

Lead Exposure Among Females of Childbearing Age — United States, 2004

What Does ABLES Tell Us?

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Lead Exposure

- Blood lead levels (BLLs) declining in US
- Remains a substantial public health problem among certain groups at high risk
 - Workers in certain industries
- CDC recommends interventions for children with $BLL \geq 10 \mu\text{g/dL}$
- Recommendations for adults less consistent

Prenatal Lead Exposure

- **Childhood neurobehavioral development affected by lead exposure**
 - Lead crosses the placenta
 - Prenatal BLL ≥ 5 $\mu\text{g/dL}$ inversely associated with child's IQ through age 10
- **Exposure should be prevented among all females of child-bearing age**

Adult BLL Recommendations

- **<5 $\mu\text{g}/\text{dL}$: limit recommended for pregnant women by the Association of Occupational and Environmental Clinics**
- **25 $\mu\text{g}/\text{dL}$: limit set by *Healthy People 2010***
- **≤ 40 $\mu\text{g}/\text{dL}$: OSHA limit for returning to work after being medically removed**

Study Objectives

- **Use ABLES data to estimate the prevalence of females of child-bearing age in the US whose BLLs exceed recommendations ranging from 5 to 40 $\mu\text{g}/\text{dL}$**
- **Identify risk factors for elevated BLLs**
- **Compare ABLES estimate to population-based NHANES sample**

Adult Blood Lead Epidemiology and Surveillance (ABLES)

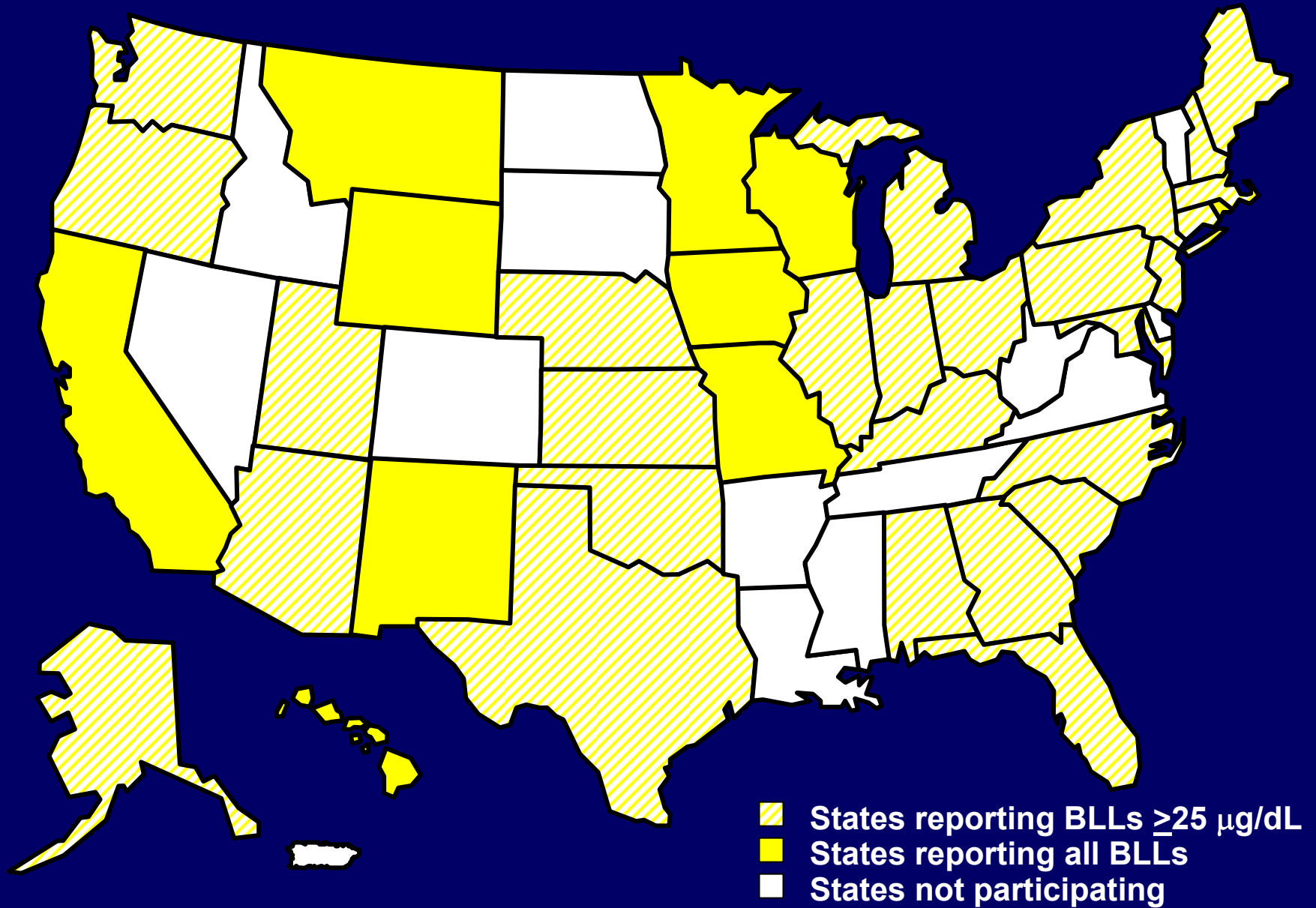
- **NIOSH — State partnership**
- **Laboratory-based BLL reporting legally mandated in states**
- **Reasons for BLL testing**
 - **OSHA mandated medical surveillance based on workplace air lead level**
 - **Clinical judgment of risk for lead exposure**

