

Environmental Lead Contamination and Blood Lead Levels of Children in Turkey

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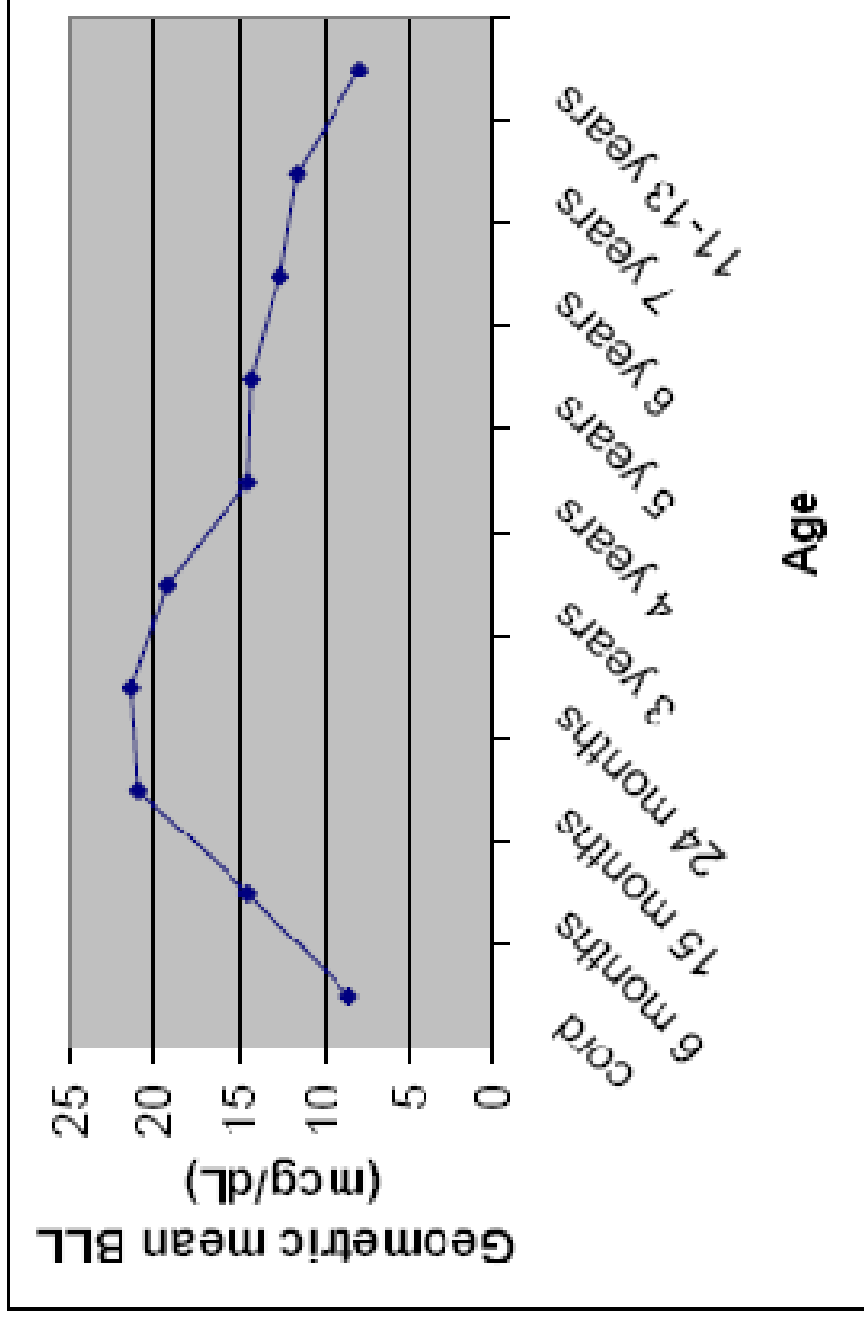
Overview

- ❖ Brief information about childhood lead poisoning
- ❖ Possible sources of childhood lead exposure in the world and in Turkey
- ❖ Data published about the childhood lead poisoning in Turkey
- ❖ Demographical data and basic indicators, nutrition and health parameters showing the state of children in Turkey
- ❖ What is missing and what are needed to be done



Lowest observed effect levels of inorganic lead in children

Adverse Health Effects	BLL ($\mu\text{g}/\text{dL}$)
Death	130-140
Neurological	
Encephalopathy	80-100
Nerve conduction velocity \downarrow	20
Hearing \downarrow	< 10
IQ \downarrow	< 10
Hematological	
Anemia	60-70
Hemoglobin synthesis \downarrow	40
Erythrocyte protoporphyrin \uparrow	10-20
Renal	
Nephropathy	70-80
Vitamin D metabolism \downarrow	30



Source: Tong et al., 1996.

Figure 4. Age trend in blood lead levels.

Table 1. Lowest blood lead level (BLL) considered elevated by CDC and the US Public Health Service

Year and Reference	BLL ($\mu\text{g}/\text{dL}$)
1971 (Surgeon General)	40
1975 (CDC)	30
1978 (CDC)	30
1985 (CDC)	25
1991 (CDC)	10

Source: A REVIEW OF EVIDENCE OF HEALTH EFFECTS OF BLOOD LEAD LEVELS <10 $\mu\text{g}/\text{dL}$ IN CHILDREN. Reported by a Work Group of the Advisory Committee on Childhood Lead Poisoning Prevention, CDC National Center for Environmental Health

