

Recommendations for Medical Management of Adult Lead Exposure

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Vol 115, No. 3, pp 463-471, March 2007

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OSHA Lead Standards: Medical removal not mandatory until blood lead concentrations $\geq 50 \mu\text{g/dL}$

Health effects of lead at low dose warrant a reappraisal of the levels of lead exposure that may be safely tolerated in the workplace.

- **Chronic effects of cumulative dose**
- **Acute effects of recent dose**

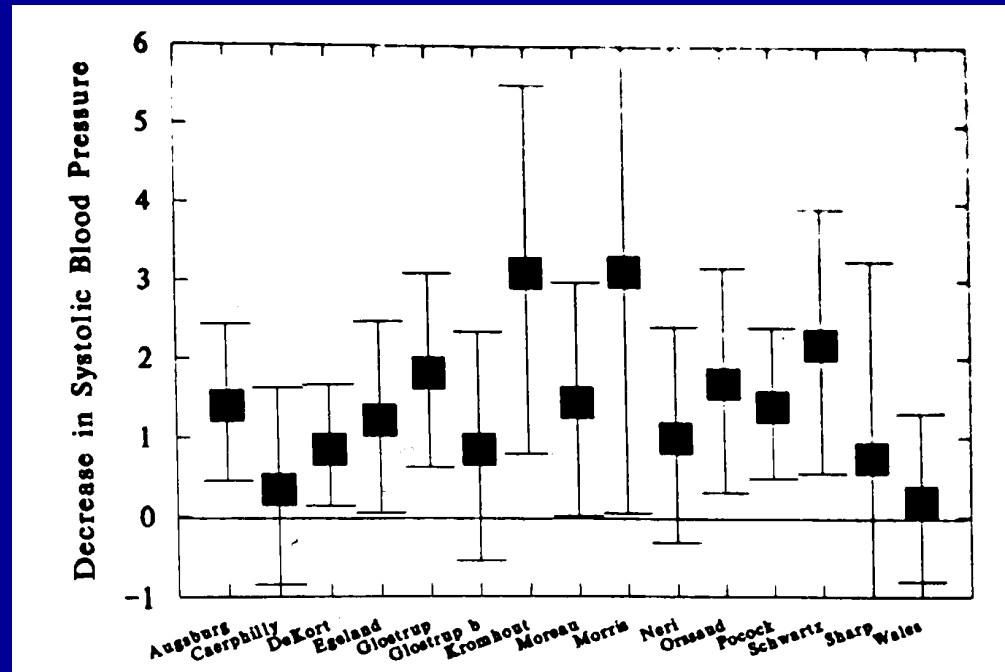
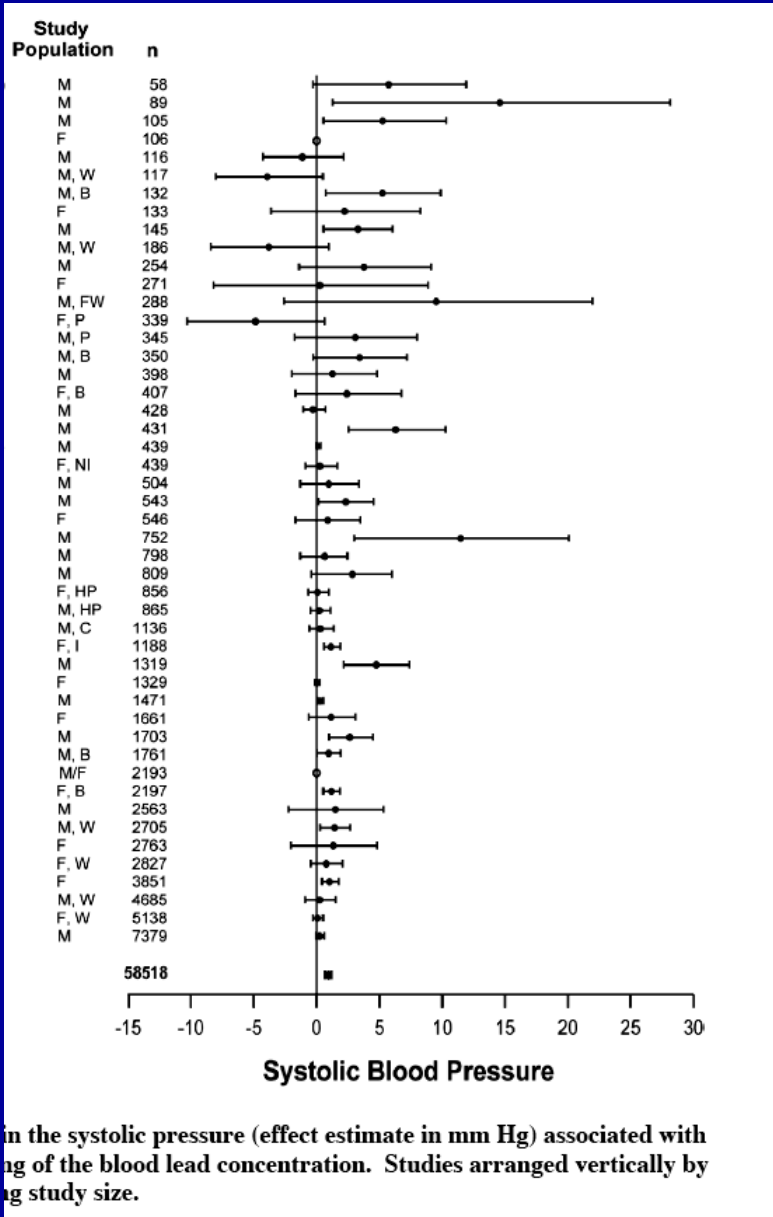
hypertension

