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**A Non-invasive Isotopic Approach to Estimate the
Bone Lead Contribution to Blood in Children:
Implications for Assessing the Efficacy of Lead
Abatement**

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**A Non-invasive Isotopic Approach to Estimate the Bone Lead Contribution to
Blood in Children: Implications for Assessing the Efficacy of Lead Abatement**

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Abbreviations:

Pb_{blood}	Concentration of lead in blood, in units of $\mu\text{g Pb/dL blood}$
Pb_{feces}	Lead excretion in feces, in units of $\mu\text{g Pb/day}$
Pb_{in}	Amount of lead in blood from external intake, in units of $\mu\text{g Pb/dL blood}$
Pb_{bone}	Amount of lead in blood from bone, in units of $\mu\text{g Pb/dL blood}$
$(^{207}\text{Pb}/^{206}\text{Pb})_{\text{blood}}$	$^{207}\text{Pb}/^{206}\text{Pb}$ isotopic ratio measured in blood
$(^{207}\text{Pb}/^{206}\text{Pb})_{\text{feces}}$	$^{207}\text{Pb}/^{206}\text{Pb}$ isotopic ratio measured in feces
$(^{207}\text{Pb}/^{206}\text{Pb})_{\text{in}}$	$^{207}\text{Pb}/^{206}\text{Pb}$ isotopic ratio of lead in blood from external intake
$(^{207}\text{Pb}/^{206}\text{Pb})_{\text{bone}}$	$^{207}\text{Pb}/^{206}\text{Pb}$ isotopic ratio of lead in blood from bone
t_1, t_2, t_3	Time of the first, second, and third sample collection round, respectively
SRM	Standard Reference Material
RSD	Relative Standard Deviation

Outline

Section	Page
Abstract.....	4
Introduction.....	5
Materials and Methods	
Experimental Approach.....	9
Subjects.....	12
Sample Collection.....	13
Analytical Techniques.....	13
Results	
Relationships between lead isotopic ratios of environmental, feces and blood samples.....	16
Estimates of bone lead contribution to blood.....	17
Discussion.....	20
Assumptions and Limitations of this Isotopic Approach...	23
Conclusions.....	25
References.....	27
Table I.....	33
Table II.....	34
Figure Captions.....	35

ABSTRACT

Lead hazard control measures to reduce children's exposure to household lead sources often result in only limited reductions in blood lead levels. This may be due to incomplete remediation of lead sources, and/or to the remobilization of lead stores from bone, which may act as an endogenous lead source that buffers reductions in blood lead levels. Here, we present a non-invasive isotopic approach to estimate the magnitude of the bone lead contribution to blood in children following household lead remediation. In this approach, lead isotopic ratios of a child's blood and five-day fecal samples are determined before and after a household intervention aimed at reducing the child's lead intake. The bone lead contribution to blood is estimated from a system of mass balance equations of lead concentrations and isotopic compositions in blood at the different times of sample collection. The utility of this method is illustrated with three cases of children with blood lead levels in the range 18 to 29 $\mu\text{g}/\text{dL}$. In all three cases, the release of lead from bone supported a substantial fraction of the measured blood lead level post-intervention, up to 96% in one case. In general, the lead isotopic compositions of feces matched or were within the range of the lead isotopic compositions of the household dusts with lead loadings exceeding EPA action levels. This isotopic agreement underscores the utility of lead isotopic measurements of feces to identify household sources of lead exposure. Results from this limited number of cases support the hypothesis that the release of bone lead into blood may substantially buffer the decrease in blood lead levels expected from the reduction in lead intake.