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Blood Lead Concentrations in 1–3 Year Old Lebanese Children: A Cross-sectional study

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Abstract

Background: Childhood lead poisoning has not made the list of national public health priorities in Lebanon. This study aims at identifying the prevalence and risk factors for elevated blood lead concentrations (B-Pb ≥ 100 μg/L) among 1–3 year old children. It also examines the need for universal blood lead screening.

Methods: This is a cross-sectional study of 281 well children, presenting to the pediatric ambulatory services at the American University of Beirut Medical Center in 1997–98. Blood was drawn on participating children for lead analysis and a structured questionnaire was introduced to mothers asking about social, demographic, and residence characteristics, as well as potential risk factors for lead exposure. Children with B-Pb ≥ 100 μg/L were compared to those with B-Pb < 100 μg/L.

Results: Mean B-Pb was 66.0 μg/L (median 60.0; range 10–160; standard deviation 26.3) with 39 (14%) children with B-Pb ≥ 100 μg/L. Logistic regression analysis showed that elevated B-Pb was associated with paternal manual jobs (odds ratio [OR]: 4.74), residence being located in high traffic areas (OR: 4.59), summer season (OR: 4.39), using hot tap water for cooking (OR: 3.96), exposure to kohl (OR: 2.40), and living in older buildings (OR: 2.01).

Conclusion: Lead screening should be offered to high-risk children. With the recent ban of leaded gasoline in Lebanon, emphasis should shift to other sources of exposure in children.

Background

Lead toxicity remains to be a shared concern for many countries, both developed and developing. Despite differences in the sources of exposure, children continue to present a uniquely vulnerable group, especially during the first three years of life [1,2]. In addition to the inhalation route, children may ingest lead through contaminated dust, soil, and drinking water [3]. Moreover, they absorb lead at a higher rate than adults and their nervous system is more susceptible to its detrimental toxic effects [2,3], thus resulting in neurocognitive delay at blood lead concentrations (B-Pb) as low as 100 μg/L [0.48 μmole/L] [4,5].

An earlier study on working men at low occupational hazard for lead toxicity in Beirut revealed that B-Pb was strongly associated with smoking and commuting [6]. Commuting came at no surprise in a country where close to 90% of the fleet of one million vehicles was operating on leaded gasoline [7], until early 2002 when leaded gasoline was banned.

In addition to ambient air lead and passive smoking, children in Lebanon may be exposed to lead through other sources, such as tap water delivered by lead-soldered pipes, paint, and kohl (traditional eyeliner rich in lead). Despite these red flags, childhood lead poisoning has not made the list of national public health priorities. Pediatricians have rarely reported cases of lead poisoning in Lebanese children. This may be attributed to failure to suspect the toxicity, probably reflecting B-Pb in the sub-clinical range (< 200 μg/L).

The blood lead concentration above which public health action should be taken has been reduced by the US Centers for Disease Control and Prevention (CDC) to 100 μg/L, based on the accumulating evidence of lead toxicity at low concentrations [3]. This warrants an active approach to understand the magnitude and determinants of lead poisoning among children in Lebanon. The proposed study aims at measuring the prevalence of lead poisoning, defined as B-Pb ≥ 100 μg/L, among children 1–3 years of age, and at identifying the risk factors for elevated blood lead concentrations in this population. It also examines the need for universal blood lead screening.

Methods

This is a cross-sectional study on 1–3 year old children presenting for routine check-up at the private, and outpatient pediatric ambulatory services of the American University of Beirut Medical Center (AUBMC), in Beirut-Lebanon. Children this age were targeted because it is the age of greatest hand-to-mouth and crawling exploratory activity, and a period of fast brain growth where exposure to lead is documented to cause irreversible damage [4]. AUBMC pediatric private clinics charge regular visit fees, while the outpatient department charges nominal fees. Although AUBMC is a tertiary medical center, patients from all over Lebanon use its ambulatory services as well for primary health care. The majority of patients though come from the city of Beirut and its suburbs, which host more than 30% of the Lebanese population.

In the outpatient department, children were identified from the roster of next day appointments. Those presenting for regular checkup or vaccination were potential candidates for the study. As for the private clinics, three busy pediatricians provided the names of children eligible for the study.