decrements in renal function

cognitive dysfunction

adverse reproductive outcome

Schwartz, 1995



Meta-analyses:

$\Delta PbB \ 5 \rightarrow 10 \ \mu g/dL$

= $\Delta 1.0$ or 1.25 mmHg
in systolic blood
pressure

Nawrot et al, 2002

The Relationship of Bone and Blood Lead to Hypertension. The Normative Aging Study

Hu H et al, JAMA 1996; 275:1171-1176

Case control study: 146 hypertensive men; 444 controls selected from large, ongoing prospective study of aging. Mean age = 66.6 ± 7.2 y

Exposure reflects that of general population. Mean PbB = 6.3 ug/dL

Final logistic model (backward elimination) yielded 3 significant risk factors for hypertension:

Body mass index

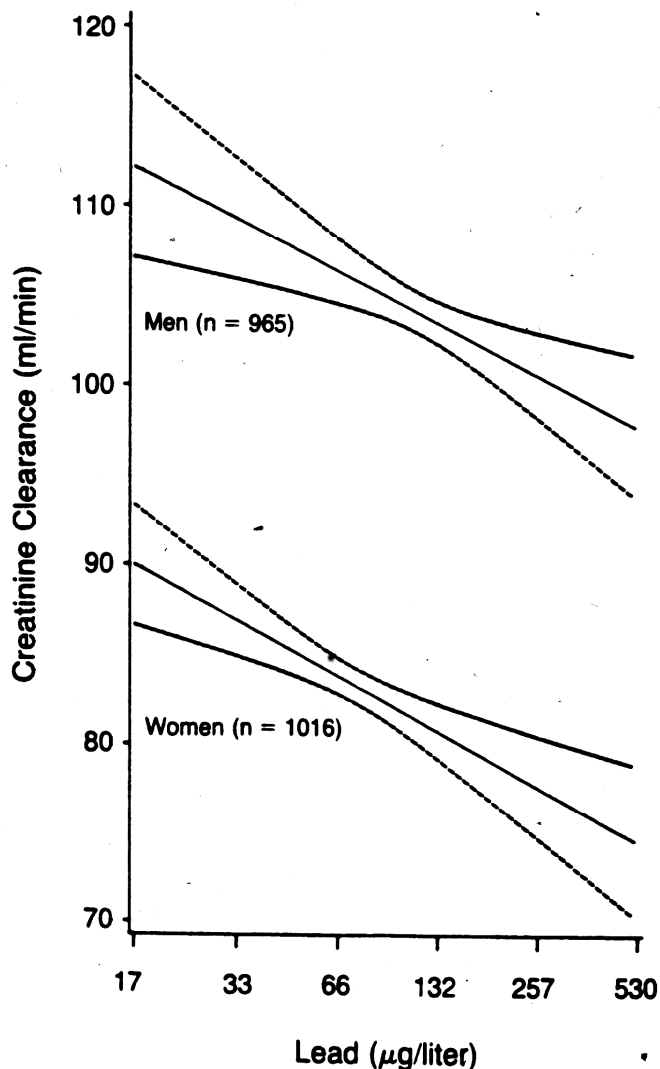
Family history of hypertension

Tibia bone lead concentration

From the lowest quintile of bone lead to the highest quintile, the odds of being hypertensive increased by 50 %

O.R. = 1.5 (95% C.I. 1.1 - 1.8)

Impairment of renal function with increasing blood lead concentration in the general population



Staessen JA et al. NEJM 327:151-6; 1992

- Random population sample of 965 men and 1016 women (age 20 to 88)
- Blood lead range 1.7 - 72.5 ug/dL; geometric mean (GM) \approx 10 ug/dL
- Significant correlation between age-adjusted creatinine clearance and blood lead
- Relationship persisted after excluding subjects with occupational Pb exposure, or those with highest tercile of PbB (GM = 18.4 ug/dL)