Possible sources of childhood lead exposure

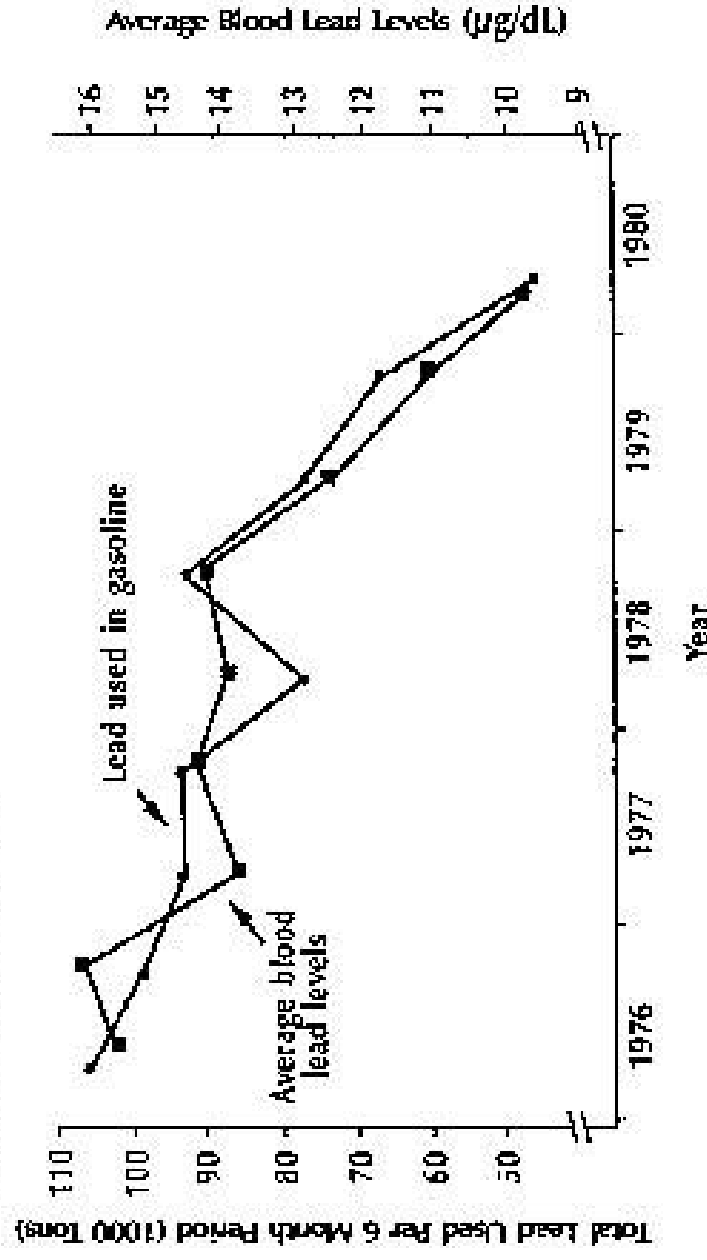
1. Leaded gasoline
2. Lead based paint
3. Lead-glazed pottery
4. Traditional food and health remedies
5. Consumer products with high lead levels
6. Uncontrolled industrial emissions in or near residential areas
7. Lead brought into home by family members whose job or hobbies are related to lead exposure
8. Occupational exposure (Child labor)



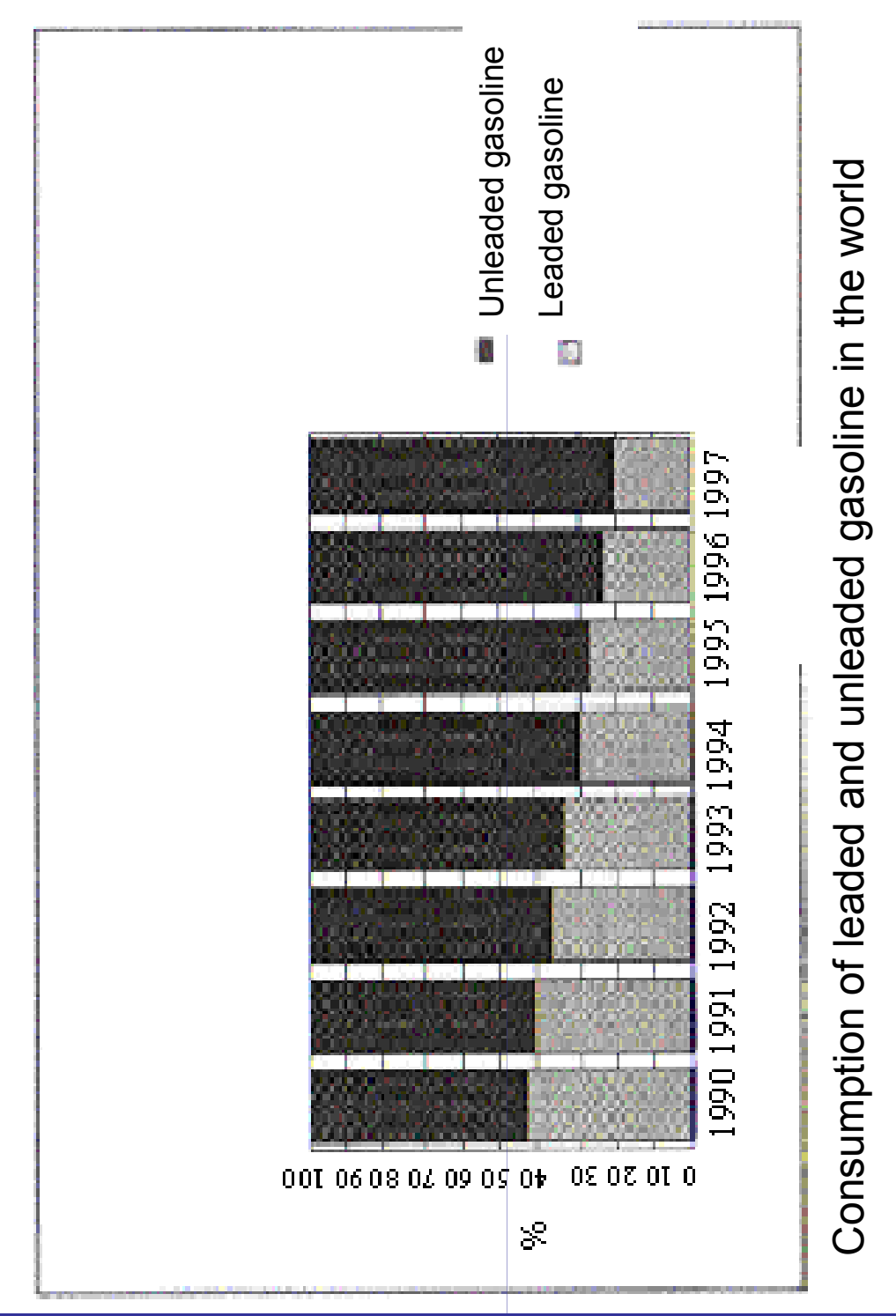
Possible sources of childhood lead exposure

1. Leaded gasoline

Figure 2-5. Change in blood lead levels in relation to a decline in use of leaded gasoline, 1976–1980



Source: Annest JL, 1983.



