Trace Metals Collaborative Study – blood lead results

JinHee Kim, MD MPH FRCPC, Public Health Physician

Katherina Chojnacki, MPH candidate

Environmental and Occupational Health, Public Health Ontario

Conflict of Interest

- None

Objectives

- Describe trends in environmental lead and blood lead levels among Canadians over time

- Describe the health effects of lead on children

- Describe the Trace Metals Collaborative Project and its objectives

- Discuss preliminary results of the blood lead analysis

- Discuss study limitations

Lead in the environment

- Lead additives in gasoline since 1920s
  - Dramatic decrease in air lead levels following the introduction of unleaded gasoline in Canada in 1975
  - Prohibited in Canada in 1990 (*Gasoline Regulations*, under the *Canadian Environmental Protection Act*)

- Lead in paint in 1940s up to 50% lead by weight
  - Current requirement *0.009% dry weight (Surface Coating Materials Regulations,* under *Canada Consumer Product Safety Act*)

- Food packaging

Blood lead levels have declined over time

	1970s	Now
Canada	**4.79 µg/dL** 6-79 years 1978-1979 CHS	**1.1 µg/dL** 3-79 years 2012-2013 CHMS Cycle 3
U.S.	***12.8 µg/dL*** 1-74 years 1976-1980 NHANES	**0.973 µg/dL** >1 year 2011-2012 NHANES

Bushnik T et al. 2010 Health Reports 21(3):7-18
Pirkle JL et al 1994. JAMA 272(4):284-91
CHMS Cycle 3 report 2015.
NHANES Fourth National report 2017.

Risk factors for lead exposure

- Population exposures:
  - Food
  - Dust
  - Water

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- Less common:
  - Occupation
  - Paint chips, lead dust (children)
  - Traditional remedies/cosmetics (e.g., Ayurvedics, surma, kohl)
  - Hobbies (e.g., stained glass; casting weights, shots; shooting ranges)
  - Consumer products (inexpensive jewelry, toys)
  - Imported candies and foods
  - Lead-glazed ceramics, china, and leaded crystal, pewter
  - Pica

Lead and children

- Higher risk of exposure, susceptibility

- Neurotoxin
  - Effects on development, IQ, behaviour, later life potential – population studies

- Risk factors for high blood lead:
  - Age (behaviours/exposures, absorption)
  - Ethnicity (US, Canada differences?)
  - Immigrant or refugee status
  - Lower SES
  - Age of housing

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Levin R et al 2008. EHP 116(10):1285-93.

Blood lead levels – Canadian data

- Canadian Health Measures Survey conducts biomonitoring of environmental chemicals

- Nationally representative

- 3 cycles
  - 1: 2007-2009 (6-79 years)
  - 2: 2010-2011 (3-79 years)
  - 3: 2012-2013 (3-79 years)

- Children under 3 years excluded

- U.S. NHANES data on >1 year olds
  - Childhood blood lead levels peak ~12-24 months

History of collaboration

- Public Health Ontario provides scientific and technical advice to the Government of Ontario and the health care system

- Question from Toronto Public Health about blood lead levels in preschool age children in the City of Toronto

- Not able to locate data

TARGetKids! cohort

- Research study to link early life exposures to health problems including obesity, micronutrient deficiencies, and developmental problems

- Enrolls healthy children 0-5 years who attend well-child visits

- Clinics in GTA, Kingston

- Data collection
  - Questionnaires (nutrition, behaviour, development, parenting stress)
  - Anthropometry, blood pressure, accelerometry
  - Other assessments – development, school readiness
  - Blood collection (nutrition, cholesterol/related measures)

Trace metal collaborative study

- Distribution of blood lead, mercury, cadmium in pre-school age children

- Subgroup analysis on foreign-born children planned

- Funding for trace metals testing for subjects

- Addition of questions to the survey questionnaire to assess for risk factors

- This project just focuses on the <u>preliminary</u> blood lead results

Research questions

- Primary
  - What is the distribution and age-related trend of blood lead levels among children in the Greater Toronto Area and Kingston in the TARGet Kids! cohort?

- Secondary
  - What risk factors are correlated with higher blood lead levels among children in the Greater Toronto Area and Kingston in the TARGet Kids! cohort?

- Intent to do subgroup analysis on foreign-born children

Study sample

- Subjects enrolled February 2013-December 2014

- N= 826

- Predominantly 0-6 years of age; some 7-9

- Cross-sectional analysis

- Outcome: blood lead (µg/dL)

Risk factors examined

- Questions on lead added to study questionnaire
  - Traditional medicine or cosmetic use
  - Lead related industry/hobby
  - Month of blood test
  - Age of dwelling
  - Type of dwelling
  - Home renovation history
  - State of paint in home (chipping?)