Bone lead concentration predicts decrements in cognitive function in older adults

1. Baltimore Memory Study (Shih et al, 2006)

N = 991 randomly selected, sociodemographically diverse community dwelling adults, aged 50 to 70 yrs

Mean PbB = 3.5 ± 2.2 $\mu\text{g/dL}$

Tibia lead: \downarrow visuoconstruction on neuropsych testing
 Δ 13 ppm equivalent impact of 4.8 years of age

2. Normative Aging Study (Weisskopf et al, 2007)

N = 1089 older, mainly white men, mean age 68.7 ± 7.4 yrs.

Repeat neuropsych testing over ≈ 3.5 yr interval

Median PbB = 5 $\mu\text{g/dL}$ (IQR 3 - 6)

Tibia lead: longitudinal \downarrow visuospatial performance (N = 761)

Blood Lead Levels Measured Prospectively and Risk of Spontaneous Abortion [Borja-Aburto et al, 1999]

- 562 of 668 women followed through week 20; (16% loss to follow-up)
- Average blood lead at enrollment: 11 ug/dL
- Cases (n=35) PbB = 12 ug/dL Controls (n=60) PbB = 10ug/dL

<u>PbB level (ug/dL)</u>	<u>Odds Ratio</u>
< 5 [referent]	1.0
5-9	2.3
10-14	5.4
≥ 15	12.2

test for trend $p = 0.021$;

for Δ PbB of 5 $\mu\text{g}/\text{dL}$, O.R. = 1.8 (C.I. 1.1, 3.1)

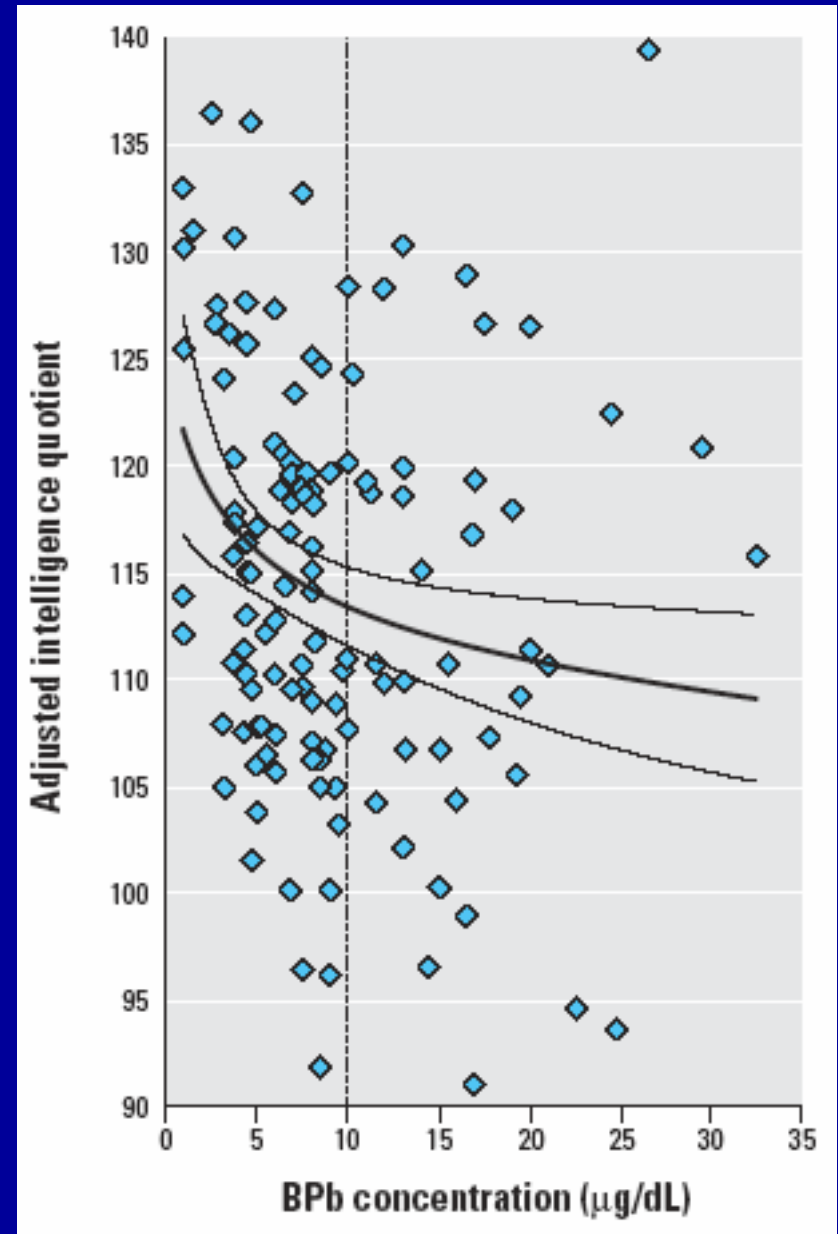
Mexico City Prospective Lead Study

(Schnaas et al 2006)