Subjects

Between August 1997 and July 1998, a total of 500 children were identified. Mothers were approached in the waiting area and informed about the study. Of these, 291 accepted to be interviewed, and signed an informed consent. Only 289 mothers allowed blood withdrawal on their children. Non-participants included refusals, no-shows, and non-eligible children. Excluded were sick or febrile children and those with a diagnosis of a chronic disease or hematological disorder. The final sample thus included 281 children. No information was collected about the 219 non-participating mothers or their children.

Data collection

A trained interviewer, using a standardized questionnaire with mostly closed-ended questions, interviewed all mothers. The interviewer inquired about the socio-demographic characteristics of the family; the medical and nutritional history, and health status of the child; and potential environmental and household sources of exposure to lead (e.g., closeness of residence to industry and construction sites; traffic; parent's occupations; use of kohl, hot tap water, or glazed pottery).

A trained phlebotomist in the hospital drew 2–3 milliliters of venous blood from each child, into metal-free heparin tubes, which were stored at 4°C for later analysis. Batches of 50–100 tubes were express-mailed, in a box of ice, to New York for analysis at an accredited clinical laboratory at the Columbia University College of Physicians and Surgeons. Blood lead concentration was measured using Atomic Absorption Spectrophotometry-Graphite Furnace (AAS-GF), following a standardized analytical method [8] with an accuracy of ± 5 μg/L. Blood was also collected in another tube for the analysis of hematocrit, iron, and iron binding capacity.

The Research Committee and the Institutional Review Board, at the American University of Beirut, approved the study protocol. A pamphlet on potential sources of lead and advisable activities that may reduce children's exposure was specifically prepared for this study, and was distributed at the end of the interview to all contacted mothers regardless of participation.

Data analysis

The CDC permissible childhood B-Pb of 100 μg/L was used as a cutoff point. The socio-demographic characteristics, residence characteristics, and potential risk factors for exposure to lead among children with a B-Pb ≥ 100 μg/L were compared to those of children with a B-Pb <100 μg/L. Due to the small number of children with B-Pb ≥ 100 μg/L and whenever possible, categorical variables were collapsed into a smaller number of categories to avoid

Table 1: Socio-demographic characteristics of children by blood lead concentration

	Blood lead concentration (μg/L)			
	<100 (N = 242) n(%)	> = 100 (N = 39) n(%)	Total (N = 281) n(%)	P-value
Blood lead concentration (μg/L)				
< 50	59 (24.4)	–	59 (21.0)	
50 – 99	183 (75.6)	–	183 (65.1)	
100 – 149	–	36 (92.3)	36 (12.8)	
159 – 199	–	3 (7.7)	3 (1.1)	
Mean B-Pb (Range)	58.3 (10 – 90)	113.8 (100 – 160)	66.0 (10 – 160)	
Age (months)				
11 – 23	125 (51.7)	17 (43.6)	142 (50.5)	0.35
24 – 44	117 (48.3)	22 (56.4)	139 (49.5)	
Mean age (SD)	22.9 (8.6)	24.8 (8.7)	23.1 (8.6)	0.19
Gender				
Males	127(52.5)	21(53.8)	148 (52.7)	0.87
Type of clinic				
Outpatient	170 (70.8)	33 (84.6)	203 (72.8)	0.07
Private	70 (29.2)	6 (15.4)	76 (27.2)	
Mother's Education				
Up to middle school	107 (44.4)	27(69.2)	134(47.9)	0.004
Secondary and above	134 (55.6)	12(30.8)	146(52.1)	
Father's Education				
Up to middle school	109(45.6)	29(74.4)	138(49.6)	0.001
Secondary and above	130(54.4)	10(25.6)	140 (50.4)	
Mother's work				
Housewife	200 (82.6)	34 (87.2)	234 (83.3)	0.009
Non-manual	39 (16.1)	2 (5.1)	41 (14.6)	
Manual	3 (1.2)	3 (7.7)	6 (2.1)	
Father's work				
Non-manual*	137(56.8)	9 (23.1)	146(52.1)	0.001
Manual	104(43.2)	30(76.9)	134(47.9)	
Number of siblings				
0	81(33.5)	12(30.8)	93(33.1)	0.84
1–2	118(48.8)	21(53.8)	139(49.5)	
>= 3	43(17.8)	6(15.4)	49(17.4)	
Family monthly income (US $)				
< 200	11 (4.5)	5 (12.8)	16 (5.7)	0.004
200 – 499	99 (40.9)	17 (43.6)	116 (41.3)	
500 – 999	71 (29.3)	16(41.0)	87(31.0)	
>= 1000	61 (25.2)	1 (2.6)	62 (22.1)	