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Sample demographics

	Frequency (N)	Percentage (%)
AGE:		
0-1	101	12.3
1-2	131	15.9
2-3	116	14.1
3-4	145	17.6
4-5	130	15.8
5-6	124	15.0
6+	77	9.3
GENDER:		
Female	384	47
CHILD CANADIAN BORN?		
Yes	771	98.2
MOTHER CANADIAN BORN?		
Yes	546	69.2

	Frequency (N)	Percentage (%)
MATERNAL ETHNICITY:		
European	474	66.7
East Asian	50	7.0
South Asian	44	6.2
Southeast Asian	26	3.7
Arab	12	1.7
African	42	5.8
Latin American	26	3.7
Mixed	34	4.8
Other	3	0.4
HOUSEHOLD INCOME:		
<$20,000	29	3.6
$20,000 to $49,999	63	7.9
$50,000 to $99,999	151	19.0
$100,000 to $149,999	174	21.9
$150,000+	378	47.6

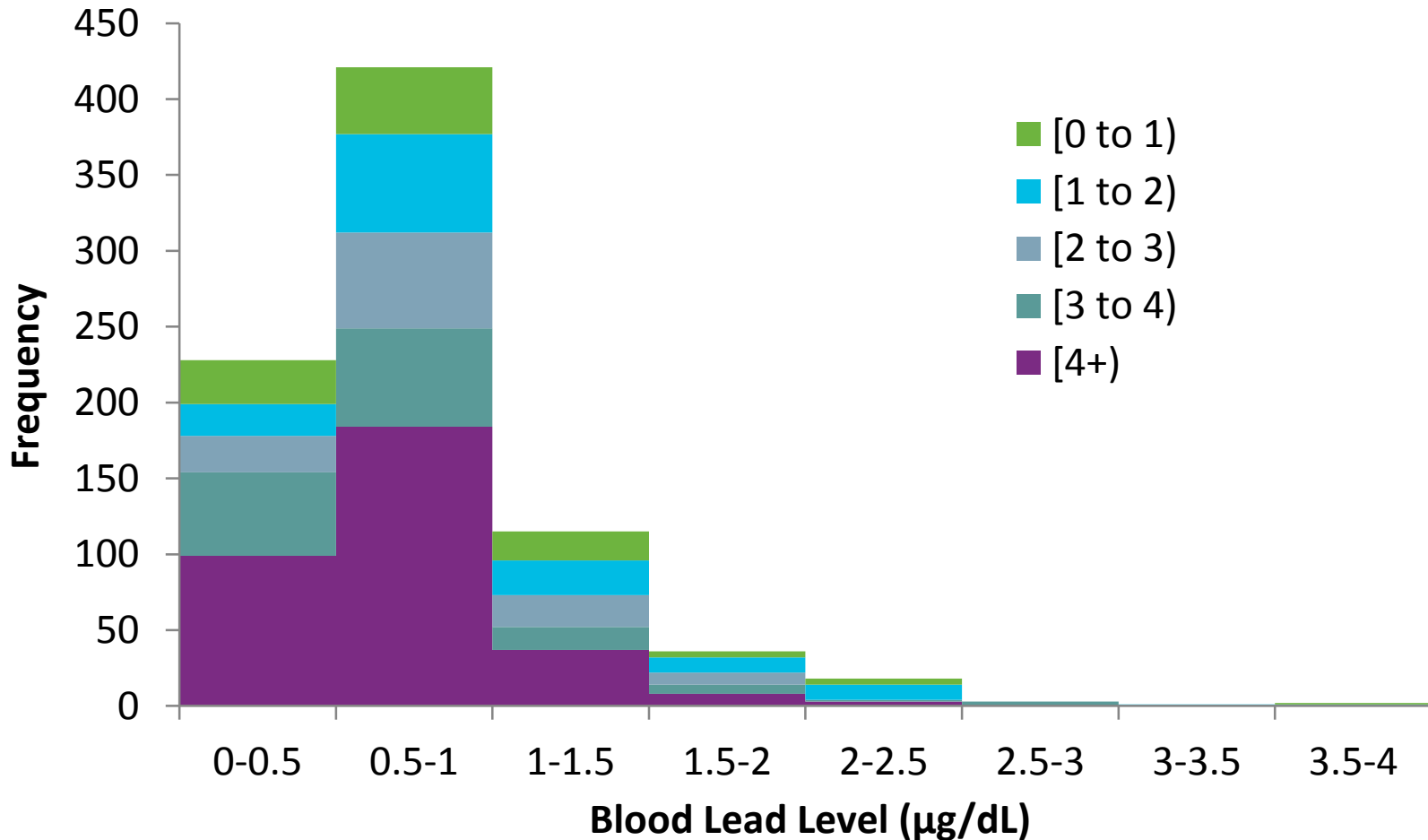# Blood lead levels

- Geometric mean= 0.68 μg/dL (GSD= 1.68)