Adult Blood Lead Epidemiology and Surveillance (ABLES)

ABLES Data Includes

- **BLL**
- **Sex, age, race**
- **Standard codes for occupation and industry**
- **Nonoccupational sources of lead exposure**
- **Code for work-relatedness of lead exposure**

States Participating in ABLES, 2004



Case Definitions

- **Occupational cases**
 - Females age 16–44
 - BLL ≥ 5 $\mu\text{g/dL}$
 - Valid industry code *or* work-related code
- **Nonoccupational cases**
 - Females age 16–44
 - BLL ≥ 5 $\mu\text{g/dL}$
 - No valid industry code *or* work-related code

Rate Calculations

- **Occupational cases**
 - Denominator: female workers aged 16–44 in reporting states
- **All cases**
 - Denominator: female residents aged 16–44 in reporting states
- **Rates above 5 and 10 $\mu\text{g}/\text{dL}$ calculated by using 10 states that reported all BLLs in 2004**
- **Rates above 25 and 40 $\mu\text{g}/\text{dL}$ calculated by using all 37 ABLES states**

Number and Rate of Females Aged 16-44 Years with Elevated BLLs Among 10 States that Reported all BLLs to ABLES—2004

Exposure status	BLL \geq 40	
	No.	Rate*
All exposures	8	0.06
Occupational exposures	2	0.02

*Rate per 100,000 female residents aged 16-44

Number and Rate of Females Aged 16-44 Years with Elevated BLLs Among 10 States that Reported all BLLs to ABLES—2004

Exposure status	BLL \geq 40		BLL \geq 25	
	No.	Rate*	No.	Rate*
All exposures	8	0.06	86	0.7
Occupational exposures	2	0.02	55	0.6

*Rate per 100,000 female residents aged 16-44

Number and Rate of Females Aged 16-44 Years with Elevated BLLs Among 10 States that Reported all BLLs to ABLES—2004

Exposure status	BLL \geq 40		BLL \geq 25		BLL \geq 10	
	No.	Rate*	No.	Rate*	No.	Rate*
All exposures	8	0.06	86	0.7	476	3.8
Occupational exposures	2	0.02	55	0.6	254	2.9

*Rate per 100,000 female residents aged 16-44

Number and Rate of Females Aged 16-44 Years with Elevated BLLs Among 10 States that Reported all BLLs to ABLES—2004