Note: Missing data in some variables. * Non-manual includes 4 who are not working.

cells with less than 5 individuals. The potential of exposure to lead in the parent's occupation or hobbies was assigned with no knowledge of the child's B-Pb. Chi-square analysis and Student's t-test were used to test statistical significance for categorical and continuous variables, respectively. The non-parametric test of Mann-Whitney U was used for continuous variables, which lacked normal distribution. Statistical significance was set at a P value of 0.05. Backward logistic regression analysis was performed to identify the best model that explains a B-Pb of 100 μg/L or above. Age, gender, type of clinic and all variables with a $P < 0.20$ in the bivariate analysis (Tables 1 to 3) were tested in the model. Interaction terms were tested but none was found to be of statistical significance. SPSS for Windows, version 11, was used for statistical analysis.

Results

Of 281 children, 133 (47.3%) were girls. The mean age was 23.1 months (SD: 8.6), with a range of 11 to 44 months. The ratio of outpatient department to private clinics subjects was 2 to 1. Figure 1 shows the distribution of B-Pb. The mean B-Pb was 66.0 μg/L (SD: 26.3), with a range of 10 to 160 μg/L and a median of 60.0 μg/L. There were 39 (14%) children with B-Pb ≥ 100 μg/L (Table 1). Children with B-Pb ≥ 100 μg/L came from less educated and lower income families, as compared to those with B-

Table 2: Residence characteristics of children by blood lead concentration

	Blood lead concentration (μg/L)			
	<100 (N = 242) n (%)	> = 100 (N = 39) n (%)	Total (N = 281) n (%)	P-value
Area of residence				
Beirut	114 (47.1)	24 (63.2)	138 (49.3)	0.13
Suburbs of Beirut	84 (34.7)	11 (28.9)	95 (33.9)	
Outside Beirut	44 (18.2)	3 (7.9)	47 (16.8)	
Season				
Winter (01–03)	59 (24.4)	6 (15.4)	65 (23.1)	0.02
Spring (04–06)	59 (24.4)	3 (7.7)	62 (22.1)	
Summer (07–09)	42 (17.4)	9 (23.1)	51 (18.1)	
Fall (10–12)	82 (33.9)	21 (53.8)	103 (36.7)	
Age of building (years)				
<= 20	137 (60.6)	16 (44.4)	153 (58.4)	0.07
> 20	89 (39.4)	20 (55.6)	109 (41.6)	
Home last painted (years)				
<= 3	160 (67.2)	21 (55.3)	181 (65.6)	0.15
> 3	78 (32.8)	17 (44.7)	95 (34.4)	
Dustiness of home				
Very dusty	85 (35.6)	15 (38.5)	100 (36.0)	0.63
Moderately dusty	53 (22.2)	6 (15.4)	59 (21.2)	
Not/ a little dusty	101 (42.3)	18 (46.2)	119 (42.8)	
Frequency of dusting				
Daily	173 (73.3)	24 (61.5)	197 (71.6)	0.13
Not daily	63 (26.7)	15 (38.5)	78 (28.4)	
Location of building				
Main road	92 (38.5)	17 (43.6)	109 (39.2)	0.55
Side road	147 (61.5)	22 (56.4)	169 (60.8)	
Industry in same building*				
Yes	30 (12.9)	9 (23.1)	39 (14.3)	0.09
No	203 (87.1)	30 (76.9)	233 (85.7)	
Traffic jam in area				
Always/often	134 (56.1)	29 (74.4)	163 (58.6)	0.03
Rarely	105 (43.9)	10 (25.6)	115 (41.4)	
Nearby construction works				
Yes	140 (58.6)	23 (59.0)	163 (58.6)	0.96
No	99 (41.4)	16 (41.0)	115 (41.4)	

Note: Missing data in some variables. * Small industries, such as mechanics, furniture, or paint shop.