  - CHMS Cycle 3 GM for 3-5 years was 0.77 (95%ile 2.2) μg/dL

- Median= 0.68 μg/dL

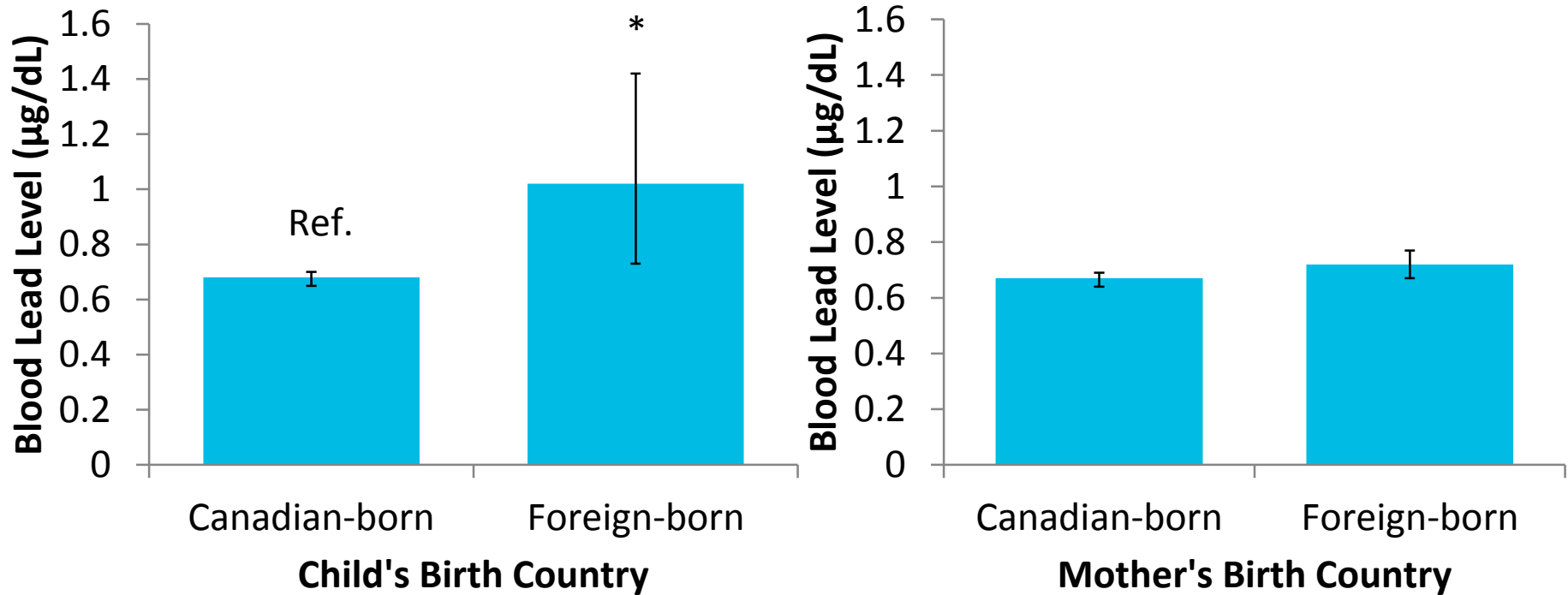- Minimum = 0.15 μg/dL

- Maximum = 3.92 μg/dL

Sample Blood Lead Level by Percentile (μg/dL)						
5th	10th	25th	50th	75th	90th	95th
0.30	0.36	0.48	0.68	0.94	1.33	1.72

