EarthTrends: Featured Topic

Title: **Laden with Lead**
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Aside from smoke, lead is probably the oldest human-made atmospheric and occupational toxin, dating back at least 8,000 years to the first lead-smelting furnaces (Elsinger 1996:50). Today, lead poisoning remains the single most significant preventable disease associated with an environmental and occupational toxin (Silbergeld and Tonat 1994:677).

Lead is particularly toxic to the brain, kidneys, reproductive system, and cardiovascular system. Exposures can cause impairments in intellectual functioning, kidney damage, infertility, miscarriage, and hypertension (Silbergeld 1996:3). Lead is a special hazard for young children. Several studies have shown that lead exposures can significantly reduce the IQ of school-aged children; some estimates suggest that every 10-microgram-per-deciliter increase in lead levels in the blood is associated with a 1- to 5-point decrease in the IQ of exposed children (Goyer 1996:1050). Lead exposures have also been associated with aggressive behavior, delinquency, and attention disorders in boys between the ages of 7 and 11 (Needleman et al. 1996). In adults, lead toxicity has been linked to increased blood pressure and hypertension, conditions known to increase the risk of cardiovascular disease.

Unlike most chemicals for

Lead Pollution Poses a Special Hazard to Children

Figure 1: Selected Studies Showing High Blood Lead Levels Among Children, 1988-95

COUNTRY (city/region)	YEAR	RANGE OF BLOOD LEAD LEVELS (µg/dL)	MEAN	% OF CHILDREN WITH LEVELS >10 µg/dL
Argentina (urban)	1989	7-42	22.1±7	NA
Bulgaria				
Haskovo	1995	5.5-19.8		NA
Kritehim	1991	4.1-15.1		NA
Kourtove-Kon	1991	6.5-41.3		NA
China				
Shenyang (polluted urban)	1991	NA	30.5	99.5
Shenyang (nonpolluted urban)	1991	NA	12.2	67.9
Beijing (polluted suburban)	1992	NA	22.4	64.9
Shanghai (polluted urban)	1988	5.0-55.0	23.4	85.6
Shanghai (nonpolluted suburban)	1988	0-55.0	18.4	88.2
Mexico (urban)	1995	1-31	9.0±5.8	27.8
Poland				
Town with no industrial emitters	1992-94	2.25-2.39		NA
Town with copper and zinc mills	1992-94	7.37-11.40		NA
Romania				
Bucharest	1995	17.10-21.93		NA
Uruguay	1994	1-31	9.5	NA

Sources: Argentina, Mexico, and Uruguay: Romieu et al. 1997:404. Bulgaria and Romania: Danish Environmental Protection Agency 1997:25. China: Shen et al. 1996:103.

Note: NA = not available.

which health impacts of low-level doses are still uncertain, exposure to lead, even at very low levels, is highly toxic (Silbergeld 1995: 336). Although 10 micrograms of lead per 1 deciliter of blood is generally used as the level above which health impacts are known to be substantial, scientists have not yet identified a level below which no adverse effects of lead occur (Shwartz 1994; Silbergeld 1996:3). Several studies have found detectable learning problems in children whose blood lead levels are as low as 5 to 10 micrograms per deciliter (Silbergeld 1996:3).

The risks of lead exposure vary greatly depending on where one lives. In Bangkok, Mexico City, and Jakarta, exposure largely stems from automotive exhausts; however, in inner-city Chicago and Washington, D.C., exposure is mostly associated with lead in house paint (McMichael 1993:279). Most human exposure to lead comes from: leaded gasoline; lead-based paint; lead pipes in water supply systems; industrial sources from processes such as lead mining, smelting, and coal combustion. Additional sources of lead exposure include soldered seams in food cans, ceramic glazes, batteries, and cosmetics (Silbergeld 1995:338, 340).

Exposure to lead is common throughout both developed and developing countries (see Figure 1). In developing countries, the majority of urban children younger than 2 years of age have average blood lead levels higher than 10 micrograms per deciliter, estimates suggest (Alliance and EDF 1994: 35). A review of 17 studies from different parts of China found that between 65 and 99.5 percent of children living in industrial and heavy traffic areas had blood lead levels above 10 micrograms per deciliter. Even outside of those high-risk areas, as many as 50 percent of China's children had unacceptably high blood lead levels (EHP 1996). In Africa, despite comparatively low levels of industrialization and car usage, lead exposure is a serious problem. In Nigeria, for instance, it is estimated that 15 to 30 percent of the children in urban areas have blood lead levels higher than 25 micrograms per deciliter (Nriagu et al. 1996:99).