Exposure status	BLL \geq 40		BLL \geq 25		BLL \geq 10		BLL \geq 5	
	No.	Rate*	No.	Rate*	No.	Rate*	No.	Rate*
All exposures	8	0.06	86	0.7	476	3.8	1,370	10.9
Occupational exposures	2	0.02	55	0.6	254	2.9	442	5.0

*Rate per 100,000 female residents aged 16-44

Number and Rate of Females Aged 16-44 Years with Elevated BLLs Among 37 States that Participated in ABLES—2004

Exposure status	BLL \geq 40		BLL \geq 25	
	No.	Rate*	No.	Rate*
All exposures	42	0.08	342	0.7
Occupational exposures	14	0.04	224	0.6
All manufacturing	11	0.4	199	7.1
Manufacturing SIC 3490 †	6	8.4	178	24.4
Metal ore mining	1	—	13	—
Construction	0	—	7	1.2
Other industry	2	0.0006	2	0.006

*Rate per 100,000 female workers aged 16-44

†Includes lead storage battery manufacturing

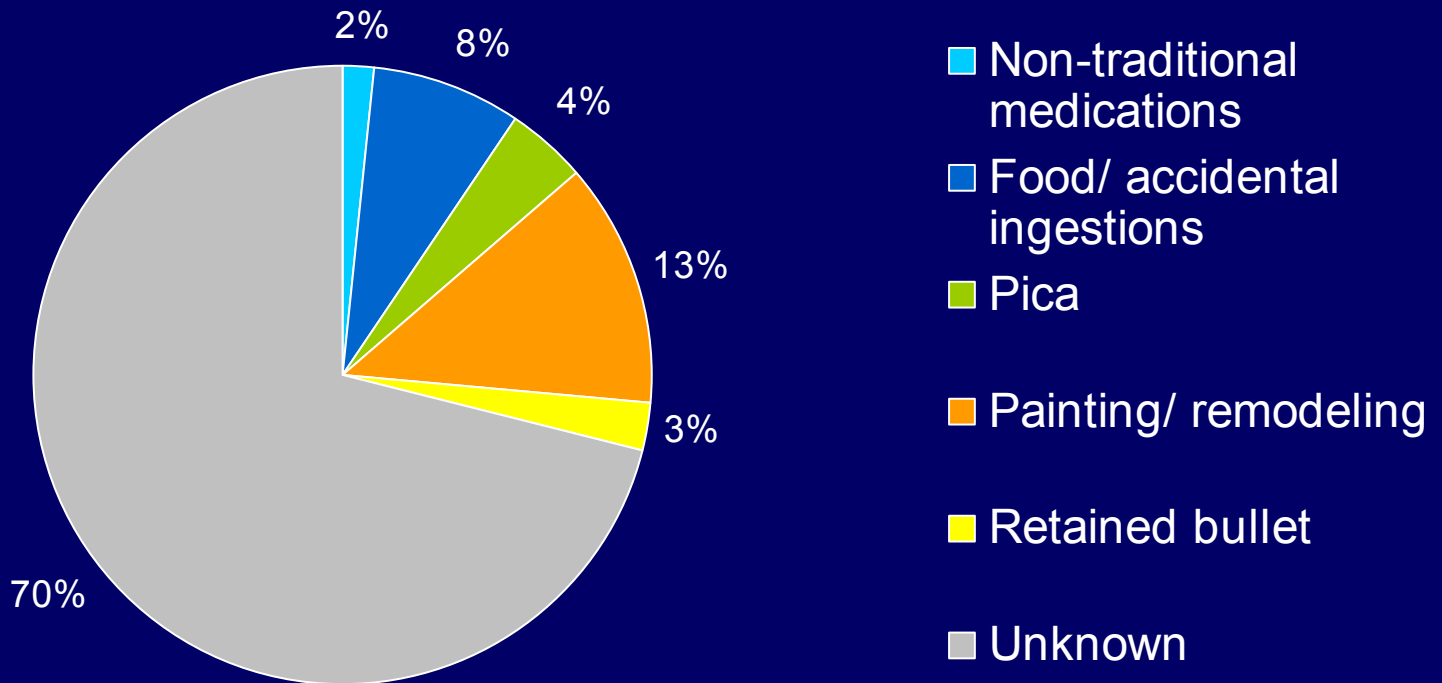
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All exposures	42	0.08	342	0.7
Occupational exposures	14	0.04	224	0.6
All manufacturing	11	0.4	199	7.1
Manufacturing CIC 3490 †	6	8.4	178	244
Metal ore mining	1	—	13	—
Construction	0	—	7	1.2
Other industry	2	0.0006	2	0.006