Consumption of leaded and unleaded gasoline in the world



Abandoning usage of leaded gasoline in various countries

Years	Countries
Before 1999	Canada, Argentina, Austria, Bahamas, Bermuda, Bolivia, Brasil, Columbia, Costa Rica, Denmark, Dominican Republic, El Salvador, Finland, Germany, Guatemala, Haiti, Honduras, Hong Kong, Hungary, Iceland, Japan, Malaysia, New Zealand, Nicaragua, Norway, Puerto Rico, Singapore, Slovenia, South Korea, Sweden, Netherlands, Thailand, USA, U.S. Virgin Islands, Luxembourg, Bangladesh, Mexico, Portugal
2000	England, France, Thailand, Monaco, China, Belgium, Philippines, India, Switzerland
2001	Uruguay, Ecuador, Egypt
2002	Panama
2003	Ireland, Italy, Jamaica
2004	Greece, Spain
2005	Peru, Bulgaria, Chili, Romaina, Australia, Czech Republic, Poland

Table 3.1 Market shares of unleaded petrol in Europe.
1990-1996. %

Country	1990	1991	1992	1993	1994	1995	1996
Austria	27	38	47	57	65	69	74
Belgium	58	64	70	77	100	100	100
Denmark	53	58	70	87	100	100	100
France	69	41	47	53	58	50	56
Germany	10	78	85	89	92	95	98
Greece	49	10	16	23	43	32	65
Ireland	6	41	47	53	58	57	92
Netherlands	49	60	71	75	80	82	92
Italy	6	8	11	26	36	39	46
Monaco							67
Norway	49	60	55	75	80	92	100
Netherlands	18	15	23	37	34	35	42
Portugal ¹⁾	45	41	47	78	58	85	100
Sweden ²⁾	<1	1	1	2	5	7	68
Switzerland	3	12	15	23	23	25	(100)
UK ³⁾	3	2	2	3	5	7	6
Albania							30
Bulgaria ³⁾							11
Croatia							55
Cyprus							81
Czech Republic							64
Estonia							60
Hungary ⁴⁾							98
Latvia							48
Lithuania							5
Poland							100
Romania							45
Slovakia							18
Slovenia ²⁾							54
Turkey	<1	<1	2	5	8	8	18

Source: UN/ECE Task Force to Phase Out Leaded Petrol in Europe, Main Report 1998, Danish Environmental Protection Agency



Lead levels of leaded gasoline in Turkey

Pre-1998	0,84 g Pb/L
June 1998	0,40 g Pb/L
2002	0,15 g Pb/L
Unleaded	0,013 g Pb/L

Vehicular lead emissions in Turkey

Year	Lead emission (tons/year)
1996	1,032
2003	230

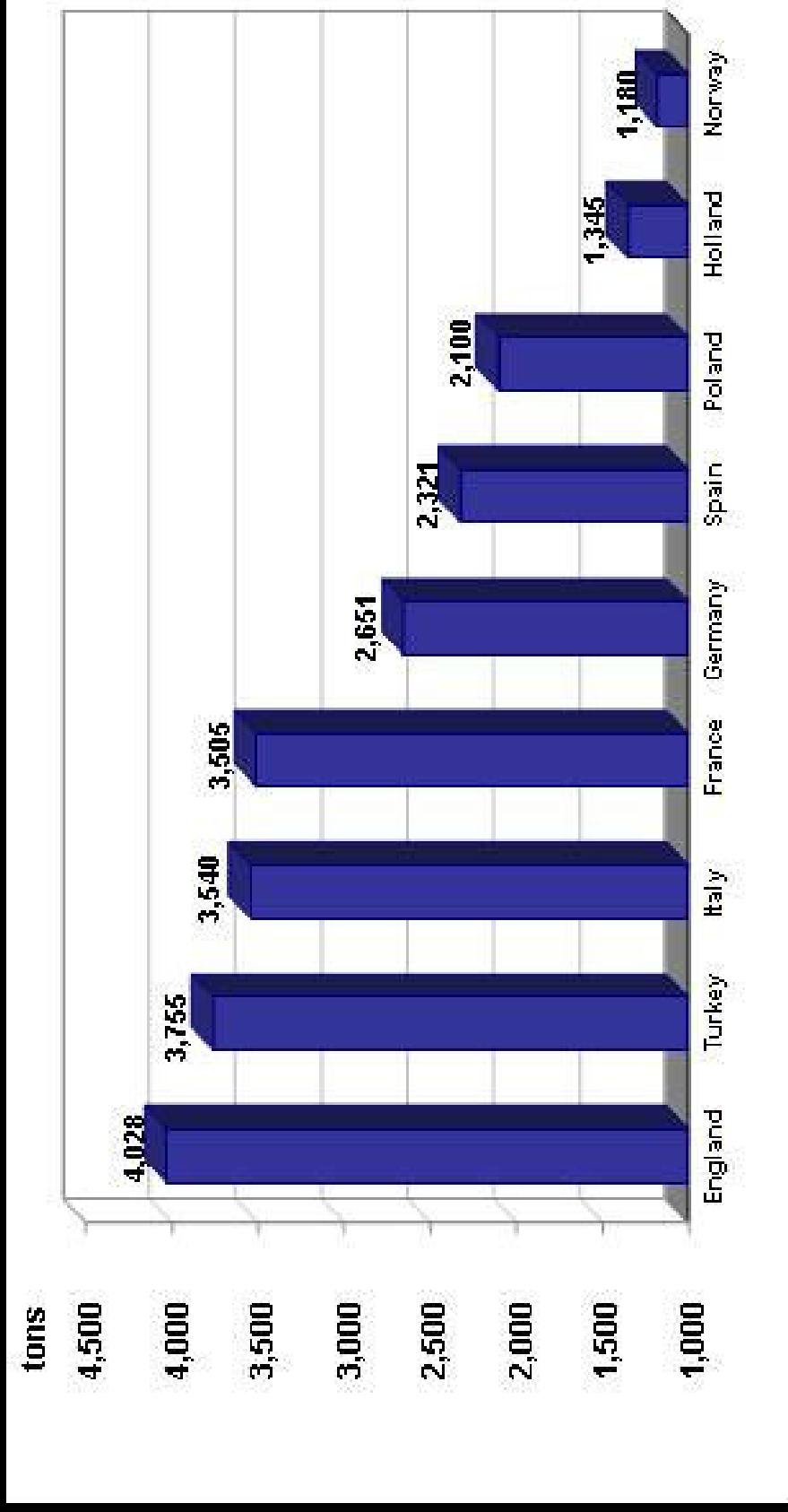
Gasoline and liquified petroleum gas (LPG) consumption in Turkey in years 1996-2004

	1996	1997	1998	1999	2000	2001	2002	2003	2004/9 mo
Regular	2.605.109	2.157.031	2.142.998	1.745.813	1.200.003	890.670	470.832	90	0
Unleaded	281.706	533.866	862.271	1.096.091	1.387.639	1.540.978	1.699.819	1.796.888	1.779.569
Total Gasoline	4.255.225	4.388.620	4.474.526	4.306.266	3.655.878	3.171.298	3.103.851	2.958.253	2.446.777
LPG			145.000	362.000	1.281.000	1.231.000	1.149.000	1.230.000	1.032.000
LPG/gasoline ratio(%)			4.19	10.2	32.11	34.38	33.32	35.95	36.28

Source: T.R. Ministry of Environment and Forestry, 2004.