Distribution of blood lead stratified by age

Birth outside Canada

*Significant difference from reference at the p=0.05 level

Income
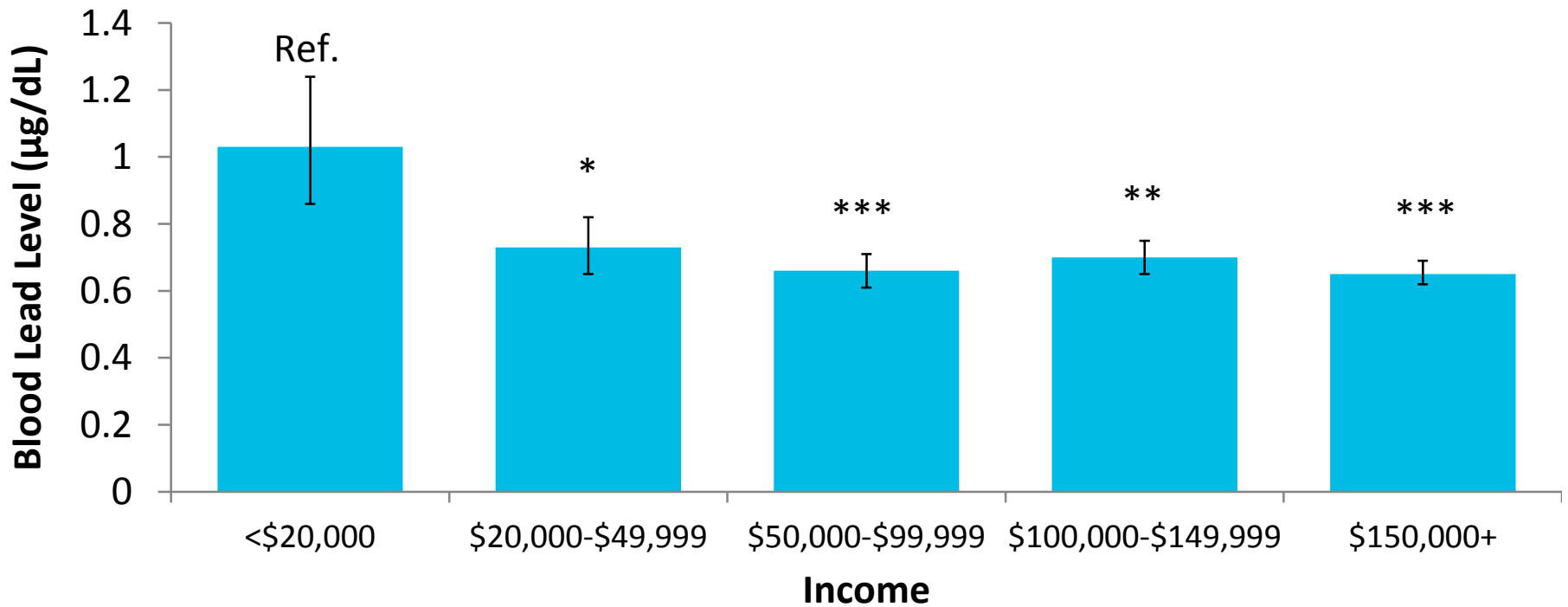
Blood Lead Level (µg/dL) vs Income bar chart with the following categories:
- <$20,000: ~1.03 (Ref.)
- $20,000-$49,999: ~0.73 (*)
- $50,000-$99,999: ~0.66 (***)
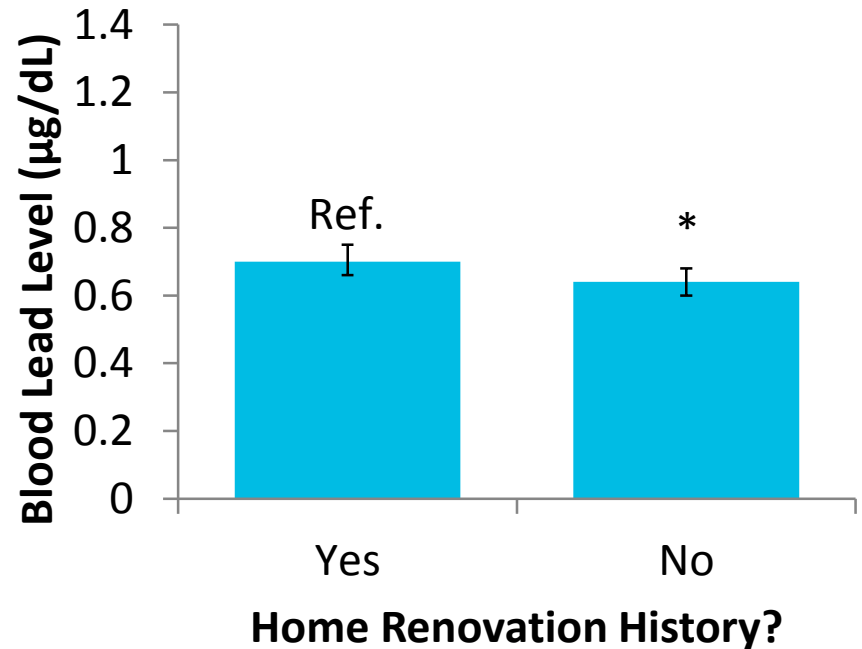- $100,000-$149,999: ~0.70 (**)
- $150,000+: ~0.65 (***)