*Rate per 100,000 female workers aged 16-44

†CIC=Census Industry Code; 3490 includes lead storage battery manufacturing

Sources of Non-occupational Exposure for Women of Child-bearing Age with BLL ≥ 25 $\mu\text{g}/\text{dL}$ — ABLES, 2004



ABLES vs. NHANES

ABLES

NHANES

Sampling strategy

Labs report all BLLs performed during clinical practice

Complex, multistage probability sample of US civilian population

Sample timing

Highest BLL reported during calendar year

Random

Number of females (16-44) tested in 2003-2004

17,990 (10 states)

1,649

Representativeness in 2003-2004

10 states reported all BLLs: CA, HI, IA, MN, MO, MN, NM, RI, WI, WY

Designed to be nationally-representative

Number and Rate of Females of Childbearing Age with BLLs ≥ 10 $\mu\text{g/dL}$

ABLES, 2004

	No.	Rate*
All exposures	476	3.8

*Rate per 100,000 female residents aged 16-44

Number and Rate of Females of Childbearing Age with BLLs ≥ 10 $\mu\text{g/dL}$

	ABLES, 2004		NHANES, 2003-2004	
	No.	Rate*	No.	Rate†
All exposures	476	3.8	2	81.9

*Rate per 100,000 female residents aged 16-44

†Rate per 100,000 females aged 16-44

Predicted Total Number of US Females of Childbearing Age with BLLs ≥ 10 $\mu\text{g/dL}$

- Based on 2004 ABLES data
 - 2,282 (95% CI 763–3,800)
- Based on 2003–2004 NHANES data
 - 49,352 (95% CI 0–117,752)
- $\frac{1}{3}$ to $\frac{1}{2}$ of US pregnancies unplanned

Conclusions

- **According to ABLES, many females of child-bearing age in the US have elevated BLLs**
 - **Discrepancy between ABLES data and NHANES prediction suggests many exposed women are not tested**
 - **Rates of nonoccupational exposure similar to occupational exposure**
- **Magnitude of the problem varies greatly according to BLL recommendation**
- **Current occupational standards not protective**

Limitations

- **Population estimates from ABLES data underestimate true prevalence of lead exposure**
 - Many women at risk do not have their BLLs measured
 - Some labs might not report results to States
- **Underreporting likely varies by industry**
- **Data on occupational sources of exposure might be incomplete, causing misclassification**
- **Industry-specific denominators based on limited sample sizes**
- **Comparison to NHANES limited by differing methodology**

Recommendations

- **Educational campaigns to increase awareness of occupational and nonoccupational risks for lead exposure among HCWs and the public**
- **Better guidance for HCWs regarding when to test adults**
- **More protective occupational standards and clinical recommendations**