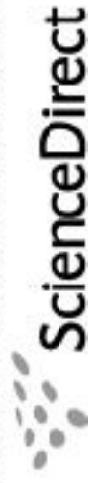
European LPG market, 2005



Turkey stands second after England in European LPG consumption figures in 2005



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www.elsevier.de/ijhch

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Dental lead levels in children from two different urban and suburban areas of Turkey

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- ❖ Lead content of the shed primary teeth was measured
- ❖ 297 teeth samples from 263 children
- ❖ Ages 4-15
- ❖ Ankara and Balikesir



Table 1. Lead levels ($\mu\text{g/g}$) in deciduous teeth according to region

Regions	<i>n</i>	Lead levels ($\mu\text{g/g}$) (mean \pm SD)	Min.-max. ($\mu\text{g/g}$)
Ankara (A)	158	1.37 \pm 0.66	0.24
Merkez (U)	89	1.30 \pm 0.59	0.29
Sincan (R)	69	1.45 \pm 0.74	0.24
Balıkesir (A)	139	1.74 \pm 1.05	0.48
Merkez (U)	117	1.77 \pm 1.03	0.48
Köy (R)	22	1.62 \pm 1.18	0.55

A: all; U: urban; S: suburban.
p < 0.05, Mann-Whitney *U*-test.

Karahalil et al. 2007

Table 4. Comparison of studies on lead levels ($\mu\text{g/g}$) in whole teeth in different countries, including the present study

Place	n	Lead levels (mean \pm SD) ($\mu\text{g/g}$)	Method	References
Mexico	100	8.28	Similar to ours	Hernandez-Guerrer et al. (2004)
Pakistan	309	5.78	Similar to ours	Rahman and Yousuf (2002)
Egypt	30	7.96	Similar to ours	Omar et al. (2001)
	30	4.97		
Bahrain	280	4.30	Sampling procedure different from ours	Al-Mahroos and Al-Saleh (1997)
	251	4.40		
	27	3.40		
Turkey (Ankara)	103	3.42	Different from ours	Karakaya et al. (1996)
	54	4.99		
	49	1.69		
South Australia (Port Pirie) (The lead smelter town)	262	8.6	Different from ours	McMichael et al. (1994)
Taiwan	390	4.3	Different from ours	Robinowitz et al. (1991)
Boston		3.4		

Concluded as Turkey has been quite successful in phasing out leaded gasoline



Blood lead levels of maternal-cord pairs, children and adults who live in a central urban area in Turkey

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¹*Department of Pediatrics, Osmangazi University Faculty of Medicine and* ²*Anadololu Hospital, Eskişehir, Turkey*

- ❖ **BLL of 99 adults, 180 children, 143 pregnant women living in Eskişehir, urban area**
- ❖ **120 cord blood and 93 breast milk**



	BLL ($\mu\text{g/dL}$)
Adults	3.1 ± 1.4
Children	3.6 ± 1.7
Pregnant women	2.8 ± 1.5
Cord blood	1.6 ± 1.4
Breast milk	2.3 ± 1.0



Possible sources of childhood lead exposure

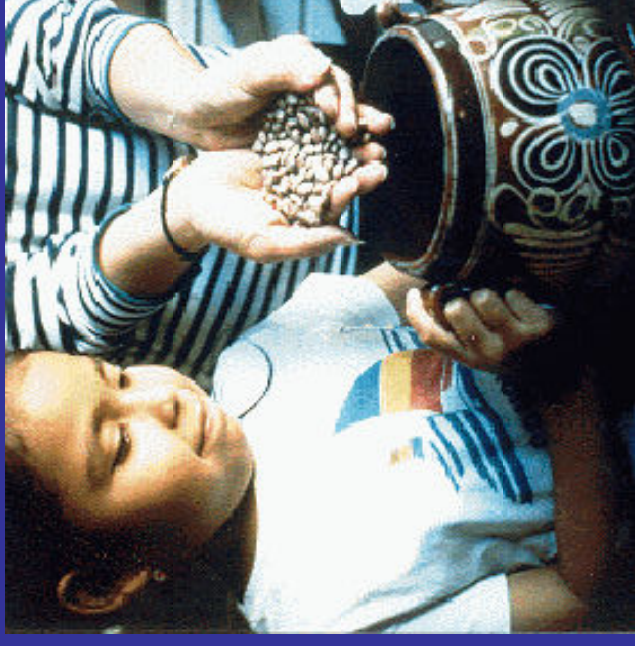
2. Lead based paint

Most common source of high dose lead poisoning in US



Possible sources of childhood lead exposure

3. Lead-glazed pottery



Tableware

- Lead used for glaze, decoration, constituent of some pottery
- Lead leaches out as a function

of:

- Condition of foodware
- Food acidity, temperature, contact time



Possible sources of childhood lead exposure

4. Traditional food and health remedies

Traditional Foods

Chapulines (grasshoppers)

Mexican delicacy snack food





Recall -- State Press Release

State Health Department Issues Health Warning on Lead-Contaminated Chapulines (Grasshoppers)

FDA:

Chapulines from Oaxaca, Mexico may contain as much as **2,300 micrograms** of lead per gram of product.

FDA recommends children < 6 yo consume, on average, **no more than 6 micrograms** lead per day from all food sources.

A child eating **one** highly contaminated chapuline could ingest **60 times** the tolerable daily intake for lead.