Significant difference from reference at the *p=0.05 level; **p=0.01 level; ***p=0.001 level
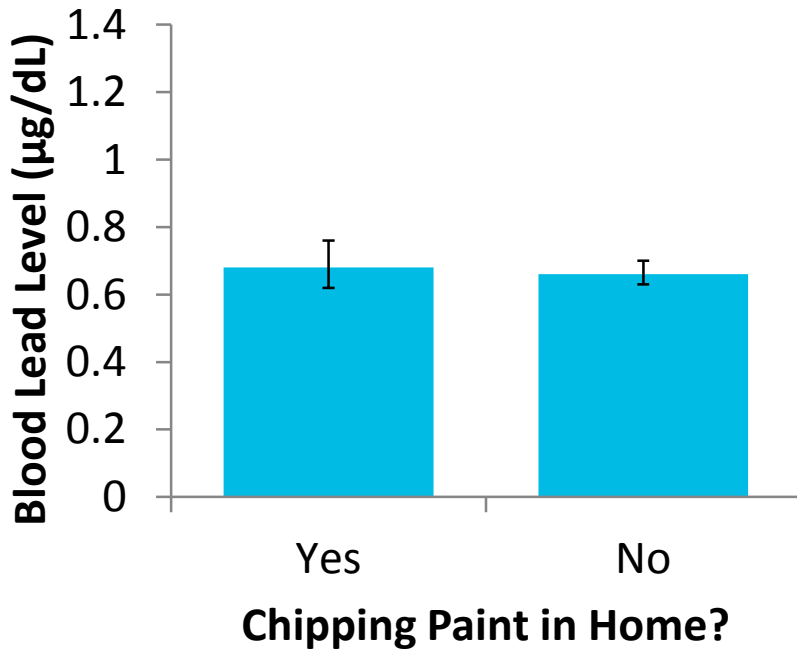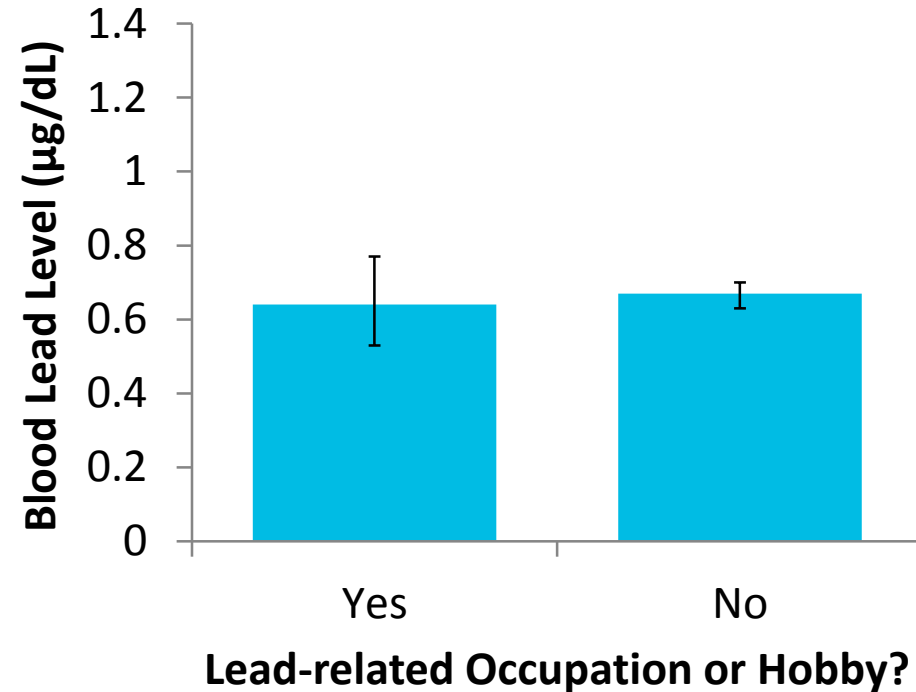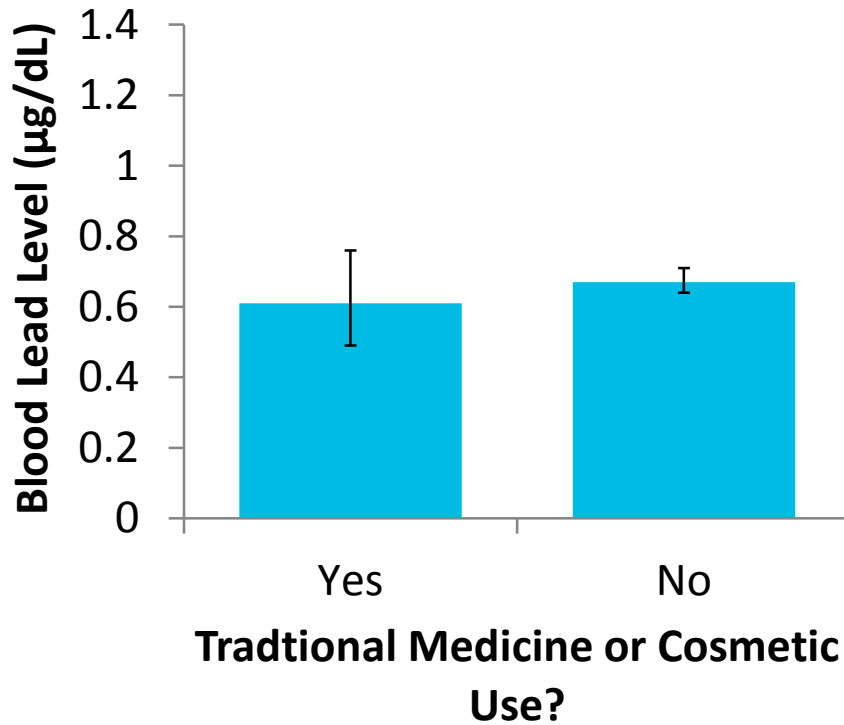