Pb < 100 μg/L (P < 0.01), and a higher proportion of their fathers and mothers worked in manual jobs (P < 0.01) (Table 1). There was no statistically significant difference in B-Pb by sex, with a mean of 67.6 μg/L (SD 26.6) among males and 64.3 μg/L (SD 25.9) among females (P = 0.29).

Almost all the residents of Beirut and its suburbs live in apartment buildings. Table 2, which compares the overall indoor and outdoor environmental conditions of children's residences, revealed that a significantly higher proportion of children with B-Pb ≥ 100 μg/L lived in buildings that were located near traffic-jammed roads (P < 0.03), as compared to those with B-Pb < 100 μg/L. A seasonal effect was also observed with most of the children with B-Pb ≥ 100 μg/L identified in the summer and fall seasons (P < 0.02).

Table 3 compares the distribution of potential risk factors for lead exposure between the two groups of children: those with B-Pb ≥ 100 μg/L and those with B-Pb < 100 μg/L. A B-Pb ≥ 100 μg/L was significantly associated with the use of hot tap water for cooking or preparation of milk (P < 0.03). The application of Kohl to the eyes of children was significantly associated with elevated B-Pb (P < 0.001). Kohl was applied either to the eyes (92.7%), umbilical cord (2.4%), or both (4.9%), mostly in the first 3 months of age (92.5%). In addition, paternal occupations with a potential for moderate to high exposure to lead had

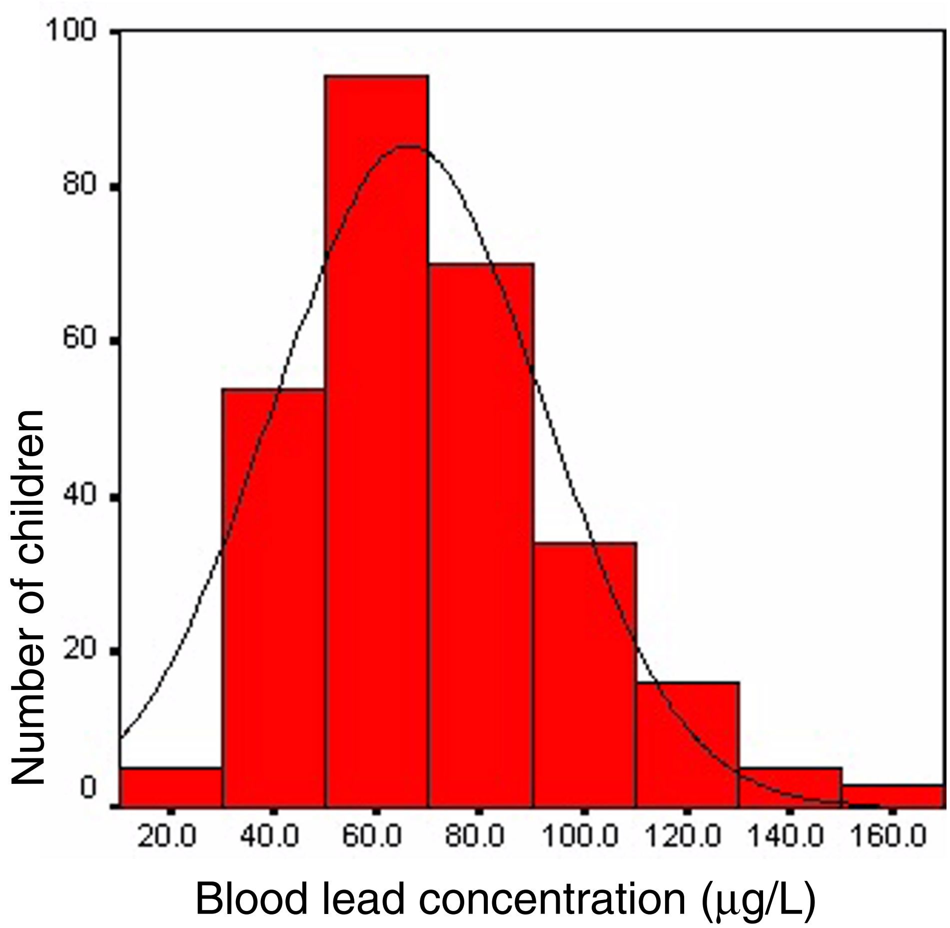

Figure 1
Distribution of blood lead concentration among 1–3 year old children

a statistically significant association with elevated B-Pb in children ($P < 0.01$).