Traditional Medications

- ❖ Indian, Mid Eastern, West Asian, Hispanic
Cultures: *Ayurvedic Medicine*
 - ❖ Prescribed by local healers, pharmacists
 - ❖ Herbs, minerals, metals, animal products
- ❖ Lead Added:
 - ❖ Negligent manufacturing practice
 - ❖ Intentionally, for perceived therapeutic benefit
 - ❖ Nearly 100% lead in some “remedies”



AZARCON & GRETA (Mexico)

- ❖ Given for “empacho”
(intestinal illness)
- ❖ Both Azarcon and
Greta are almost
100% lead



Courtesy of
 Tim Hadac
 Director of
 Public
 Information
 Chicago
 Department
 of Public
 Health

South Asian Traditional Remedies Tested by the Chicago
 Department of Public Health



Traditional Medications

Case Study:

- ❖ 5 y.o. Indian boy in US developmentally delayed from neonatal asphyxia
- ❖ Mom (well educated, fluent in English) gave him a Tibetan herbal vitamin to “fix his brain”
- ❖ 3x/day for past 4 years



- ❖ high Pb and Hg content
- ❖ boy ingested 63 grams Pb over 4 years
- ❖ presented with 86 ug/dl BLL
- ❖ 7 chelations; latest BLL 24.5 µg/dl



Possible sources of childhood lead exposure

5. Consumer products with high lead levels

Toy Jewelry

In 2004, Consumer Product Safety Commission (CPSC) announced recalls of more than 150 million pieces of toy jewelry sold in vending machines and through other outlets



U.S. Consumer Product Safety Commission

March 21, 2008
Release #08-229

- ❖ The paint on the toys contains excessive levels of lead, violating the federal lead paint standard.
- ❖ Store recalls easter egg containers and spinning egg tops due to violation of lead paint standard



U.S. Consumer Product Safety Commission

March 25, 2008
Release #08-231



- ❖ Surface paint on the metal water bottles contains excessive levels of lead, violating the federal lead paint standard.
- ❖ The company recalls water bottles due to violation of lead paint standard

Possible sources of childhood lead exposure

6. Uncontrolled industrial emissions in or near residential areas
7. Lead brought into home by family members whose job or hobbies are related to lead exposure



Şanlı et al. Çocuk Sağlığı ve Hastalıkları Dergisi 2006; 49: 12-18

- ❖ May-June 2002 in Kırkkale
- ❖ TÜPRAŞ refinery, Gun and gun powder factories
- ❖ 533 healthy children aging 7-16
- ❖ From 4 different schools in districts close to / far from factories



Şanlı et al. Çocuk Sağlığı ve Hastalıkları Dergisi 2006; 49: 12-18

	n	BLL (µg/dL)
All	533	2.5±1.4
Ages 7-11	314	2.7±1.4
Ages 12-16	219	2.4±1.4
School close to fact.	115	3.03±1.3
School far from fact.	136	1.8±1.3*
Fathers' work rit Pb	166	2.5 ± 1.5
Fathers' work not related Pb	335	2.6 ± 1.4

* p<0.001

Yapıcı G. et al 2006

- ❖ Asymptomatic lead poisoning prevalence and Cd exposure of preschool children living in a coal-mining area in Yatağan, Muğla.

- ❖ May-June 2002
- ❖ 236 healthy children (53.4% ♀, 46.6% ♂)
- ❖ Ages of 6 months-6 years

	Age (mo)	BLL (µg/dL)
♀	49±18	33.8±15.6
♂	43±19	38.8±16*

* p<0.05

BLL>10 µg/dL in 95.7%
BLL> 20 µg/dL in 87.6% of all children

Yapıcı G. et al 2006

- ❖ Indicates that asymptomatic lead poisoning is a significant problem in children living in Yatağan.
- ❖ It is not obvious whether the lead burden results from mining waste or other sources.
- ❖ Environmental screening, to find out the source and to avoid it, is necessary.



Yapıcı G. et al 2006

No correlation was found between:

- ❖ BLL- hand to mouth activity
- ❖ BLL- parent working at a job with high risk of lead exposure
- ❖ BLL- cigarette consumption at home

Significant correlation was found between:

- ❖ BLL – age (negative)
- ❖ BLL – pika
- ❖ BLL – anemia
- ❖ BLL – consumption of canned food



Lead mining in Turkey

- ❖ Usually lead and zinc
- ❖ Keban (Elazığ)
- ❖ Kayseri
- ❖ No studies are conducted in those areas yet



Kismet et al. *Gülhane Tıp Dergisi* 46 (1) : 33 - 37 (2004)

- ❖ 587 children
- ❖ Ages 2-16 years old
- ❖ From 5 different areas of Ankara

	2-5	6-10	11-16
ANKARA (n = 587)	3.40 ± 4.20 (n=236)	2.30 ± 2.96 (n=182)	5.40 ± 3.62 (n=169)
ÇİĞİLTEPE (n = 50)	3.80 ± 2.35	3.40 ± 4.08	0.90 ± 0.39
ETLİK (n = 60)	0.90 ± 0.37	0.90 ± 0.39	1.40 ± 0.93
ANITTEPE (n = 44)	3.60 ± 1.98	3.70 ± 2.14	0.90 ± 0.35
ORAN (n = 180)	6.30 ± 5.67	0.60 ± 0.33	5.40 ± 3.41
ETİMESGUT (n = 253)	0.90 ± 0.61	2.80 ± 3.26	6.10 ± 3.64

Possible sources of childhood lead exposure

8. Child labor

Occupation Exposures – Child Labor

- UNICEF Estimates of Child Labor
 - 246 million children engaged in child labor, most in hazardous conditions
 - mines, chemicals, pesticides, dangerous machinery, etc.

www.unicef.org/protection/index_childlabour.html



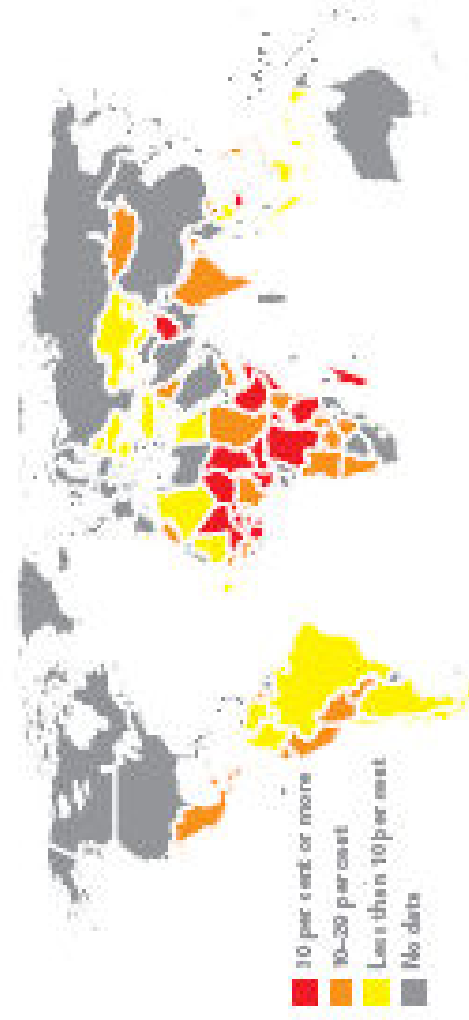
Child labor in Turkey

Unicef, progress for children, Dec 2007

Countries and territories	Child labour (5-14 years) 1999-2006*		
	total	male	female
Turkey	5	4	6
Industrialized countries§	-	-	-
Developing countries§	16	19	17
Least developed countries§	29	31	28