Housing-related factors
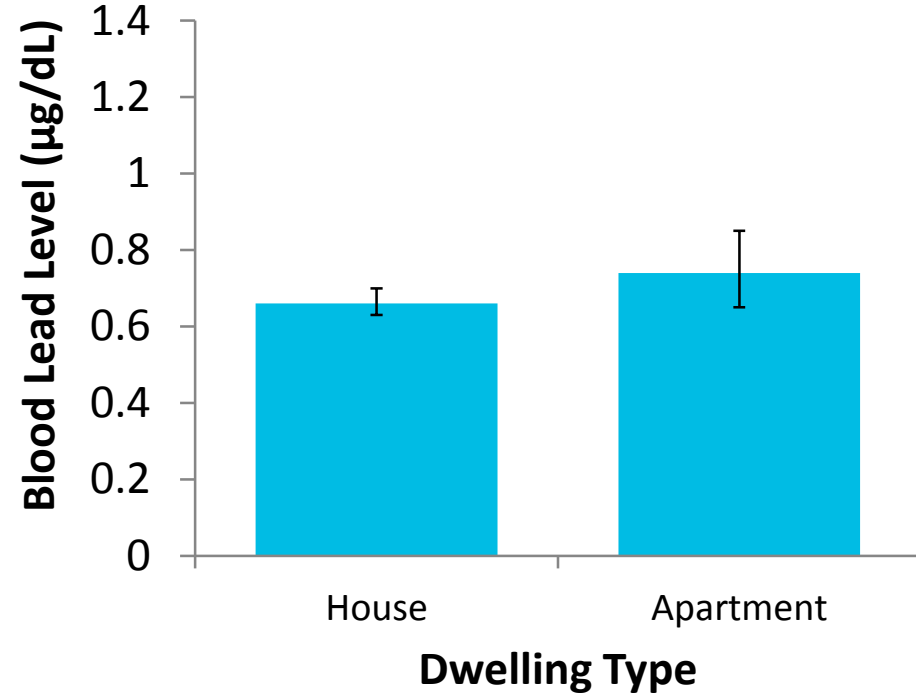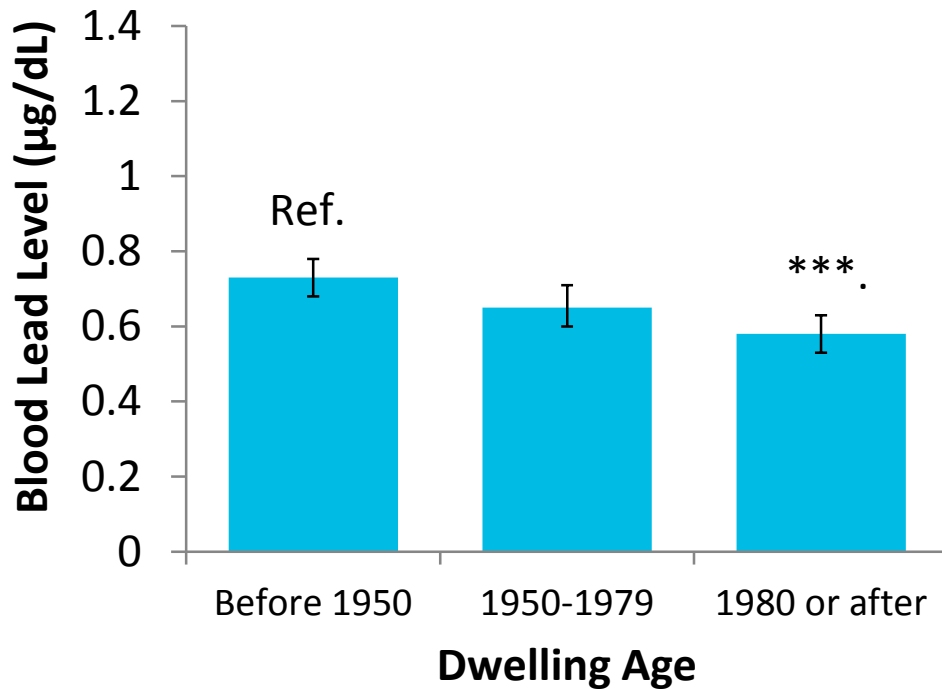
Significant difference from reference at the *p=0.05 level; **p=0.01 level; ***p=0.001 level