Acknowledgments

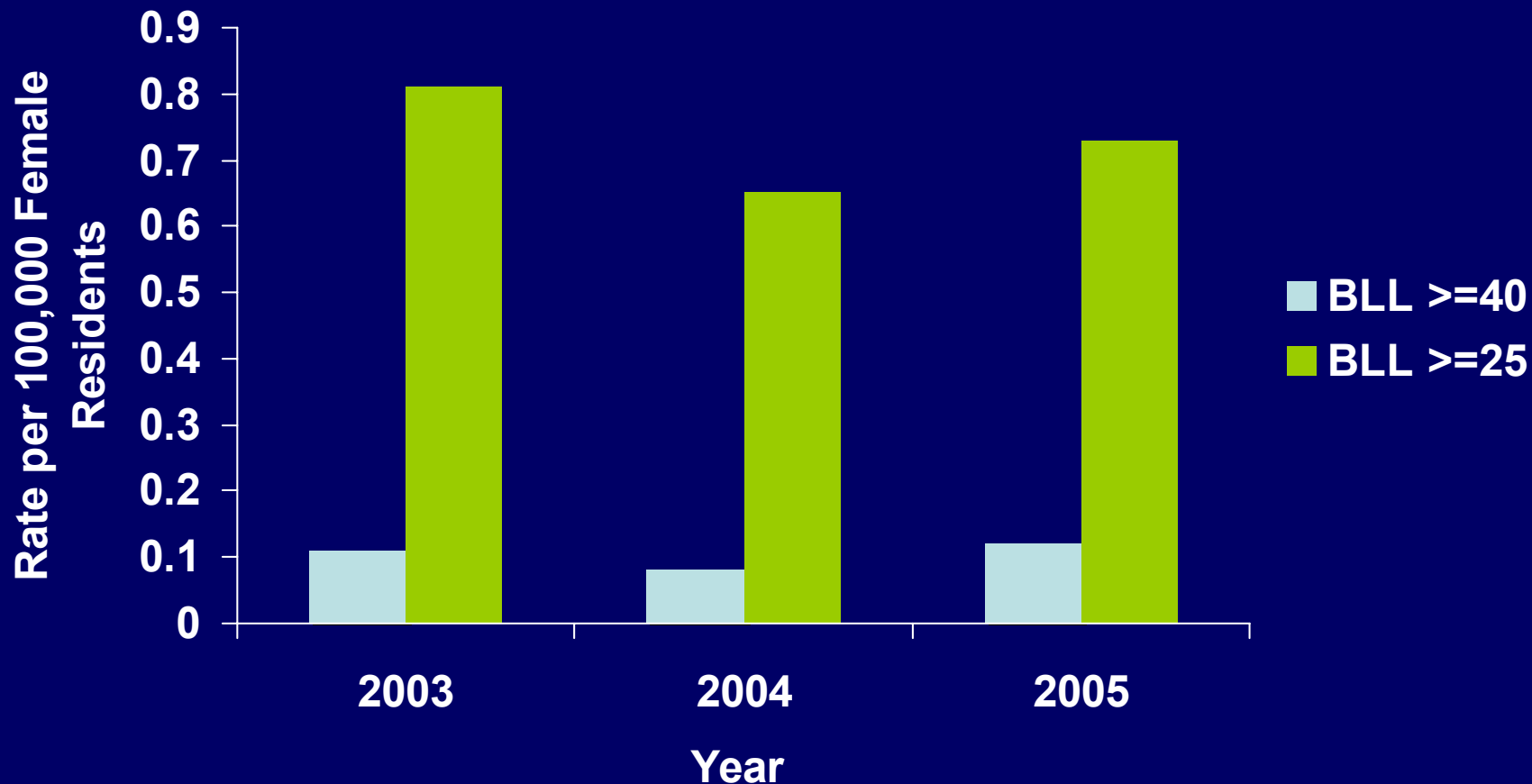
- **NIOSH**
 - Geoffrey Calvert
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 - Robert Roscoe
 - Janet Graydon
 - Marty Petersen

- **ABLES State Coordinators**

The findings and conclusions in this report have not been formally disseminated by the National Institute for Occupational Safety and Health and should not be construed to represent any agency determination or policy.

