SEASONAL CHANGES OF CHILDHOOD BLOOD LEAD LEVEL: A STRUCTURED LITERATURE REVIEW

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BACKGROUND

Lead can cause significant neurologic damage and behavioural impairment in children. According to *U.S. Environmental Protection Agency (EPA)*, a difference in blood lead levels (BLLs) can be at least partly due to both lead bioavailability and lead biokinetic Although these parameters could change over season of year, the magnitude of seasonal BLL change and related factors are still not clearly studied.

OBJECTIVES

1) To assess the extent of seasonal changes in blood lead levels in children from 1 to 5 years in age and **2)** to identify factors that may explain those changes.

METHODOLOGY

1. Four large databases used for search relevant articles

PubMed, CINAHL, embase, ISI Web of Knowledge

2. Selection of studies

➔ Inclusion criteria

(1) Studies including 1-to-5 year-old children
(2) Studies published in peer reviewed journals,
(3) Studies published in English or French,
(4) Studies with BLL as a response variable, and
(5) Studies reporting individual BLLs.

➔ Exclusion criteria

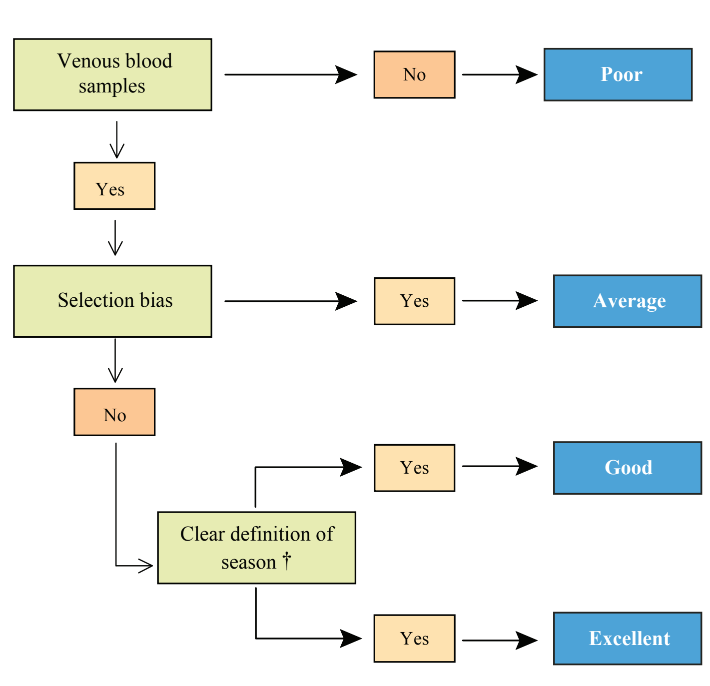
(1) not clearly report temporal comparisons of BLLs,
(2) including only children younger than 1 year of age or children more than 5 years old
(3) not report original research.

3. Data extraction into 7 categories by two independent reviewers (GN and CG): **1)** main purpose of the study, **2)** study design **3)** methods for blood collection or for assessing blood lead data, **4)** definitions of seasons, **5)** characteristics of the subjects (mainly age, race, and socioeconomic status, when available), **6)** characteristics of the study (place of study, date of study, sampling method, sample size), **7)** analytical framework: statistical methods used to estimate seasonality effects on BLLs, estimates used to report effects (regression coefficients, odds ratios, relative risk, etc.), adjustment variables.

4. Each study included in the review was assessed for quality using three target criteria: **1)** blood collection method, **2)** selection of subjects, and **3)** definition of seasons.

Figure 1

Main criteria for defining quality of studies



†Studies that either evaluated mean BLL monthly or clearly specified what months are related to a specific season.

5. Extent of seasonal changes was estimated by using maximum-to-minimum ratio (MMR):
MMR = highest mean blood lead values/ lowest mean blood lead values

6. Factors associated with seasonal change were assessed by reviewing multiple regression analysis from included studies.

RESULTS

➡ **A total of 34 articles met our inclusion criteria**

Table 1

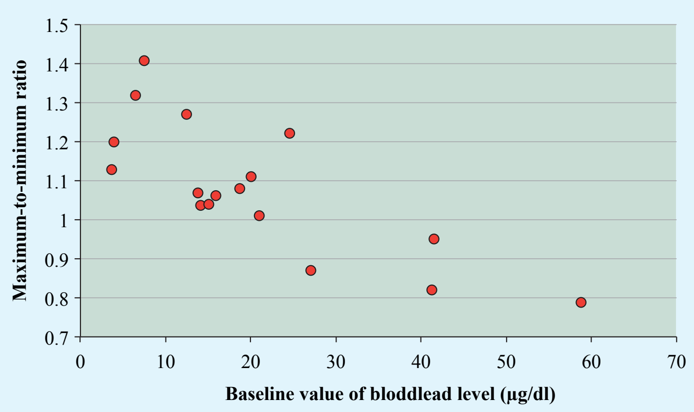
Description of included studies

	Cohort studies	Cross-sectional studies
Included studies	10	24
Children's age range	0-15 years	0-18 years
MMR range	0.79 – 3.57	1.08 – 1.48
Reported significant effect of seasonality on mean BLL	10/10	17/20†