Housing-related factors
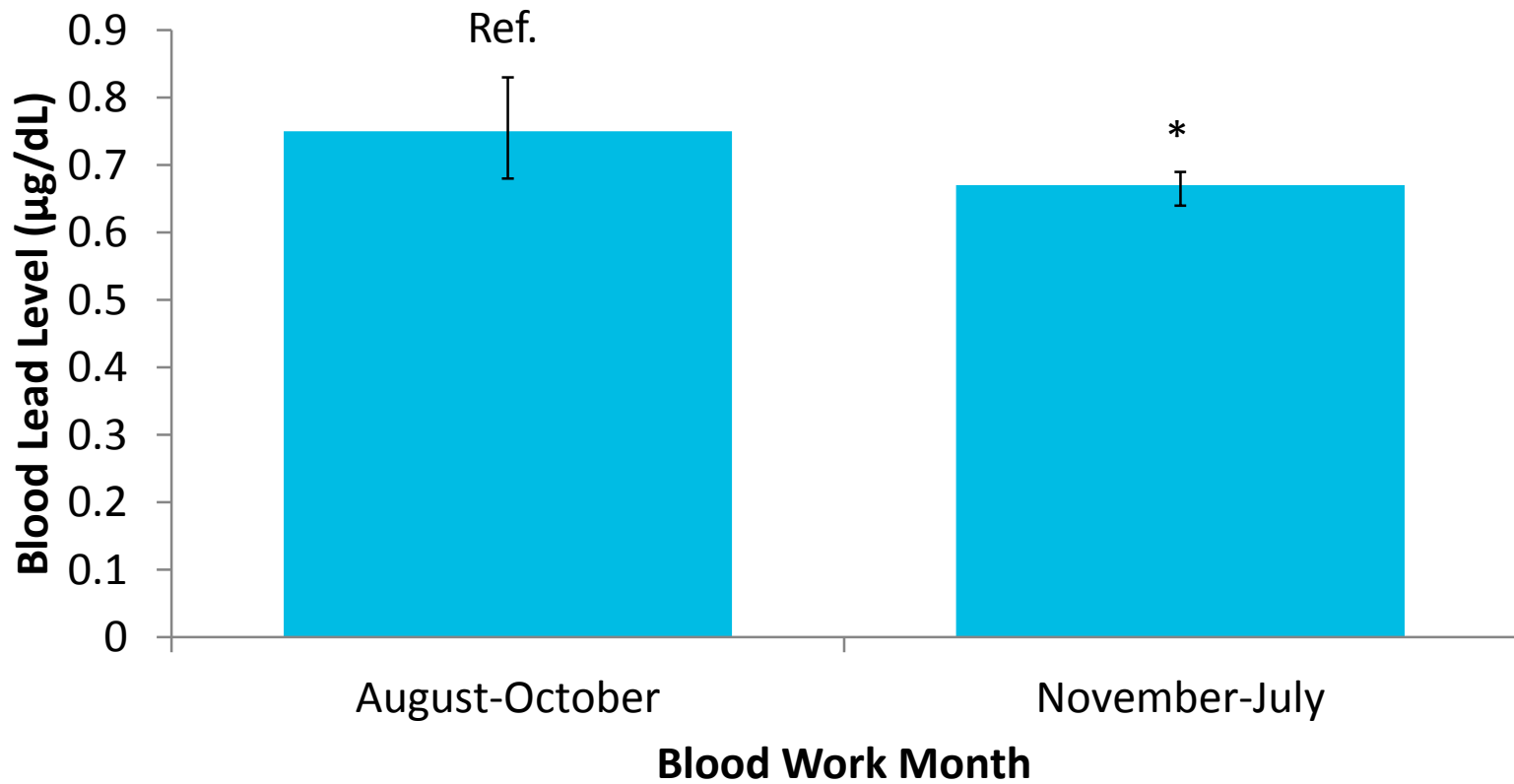

Significant difference from reference at the *p=0.05 level; **p=0.01 level; ***p=0.001 level