EXTRA SLIDES

Rate of Females Aged 16-44 Years with Elevated BLLs Among 37 States that Participated in ABLES, 2003–2005



No significant linear trend

Occupational Lead Standards

- **NIOSH *Recommended* Exposure Limit (REL): 50 $\mu\text{g}/\text{m}^3$ in air, averaged over an 8-hour period (1978?)**
- **OSHA *Permissible* Exposure Limit (PEL): 50 $\mu\text{g}/\text{m}^3$ in air, averaged over an 8-hour period (1978)**
- **OSHA Action Level: 30 $\mu\text{g}/\text{m}^3$ in air, averaged over an 8-hour period**
 - **Medical surveillance required for employees exposed at or above action level for >30 days/yr**
 - **Employee removed if BLL $\geq 60 \mu\text{g}/\text{dL}$ or average $\geq 50 \mu\text{g}/\text{dL}$**
 - **Employee may return to work when BLL $\leq 40 \mu\text{g}/\text{dL}$ (x2)**

Country	Occupational Airborne Lead Exposure limits (mg/m ³)	Occupational Blood Lead Levels/men (µg/100ml)	Occupational Blood Lead Levels /women (µg/100ml)
Argentina	0.2	N/A	N/A
Australia	0.2	50	20
Austria	0.1	N/A	N/A
Belgium	0.2	50	N/A
Canada	N/A	N/A	N/A
Denmark	0.1	50	N/A
Finland	N/A	40	N/A
France	0.15	N/A	N/A
Germany	0.1	70	30
Greece	0.15	70	N/A
India	0.15	N/A	N/A
Israel	0.1	N/A	N/A
Italy	0.15	70	N/A
Israel	0.1	60	30
Ireland	0.15	70	N/A
Japan	0.1	60	N/A
Luxembourg	N/A	70	N/A
Mexico	0.15	N/A	N/A
Morocco	0.2	60	N/A
Netherlands	0.1	60	45
New Zealand	0.15	N/A	N/A
Norway	0.05	60	N/A
Peru	0.2	60	N/A
Singapore	N/A	N/A	N/A
South Africa	0.15	80	40
Spain	0.15	70	N/A
Sweden	0.1	50	30
Switzerland	0.1	N/A	N/A
Thailand	0.2	70	N/A
Taiwan	N/A	N/A	N/A
Turkey	N/A	N/A	N/A
UK	0.15	70	40
USA	0.05	50	50
USSR	N/A	N/A	N/A
Average	0.14	61	36

Sex-Specific Occupational Exposure Limits for Lead

Country	Airborne Limit (mg/m ³)	BLL for Men (μg/dL)	BLL for Women (μg/dL)
Australia	0.2	50	20
Finland	N/A	40	40*
Germany	0.1	70	30
Israel	0.1	60	30
Netherlands	0.1	60	45
South Africa	0.15	80	40
Sweden	0.1	50	30
UK	0.15	70	40
USA	0.05	50	50*

*No difference in limits for women vs. men

Results

- **BLLs for 20,079 women of child-bearing age (WCBA) reported to ABLES in 2004**
 - 1,773 (8.8%) had multiple tests
- **In 10 states that reported BLLs of all levels**
 - 1,370 WCBA had BLLs ≥ 5 $\mu\text{g/dL}$
 - 476 WCBA had BLLs ≥ 10 $\mu\text{g/dL}$
- **In 37 states that reported all BLLs ≥ 25 $\mu\text{g/dL}$**
 - 342 WCBA had BLLs ≥ 25 $\mu\text{g/dL}$
 - 42 WCBA had BLLs ≥ 40 $\mu\text{g/dL}$

Number and Rate of Females Aged 16-44 Years with Elevated BLLs Among 10 States that Reported all BLLs to ABLES—2004

Exposure status	BLL \geq 5		BLL \geq 10		BLL \geq 25		BLL \geq 40	
	No.	Rate	No.	Rate	No.	Rate	No.	Rate
All exposures	1,370	10.9	476	3.8	86	0.7	8	0.06
Occupational exposures	442	5.0	254	2.9	55	0.6	2	0.02