†Four studies reported the monthly distribution of the proportion of children with BLLs greater than or equal to a specific blood lead action level rather than mean values of BLLs

➡ **The magnitude of seasonal changes in BLLs is inversely correlated with BLLs at baseline in cohort study, and this relationship is expressed by a linear pattern.**

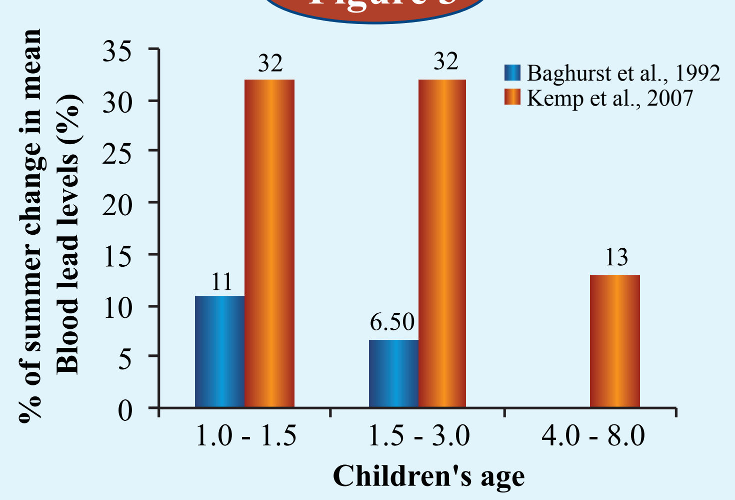
Figure 2



Maximum -to-minimum ratio for minimum blood lead values in the cohort studies [*The values of the coordinates from U.S. EPA, 1995 (2.13,3.57) were identified as outliers*]

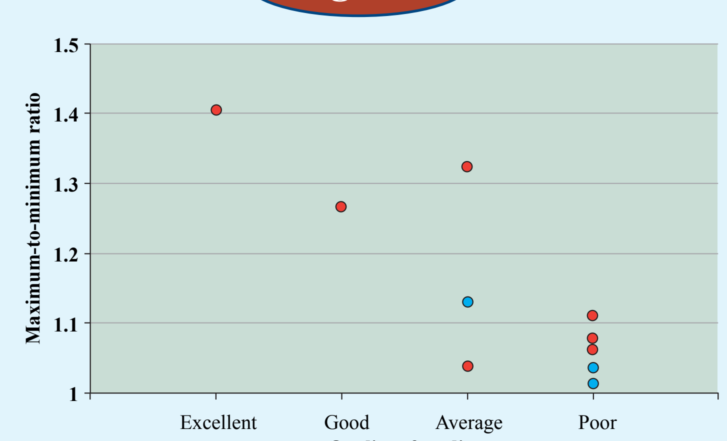
➡ **The magnitude of the summer effect tends to decrease as children's age increases.**

Figure 3



➡ **The magnitude of seasonal change appears to be less pronounced in studies with "poor" quality ratings in cohort studies that reported results in very young children (≤ 3 years-old) and/or in those who were more than 3 years old.**

Figure 4



Distribution of reported maximum-to-minimum ratio by quality of cohort studies (Red dot represent children ≤ 3 years-old and blue dot represent those > 3 years old). *U.S.EPA value (3.571) was considered as outlier*

➡ **In the main cohort studies, the seasonal effect was not significant in the multivariate model adjusted for environmental variables: Floor-dust, child's age, lead loadings on floors and windowsills as well as carpet lead concentrations were more relevant variables for determining BLLs.**

DISCUSSION

The magnitude of seasonal changes in BLLs is inversely correlated with BLLs in the months preceding the summer months, this could perhaps be explained by the very high BLLs at baseline (≥55 µg/dL) observed in the children who were part of their previous study; It is very likely that children with high BLLs are either receiving treatment or undergoing a lead-hazard reduction program and so are less exposed outdoors.

The magnitude of the summer effect tends to decrease as children's age increases: the higher magnitude of the summer increases in BLLs may be due to hand-to-mouth behaviours which are more prevalent in younger children[50].

Multivariate analysis indicates that dust lead-related factors were more relevant variables for determining BLLs. None of the included studies controlled for water lead levels or vitamine D status.

CONCLUSIONS

- Blood lead levels in young children can increase from 10% to 40% during warm months.
- The magnitude of the changes involved depends on a child's age and blood lead values in the months preceding the summer period.
- Multivariate regression results suggest that dust-related factors are those that most influence seasonal changes in BLLs.
- Contribution of water-related variables, children's nutritional status and serum vitamin-D levels still need further careful study.

AKNOWLEDGEMENTS

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