CHILD LABOUR OCCURS THROUGHOUT THE WORLD BUT IS MOST PREVALENT IN SUB-SAHARAN AFRICA

Percentage of children aged 5-14 engaged in labour (1999-2006)



Unicef, the state of the world's children, 2008

	n	ages	BLL ($\mu\text{g/dL}$)
Sönmez et al. 2002			
Auto repair adol.	39	16.8 \pm 3.2 (12-19)	8.13 \pm 7.4
Battery workers	13	32.1 \pm 10.9 (21-43)	25.3 \pm 9.8
Controls	29	14.8 \pm 2.7 (12-18)	3.5 \pm 1.38
Öktem et al. 2004			
Auto repair wrk.	79	17.3 \pm 1(15-19)	7.8 \pm 3.8 (3.4-24.8)
Controls	71	14.8 \pm 2.7 (15-19)	1.6 \pm 0.8 (0-3.0)
Sevinç et al. 2004			
Auto repair wrk.	60	14.9 \pm 2.0 (11-17)	27.8 \pm 20 (4.4-99.5)
Controls	40	14.0 \pm 2.0 (11-17)	18.1 \pm 11 (4.3-45)
İşeri et al. 2005			
Auto repair wrk.	168	16.8 \pm 1.2	BLL of 44.1% >10 $\mu\text{g/dL}$

Summary of data on BLL of Turkish children

<u>DATE</u>	<u>AUTHOR</u>	<u>LOCATION</u>	<u>n</u>	<u>Samples from</u>	<u>BLL ($\mu\text{g/dL}$)</u>
1987	Vural	Ankara	56	Children	19.3
1995	Göker	Istanbul	201	Children	5.5
1997	Can	Tekirdağ	158	Children	29.6
2002	Yapıcı	Yatağan	178	Children	36.2
2002	Şanlı	Kırıkkale	533	Children and adolescents	2.5
2003	Kismet	Ankara	587	Children and adolescents	3.6
2005	Kırel	Eskişehir	180	Children	3.5



Developing World – Some Risk Factors For Lead Toxicity

- ❖ Health factors
- ❖ No or limited emphasis on disease prevention
- ❖ Poor nutrition enhances lead toxicity
- ❖ Limited knowledge of toxic chemicals among caregivers
- ❖ Laboratory monitoring capacity inadequate
- ❖ Absence or incomplete disease surveillance

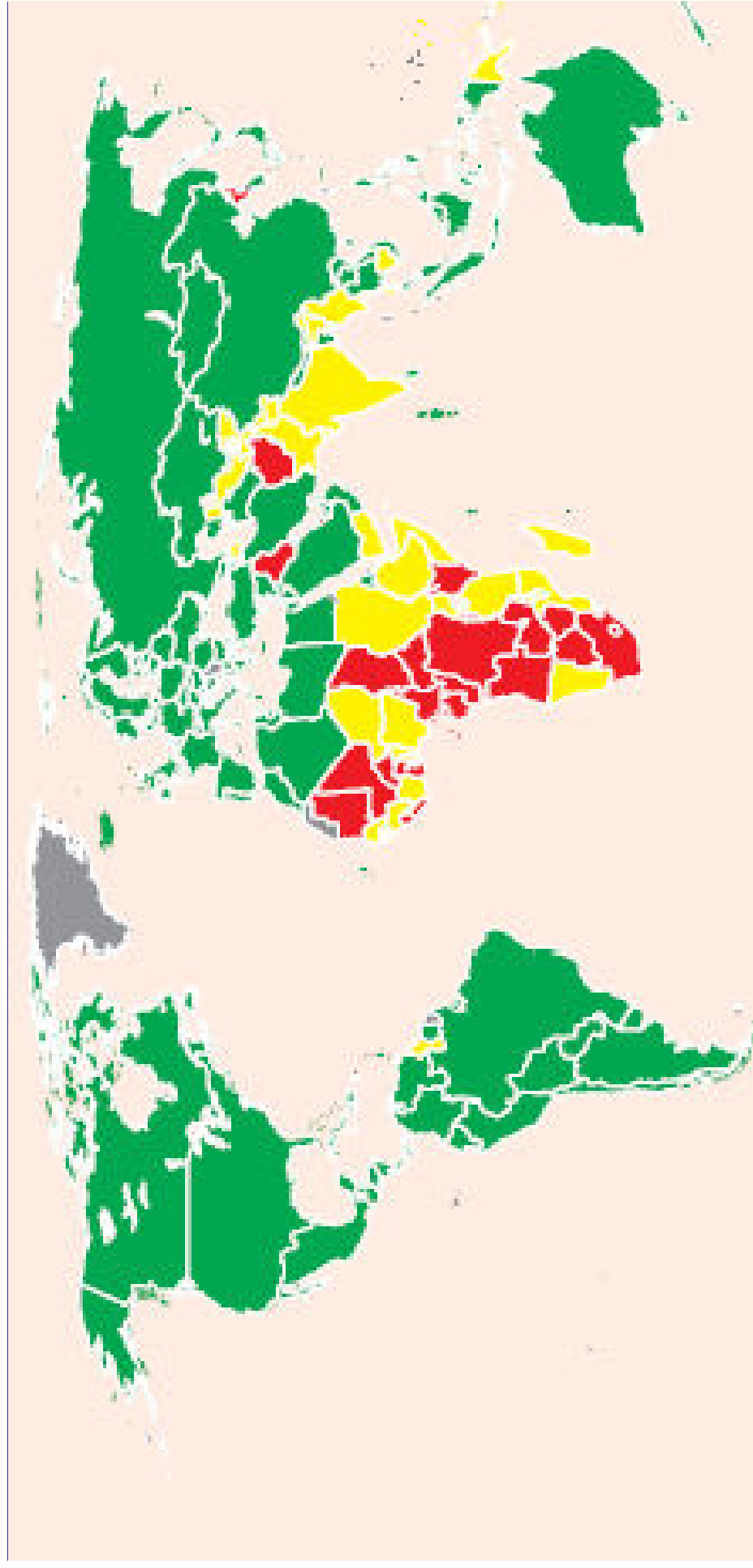


Basic Indicators from UNICEF 2008 report

	Under-5 mortality rate		Infant mortality rate (under 1)		Neonatal mortality rate
	1990	2006	1990	2006	
Turkey	82	26	67	24	22
Industrialized countries	10	6	9	5	4
Developing countries	103	79	70	54	33

