringing such products, receiving families should be cautious of such items as they are most likely unregulated and disposed to heavy metal contamination.

Table 7. Screening questionnaire

Screening Questionnaire for Identifying Possible Sources of Lead Contamination
1. Where has the child lived *(including day care centers & vacation residence)* in the past year? Address — Duration (specify dates) — Approx. age of dwelling — General condition of dwelling _____ __/__/___ - __/__/___ _____ yrs. _____ _____ __/__/___ - __/__/___ _____ yrs. _____
2. Does the child live near a lead smelter, battery recycling plant, or any industry that releases lead?
3. Is there anyone in the child's household who works with lead (electronics assembly, construction, etc.)?
4. Does the child's home have lead pipes or lead-soldered plumbing?
5. Does the child have a habit of eating/chewing/sucking non-food items? Please specify: Paint chips Soil Jewelries/Fashion Accessories Pellets Chalk Toys Others: _____ *Consider requesting abdominal x-ray to check for any metallic foreign body ingestion, if history is highly suggestive*
6. Does the child eat any imported candies? From where? *(check for lead-contaminated Mexican candies)*
7. Does the family use any ethnic condiments, imported spices, food coloring, or exotic food additives?
8. Does the family use any glazed pots/ceramics, pewter, leaded crystals, painted or soldered cooking or dinner wares?
9. Does the child use any metallic or vinyl lined lunch boxes?
10. What medications, supplements, and herbal products does the child take?
11. Does the family use ethnic cosmetics? *Surma/Kohl Sindoor Kajal* others:_____
12. Does the family use any of the following home remedies? *Greta Azarcon Litargirio Moonshine Paylooah Ceruse Ghasard Bala Goli Kandu* others:_____
13. Does the child wear jewelry or any metallic clothing accessory? *(Are there any missing pendants, beads, or metallic accessories?)*
14. Any pellets, fishing sinkers or lead beads within the child's reach in the house, school or playground?
15. Does the child's family frequently light candles at home *(There are imported candles with leaded wicks)*
16. Are there plastic or vinyl miniblinds in any of the child's activity or living quarters?
17. Does the child's favorite hobby involve pellets, bullets, pool cue chalks?
18. Any history of gun shot wounds? (*Check for possible retained bullet fragments)*
19. Any other household member/ playmate/ classmate with increased blood lead level (≥10 µg/dL)? If yes: Who? What activities they may have in common with the child? Any common utensil used? Any common food consumed with the child? Any common habit shared with the child? Any common place frequently shared with the child (e.g. bedroom)? 20. If none: Any frequent activity of the child that is different from other household members? Any specific place frequently visited by the child that is different from other household members? Where does the child spend most of his/her time? What objects does the child usually play / come in contact with?

Majority of the cases in this review presents children who are asymptomatic and diagnosed only on routine screening with elevated BLLs. However, with the continued decline in BLLs of the general U.S. population, the U.S. Preventive Services Task Force (USPSTF) recommends against routine screening for elevated BLLs in asymptomatic children, ages 1–5 years old, whose risks for lead poisoning are similar only to the general population. Moreover, the USPSTF concedes that there is insufficient evidence to recommend for or against routine screening for elevated BLLs even for asymptomatic children ages 1–5 years old who are at increased risk (46). In light of this recommendation, clinicians should have a heightened level of diagnostic suspicion for cases which might present with subtle signs and symptoms of lead poisoning. Healthcare providers must continue to recognize that there are still communities and special populations which remain vulnerable to lead poisoning (47).

Clinicians should not hesitate to consider lead poisoning as one of the possible diagnostic differentials in a child complaining of intermittent abdominal colic with neurologic deficits. Abdominal pain in a child which does not present with classic symptoms of gastroenteritis or any other recognizable acute abdominal problems especially in the setting of motor-sensory deficits or evolving signs of encephalopathy should alert healthcare providers for possible lead toxicity.

As a limitation, this review may not be indicative of the real incidence of U.S. childhood lead poisoning from atypical sources as we have only included published reports. Underreporting and mis-diagnosis are unavoidable limitations in lead poisoning due to its subtle symptoms and difficulty in identifying its source. Nevertheless, we believe that this is an exhaustive attempt to present all available published reports indexed in major databases from which we can formulate sound recommendations for identifying atypical sources of lead.

Conclusion

This systematic review presents the diverse and atypical sources of childhood lead poisoning in the U.S. from 1966 to 2006. The sources range from both local and imported items as well as the common household utensils to culturally unique urns and esoteric folk remedies. These recent atypical sources may be classified as: fashion accessories, folk remedies, imported condiments & candies, recreational items, domestic items and lastly, lead-rich pellets and bullets. Healthcare providers and public health professionals confronted with cases of childhood lead poisoning from unclear sources should investigate a possible common source affecting other family members, systematically examine the child's activities which can predispose him to lead poisoning, review the child's past medical and dietary history in detail, document all medications and supplements with special attention to the use of traditional or alternative therapies. This review suggests the need for greater surveillance for products used and given to children. Healthcare professionals are encouraged to report cases of lead poisoning especially from atypical sources to advance our awareness and capacity to detect products that pose a threat to children's safety and well-being.

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