3rd Trimester PbB = 7.8 $\mu\text{g}/\text{dL}$

Every doubling of PbB
associated with IQ $\downarrow 2.7$ pts
at 6 - 10 yrs of age

N = 150



BLL ($\mu\text{g}/\text{dL}$)	Management
< 5	None indicated
5 - 9	Discuss health risks Reduce Pb exposure for women who are or may become pregnant
10 - 19	Decrease lead exposure. Increase biological monitoring. Consider removal from exposure to avoid long term risks if exposure control over an extended period does not decrease BLL < 10, or if medical condition present that increases risk with continued exposure
20 -29	Remove from exposure if repeat BLL measured in 4 weeks remains ≥ 20

BLL (µg/dL)	Management
30 - 39	Remove from lead exposure
40 - 79	Remove from lead exposure Refer for prompt medical evaluation Consider chelation for BLL >50 with significant symptoms or signs
≥ 80	Remove from lead exposure Refer for immediate/urgent medical evaluation Probable chelation therapy

Category	Recommended medical surveillance
All lead-exposed workers	Baseline/preplacement H&P, baseline BLL, serum creatinine
BLL < 10	BLL q month for first 3 mo. <i>or</i> if Δ to higher exp., then BLL q 6 mo. If BLL $\uparrow \geq 5$, evaluate exposure and protective measures. Increase monitoring if indicated
BLL 10 - 19	As above for BLL < 10, plus: BLL q 3 months Evaluate exposure, controls, work practices Consider removal Revert to BLL q 6 mo after 3 BLLs < 10
BLL ≥ 20	Remove from exposure if repeat BLL measured in 4 weeks remains ≥ 20, or if first BLL ≥ 30 Monthly BLL Consider return to lead work after 2 BLLs <15 a month apart, then monitor as above

Surveillance recommendations apply to all potential lead exposed workers, even in absence of documented elevations in air lead levels.

Routine measurement of zinc protoporphyrin not indicated

With potential exception of annual BP measurement and risk factor questionnaire, medical evaluations unnecessary for workers maintaining BLL < 20 µg/dL.

Annual worker education about lead hazards is recommended.

Chelation for lead intoxication in adults

BLLs \geq 100 $\mu\text{g}/\text{dL}$ almost always warrant chelation.

BLL 80 - 99 $\mu\text{g}/\text{dL}$, with or without symptoms, can be considered for chelation, as may some symptomatic individuals with blood lead concentrations of 50 - 79

Chelation not recommended for asymptomatic individuals with low blood lead concentrations

C7004137

RECEIVED

UNEXPECTED

SPECIMEN INFORMATION

02/10/2003
DATE

9:27 PM
TIME

02/12/2003
DATE

11:34 AM
TIME

02/12/2003
DATE

2:11 PM
TIME

DATE OF BIRTH: 06/09/1958

HI
LO

EXPECTED VALUES

Zinc, S

0.84

ug/mL

0.64-1.10

Lead with Demographics

Lead, B

2

ug/dL

<20

(Toxic >= 70)

Patient Demographics

Venous/Capillary

VEN

Table 3. Recommended interpretive guidance for clinical laboratories reporting adult blood lead concentrations.

Blood lead level (µg/dL)	Management recommendations and requirements ^a for adults
< 5	No action needed
5–9	Discuss health risks Reduce exposure for pregnancy
10–19	Discuss health risks. Decrease exposure. Monitor BLL Remove from exposure for pregnancy, certain medical conditions, long-term risks
20–29	Remove from exposure if repeat BLL in 4 weeks remains ≥ 20 µg/dL
30–79	Remove from exposure. Prompt medical evaluation and consultation advised for BLL > 40 µg/dL OSHA requirements may apply Chelation not indicated unless BLL > 50 µg/dL with significant symptoms
≥ 80	Urgent medical evaluation and consultation indicated OSHA requirements may apply Chelation may be indicated if symptomatic and/or BLL ≥ 100 µg/dL

BLL, blood lead level. Primary management of lead poisoning is source identification and removal from exposure. A single BLL does not reflect cumulative body burden or predict long-term effects.

^aRefer to OSHA general industry and construction lead standards for occupational exposure.