Under-5 mortality rank

2000



Progress towards MDG 4, with countries classified according to the following thresholds:

- On track:** U5MR is less than 40, or U5MR is 40 or more and the average mortality rate observed for 1990–2006 is 4.0 per cent or more
- Insufficient progress:** U5MR is 40 or more and AARR is between 1.0 per cent and 3.9 per cent
- No progress:** U5MR is 40 or more and AARR is less than 1.0 per cent
- Data not available**

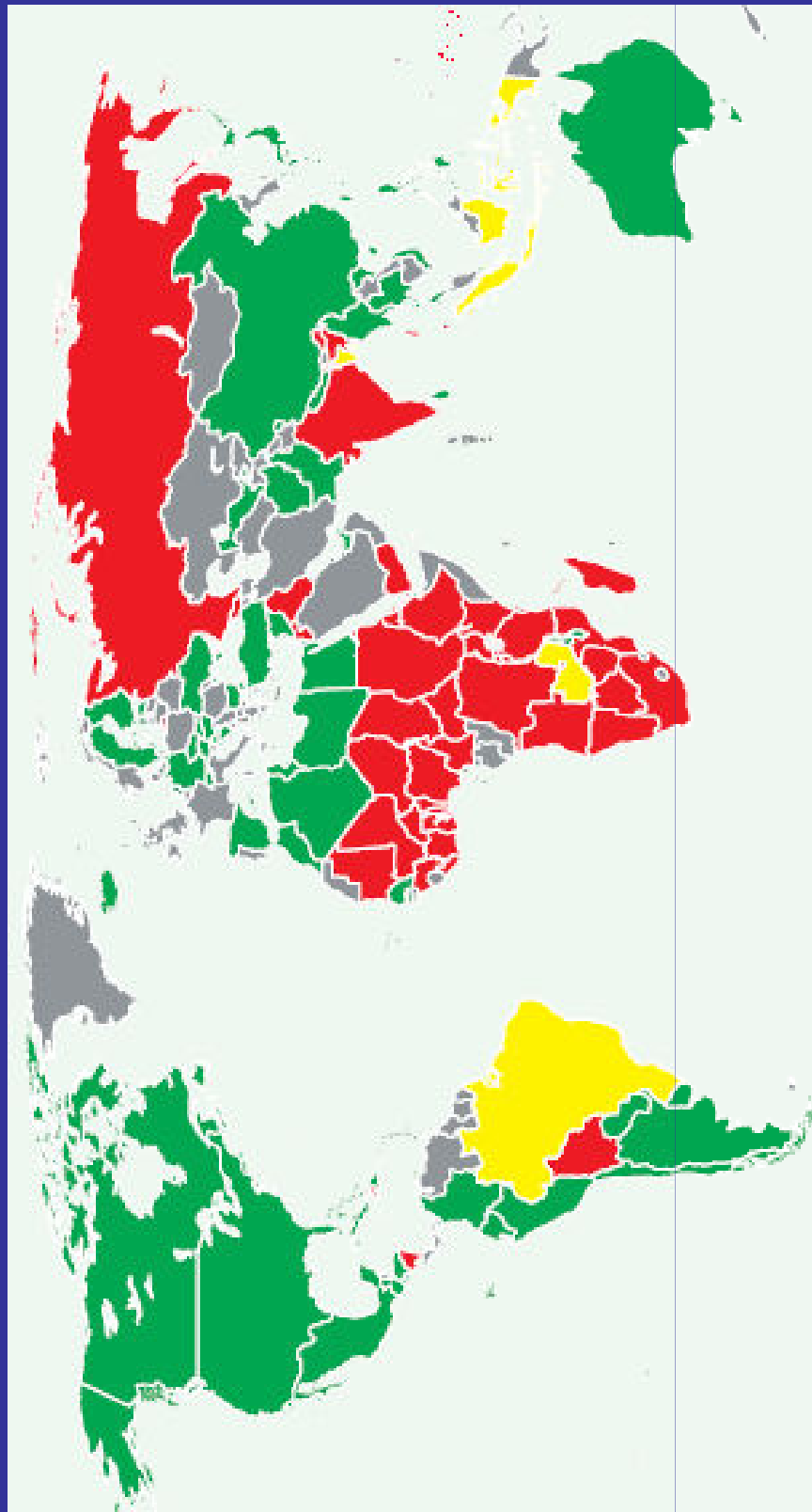
NUTRITION facts from UNICEF 2008 report

	% of infants with low birthweight 1999-2006*			% of children (2000-2006*) who are:			% of under-fives (2000-2006*) suffering from:		
	exclusively breastfed (<6 months)	breasted with complementary food (6-9 months)	still breastfeeding (20-23 months)	underweight	wasting	stunting			
Turkey	42	--	22	4	1	2	12		
Industralized countries	--	--	--	-	-	-	--		
Developing countries	38	56	43	25	10	11	32		

HEALTH parameters from UNICEF 2008 report

	% of population using improved drinking-water sources 2004		% of population using adequate sanitation facilities 2004		% of routine EPI vaccines financed by government 2006		Immunization 2006									
	total	urban	rural	total	urban	rural	total	1-year-old children immunized against			% new-borns protected against tetanus ^a					
								TB	DPT	Polio	Measles	HepB	Hib	BCG	DPT ^b	DPT ^b
								corresponding vaccines:								
							88	92	90	90	98	82	-	67		
Turkey	96	98	93	88	96	72	-	-	-	98	96	94	93	64	82	-
Industrialized countries	100	100	100	100	100	99	-	-	98	96	94	93	64	82	-	-
Developing countries	80	92	70	50	73	33	78	86	88	78	79	78	59	17	80	80