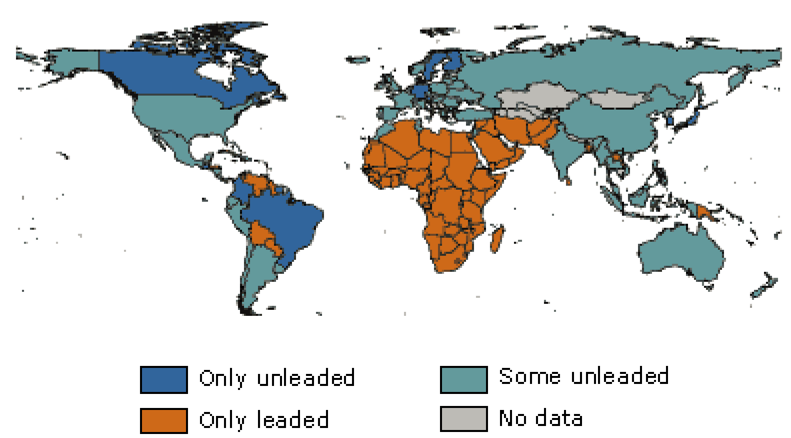
The health toll of lead exposure is particularly high among poor populations of developed and developing countries alike, both because exposures are typically higher and because the populations may be more susceptible. In urban areas, for instance, the poor may live near major roadways where exposure lead from vehicle emissions is high. They also tend to live in older housing, where the likelihood of exposure to lead-based paint is greater. In addition, lead is believed to be absorbed from the stomach more completely when the stomach is empty and when the diet lacks essential trace elements such as iron, calcium, and zinc (Goyer 1996:1051).

Lead in Gasoline

Although lead in gasoline represents only 2.2 percent of total global lead use, leaded gasoline is by far the single most significant source of lead exposure in urban areas. Approximately 90 percent of all lead emissions into the

Global Opportunities for Reducing the Use of Leaded Gasoline

Figure 2: Countries Using Leaded Gasoline vs. Unleaded, 1998



Source: IOMC 1998.

atmosphere are due to the use of leaded gasoline (Lovei 1997:2). Although the UN Commission on Sustainable Development in 1994 called on all governments to eliminate lead from gasoline, populations in most countries are still exposed to air polluted with lead from gasoline (see Figure 2). Besides posing an immediate health risk through inhalation, vehicular lead emissions also accumulate in soil, contaminate drinking water, and enter the food chain (Silbergeld 1996:7).

The use of lead in gasoline has a long history. In 1922, auto manufacturers realized that adding lead to gasoline could boost its octane rating and produce more power. Concerns over the health effects of lead in gasoline surfaced just two years later, when, in the experimental laboratories of the Standard Oil Company, 5 out of 49 workers died and 35 experienced severe neurological symptoms from organic lead poisoning. Soon thereafter, the state of New York, the city of Philadelphia, and some other municipalities briefly banned the sale of leaded gasoline. However, once the immediate furor subsided, the use of lead in gasoline resumed (Gray et al. 1997:18). The amount of lead additives increased quickly, rising to 375,000 metric tons annually by the early 1970s (Nriagu 1990).

By 1970, however, concerns about tailpipe emissions led to the introduction of catalytic converters in the United States and Canada. Because leaded gasoline is incompatible with catalytic converters, cars with converters required unleaded gasoline (Lovei 1997:7). In 1985, the U.S. EPA decided to accelerate its gradual phaseout of leaded gasoline and implemented legislation designed to slash the use of lead in gasoline by more than an order of magnitude in less than 1 year (Nichols 1997:1). The public health benefits of these reductions have been dramatic. Between 1976 and 1990, average blood lead levels in the U.S. population declined from 14.5 to 2.8 micrograms per deciliter, paralleling the phaseout of leaded gasoline (Pirkle et al. 1994). This finding suggests that as much as 40 to 60 percent of blood lead levels in the U.S. population were associated with leaded gasoline (Needleman et al. 1996:9). Similarly, after unleaded gasoline was introduced in Mexico City in 1990, mean

Less Lead in Gas Lowers Lead Exposure

Figure 3: Summary of Selected Studies on Lead in Blood, Gasoline, and Air

LOCATION	YEAR	BLOOD LEAD (µg/dL)	LEAD IN GAS (g/L)	AIR LEAD (µg/m³)	POPULATION AGE RANGE
Athens, Greece	1982	16.0	0.40	1.76	adults
	1993	5.5	0.14	0.43	
Belgium	1979	17.0	0.45	1.05	20+
	1987	9.0	0.15	0.49	
Caracas, Venezuela	1986	17.4	0.62	1.9	15+
	1991	15.6	0.39	1.3	
Mexico City, Mexico	1988	12.2	0.2	NA	0.5-3
	1993	7.0	0.06	NA	
Ontario, Canada	1984	11.9	0.30	NA	3-6
	1992	3.5	0.00	NA	
Turin, Italy	1980	21.0	0.6	3	18+
	1993	6.4	0.11	0.53	
United Kingdom	1979	12.9	0.42	NA	adults & children
	1995	3.1	0.055	NA	
United States	1976	15.9	0.465	0.97	1-74
	1988-1991	2.8	0.00	0.07	

Source: Thomas et al. 1999.