Other risk factors and blood lead

Blood work month and blood lead

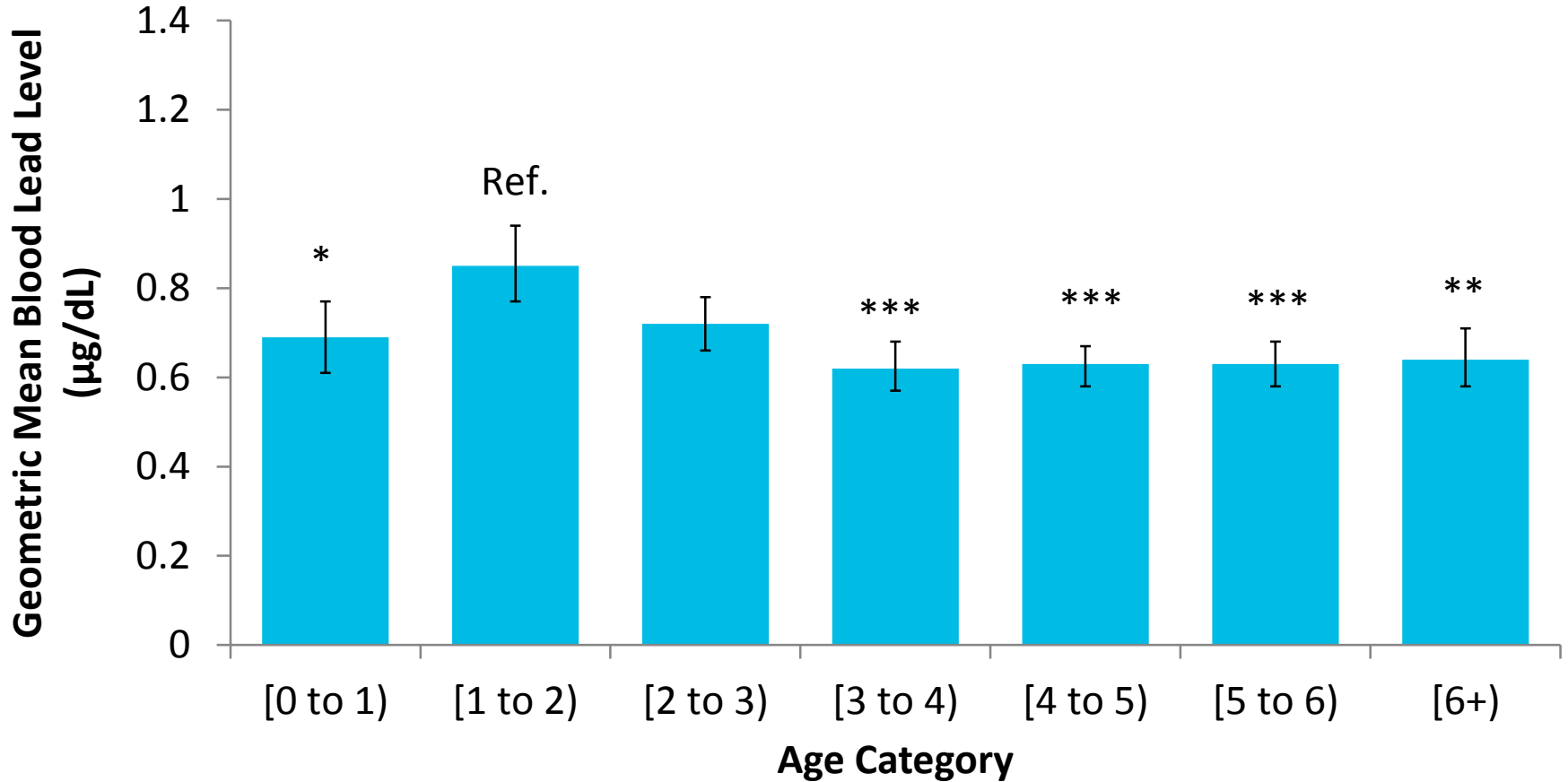
*Significant difference from reference at the p=0.05 level

Blood lead levels by age

AGE	N (%)	Min-Max	Geometric Mean (95% CI)	p-value
0-1	101 (12.3)	0.15-3.80	0.69 (0.61-0.77)*	
1-2	131 (15.9)	0.21-3.92	0.85 (0.77-0.94) *(ref.)*	
2-3	116 (14.1)	0.23-1.95	0.72 (0.66-0.78)	
3-4	145 (17.6)	0.19-2.96	0.62 (0.57-0.68)***	1.34e-06
4-5	130 (15.8)	0.24-2.46	0.63 (0.58-0.67)***	
5-6	124 (15.0)	0.26-2.28	0.63 (0.58-0.68)***	
6+	77 (9.3)	0.23-2.37	0.64 (0.58-0.71)**	

Significant difference from reference at the *p=0.05 level; **p=0.01 level; ***p=0.001 level

Blood lead levels by age

Figure: Bar chart of Geometric Mean Blood Lead Level (μg/dL) by Age Category.

- [0 to 1): ~0.69 *
- [1 to 2): ~0.85 Ref.
- [2 to 3): ~0.72
- [3 to 4): ~0.62 ***
- [4 to 5): ~0.63 ***
- [5 to 6): ~0.63 ***
- [6+): ~0.64 **

Significantly different from the [1-2) age category at the *p=0.05 level; **p=0.01 level; ***p=0.001 level

Examples of BLL <u>trends</u> from other studies

Age	Lanphear et al (c. 2002)	Benson et al (NHANES 1999-2006)
0 to <1	2.9 µg/dL (6 months)	
1 to <2	5.7 µg/dL (12 months) 6.1 µg/dL (18 months)	1.97 µg/dL
2 to <3	7.5 µg/dL (24 months)	1.90 µg/dL
3 to <4		1.69 µg/dL
4 to <5		1.62 µg/dL
5 to <6		1.53 µg/dL

Lanphear et al. J Pediatr. 2002. 140(1):40-7
Benson et al. Arch Environ Occup Health. 2017 ;72(2):70-78

Limitations

- Low variation in outcome

- Small number of foreign-born children

- Data on risk factors by self-report
  - Objective measures of lead in environment would be ideal
  - E.g. Water, dust, items suspected to contain high lead levels

- Data are cross-sectional
  - Prospectively collected data on subjects for age-related trends

Ongoing and future work

- Further analysis of risk factors associated with blood lead levels in cohort, refine non-linear model of age and blood lead

- Support clinicians to identify elevated BLLs in children relative to what is expected

- Support and facilitate public health interventions in addressing cases of high blood lead levels

Thank you!

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Questions?

- JinHee Kim
  - Jinhee.Kim@oahpp.ca

- Katherina Chojnacki
  - Katherina.Chojnacki@oahpp.ca