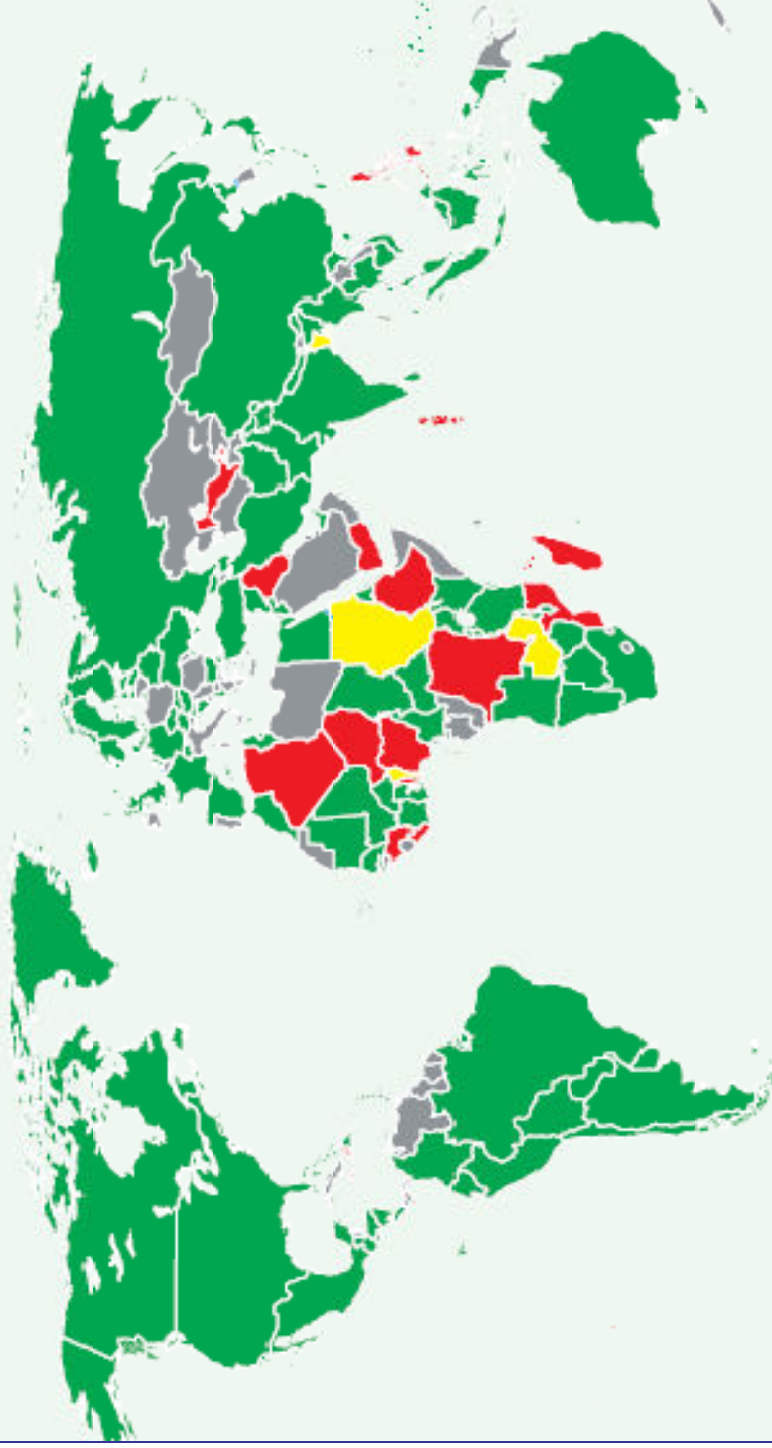


Progress towards the MDG target with countries classified according to the following thresholds:

- **On track:** Use of improved sanitation facilities in 2004 was less than 5 per cent below the rate needed for the country to reach the MDG target, or use was 95 per cent or higher
- **No progress:** Use of improved sanitation facilities in 2004 was more than 10 per cent below the rate needed for the country to reach the MDG target, or the 1990–2004 trend shows unchanged or decreasing use
- **Insufficient progress:** Use of improved sanitation facilities in 2004 was 5 per cent to 10 per cent below the rate needed for the country to reach the MDG target
- **Data were insufficient to estimate trends**

76 DEVELOPING COUNTRIES ARE ON TRACK TO REACH THE MDG TARGET ON SAFE DRINKING WATER

Progress in 5 developing countries has been insufficient to reach the target, and 23 developing countries have made no progress



Progress towards the MDG target, with countries classified according to the following thresholds:

- Green:** On track: Use of improved sources of drinking water in 2004 was less than 5 per cent below the rate needed for the country to reach the MDG target, or use was 95 per cent or higher
- Yellow:** Insufficient progress: Use of improved sources of drinking water in 2004 was 5 per cent to 10 per cent below the rate needed for the country to reach the MDG target
- Red:** No progress: Use of improved sources of drinking water in 2004 was more than 10 per cent below the rate needed for the country to reach the MDG target, or the 1990–2004 trend shows unchanged or decreasing use
- Grey:** Data were insufficient to estimate trends

Demographic Indicators from UNICEF 2008 report

	Life expectancy		Total fertility rate 2006	% of population urbanized 2006	Average annual growth rate of urban population (%)	
	1970	1990			1970-1990	1990-2006
Turkey	56	65	2.2	68	4.5	2.4
Industrialized countries	71	76	1.7	76	1.0	0.9
Developing countries	55	63	2.8	43	3.8	2.9

Summary

- ❖ Turkey seems to be successful in phasing out leaded gasoline.
- ❖ Although the growth rate of urban population decreases, 68% of population lives in urban cities. Since lead from all sources are additive, the urban child is at a higher risk because of the higher level of environmental pollution and needs to be screened.



Summary

- ❖ Nutritional and health parameters are being improved but children of the lowest socioeconomic class, who live in urban area are at the greatest risk and needs to be screened.
- ❖ Children living in industrialized cities or close to the mines are also found to be high risk groups and needs to be taken care of.



Data needed for Turkey:

- ❖ Nationwide screening BLLs of children
- ❖ Demographic data with BLL, to figure out the possible sources and high risk groups
- ❖ Environmental monitoring to find out the possible sources of lead exposure
- ❖ Lead levels in canned food, toys and products usually consumed by children
- ❖ Educating parents, preschool and preliminary school teachers about the toxic effects of lead is necessary





THANK YOU....