Few Countries Have Committed to Unleaded Gasoline

Figure 4: Signatories and Ratifiers of the Aarhus Convention on Heavy Metals as of August 2001

SIGNED

1	Armenia	14	Italy
2	Austria	15	Latvia
3	Belgium	16	Liechtenstein
4	Bulgaria	17	Lithuania
5	Croatia	18	Poland
6	Cyprus	19	Portugal
7	Czech Republic	20	Republic of Moldova
8	France	21	Romania
9	Germany	22	Slovakia
10	Greece	23	Slovenia
11	Hungary	24	Spain
12	Iceland	25	Urkraine
13	Ireland	26	United Kingdom

SIGNED AND RATIFIED

1	Canada	6	Netherlands
2	Denmark	7	Norway
3	European Community	8	Sweden
4	Finland	9	Switzerland
5	Luxembourg	10	United States

Source: UN/ECE 2001.

blood lead level concentrations in schoolchildren dropped from 16.5 to 11.14 micrograms per deciliter in 1992 (Finkelman 1996:1). Numerous studies from other countries have also indicated that reducing gasoline lead levels has a major effect on population blood lead levels (Thomas et al. 1999:3942) (see Figure 3).

Despite these remarkably successful programs, as of October 2001, only 36 countries had signed a declaration promising to phase out leaded gasoline by 2005 (UN/ECE 2001) (see Figure 4). Although the total amount of lead added to gasoline worldwide dropped by 75 percent between 1970 and 1993, in many countries in Africa and Western and Southern Asia, unleaded gasoline is still scarce, and the maximum allowed lead content of gasoline may reach or exceed 0.8 grams per liter (IOMC 1998:27-30). A survey of 52 African countries found that only two had unleaded gasoline available (IOMC 1998:27). Nigeria, Indonesia, Saudi Arabia, Iraq, South Africa, and Venezuela are among the countries where both gasoline consumption and gasoline lead concentrations are relatively high (Thomas et al. 1999:3947).

Even in countries where gasoline consumption is still relatively low, lead emissions represent a serious health hazard because of the increasing pace of urbanization and the increased use of motor vehicles (Lovei 1997:19). In Latin America, where several countries are making concerted efforts to reduce the lead in gasoline, increased gasoline consumption associated with urban growth and car ownership is nevertheless causing large increases in the total amount of lead emissions (Finkelman 1996:1). In most European countries, roughly one-half of the cars use unleaded gasoline, while the other half still use gas containing 0.15 grams of lead per liter (Lovei 1997:17).

Other Sources of Lead

For some populations, other sources of lead may pose a greater threat than gasoline. The most acute and even fatal lead poisoning cases are associated with lead mining and processing. In a 1992 study of the Baia Mare (Big Mine) in Romania, lead smelter workers had mean blood lead levels of 77.4 micrograms per deciliter. In children living near the lead smelter, mean blood lead levels of 63.3 micrograms per deciliter were found (Verberk et al. 1993:1221).

Battery recycling is also an important source of lead exposure. On a global scale, 63 percent of all processed lead is used in the manufacturing of batteries (Alliance and EDF 1994:9). In Mexico, the Caribbean, and India, family-based industries use open furnaces in their backyards to recover lead from batteries by crude smelting. These cottage industries can result in extremely high lead exposures for the whole family. In Jamaica, children living near backyard smelter sites had mean blood lead levels nearly three times those of children from communities with no backyard smelting activities (Matte et al. 1991). In Russia, the political and economic upheaval of the 1990s disrupted the country's lead battery recycling system. Car owners are no longer required to recycle their batteries and may simply throw them in dumps (Thomas and Orlova 2001).

Lead-glazed pottery and lead pigments in children's toys and pencils are other routes of exposure (Finkelman 1996:1). Approximately 30 percent of the population in Mexico uses glazed pottery regularly, placing nearly 24 million people at risk of exposure to lead from this single source (Lopez-Carillo et al. 1996:1210). Lead solder in aluminum cans can also pose significant risks; in Honduras, for instance, studies have shown that lead residues in canned food range from 0.13 to 14.8 milligrams per kilogram, far above WHO guidelines (Finkelman 1996:1).

In the United States, despite much progress in reducing mean blood lead levels and eliminating lead from gasoline, lead poisoning remains a major health hazard for children under the age of 6. Approximately 1.7 million children in the United States have blood lead levels that exceed the recommended level of 10 micrograms per deciliter (Brody et al. 1994: 277), with the highest average blood lead levels found among poor, urban, African-American, and Hispanic children (Goldman 1994:315). Lead-based paint is a major exposure route. Although lead has been banned from residential paint since 1978, about three-quarters of all housing units built before 1980 contain some lead-based paint (Goldman 1994:315). Because lead-based paint is still used throughout Latin America and the Caribbean, this threatens to become a major route of exposure in those countries as well (Finkelman 1996:1).

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