A comparison of health status, nutrition, and the status of iron deficiency between the two groups of children revealed that a higher proportion of children with lower B-Pb were reported to have lack of appetite (40% v 21%; $P < 0.02$) and fatigue (9% v 0%; $P < 0.05$), as compared to children with high B-Pb (selected variables shown in table 3).

Table 4 presents the findings of the multivariate logistic regression analysis. Elevated B-Pb (≥ 100 μg/L) was associated with paternal manual jobs (odds ratio [OR]: 4.74), residence being located in high traffic areas (OR: 4.59), summer season (OR: 4.39), using hot tap water for cooking (OR: 3.96), exposure to kohl (OR: 2.40), and living in older buildings (OR: 2.01).

We reviewed the characteristics of the children with the highest B-Pb, two children with a B-Pb of 150 μg/L (a 15-month-old girl and a 37-month-old boy) and a 29-month-old boy with a B-Pb of 160 μg/L. The only risk factors consistently identified for the three children were living in older buildings (> 20 years of age), and having moderately to very dusty homes

Discussion

A prevalence of 14% of blood lead concentrations ≥ 100 μg/L, among 1–3 year old well children presenting for routine pediatric visits in Beirut, is much higher than the prevalence of B-Pb ≥ 100 μg/L reported among children in economically advantaged countries [9–11]. In these countries, decrease in blood lead concentrations was mainly attributed to the elimination of leaded petrol and lead-soldered food cans. In spite of this, the prevalence of lead poisoning is still high among urban low-income popula-

Table 3: Other potential risk factors for children's exposure to lead by blood lead concentrations

	Blood lead concentration (μg/L)			
	<100 (N = 242) n (%)	> = 100 (N = 39) n (%)	Total (N = 281) n (%)	P-value
Overall health status				
Good-Excellent	188 (77.7)	30 (76.9)	218 (77.6)	0.92
Poor-Satisfactory	54 (22.3)	9 (23.1)	63 (22.4)	
Iron deficiency				
No	163 (76.9)	26 (66.7)	189 (67.7)	0.94
Yes, without anemia	27 (11.3)	4 (10.3)	31 (11.1)	
Yes, with anemia	50 (20.8)	9 (23.1)	59 (21.1)	
Source of drinking water				
Municipality	88 (36.4)	20 (51.3)	108 (38.4)	0.08
Other†	154 (63.6)	19 (48.7)	173 (61.6)	
Source of water for cooking				
Municipality	144 (60.3)	25 (64.1)	169 (60.8)	0.65
Other†	95 (39.7)	14 (35.9)	109 (39.2)	
Use hot tap water for milk or cooking				
Yes	14 (5.9)	6 (15.8)	20 (7.2)	0.03
No	225 (94.1)	32 (84.2)	257 (92.8)	
Runs tap water before use				
Yes	121 (51.3)	23 (59.0)	144 (52.4)	0.37
No	115 (48.7)	16 (41.0)	131 (47.6)	
Child eats canned food				
Yes	73 (30.2)	12 (30.8)	85 (30.2)	0.94
No	169 (69.8)	27 (69.2)	196 (69.8)	
Use glazed pottery for food‡				
Yes	19 (8.2)	1 (2.6)	20 (7.4)	0.33
No	213 (91.8)	38 (97.4)	251 (92.6)	
Pica behavior§				
Yes	66 (27.7)	9 (23.1)	75 (27.1)	0.54
No	172 (72.3)	30 (76.9)	202 (72.9)	
Ever applied kohl on child				
Yes	30 (12.4)	13 (33.3)	43 (15.3)	0.001
No	212 (87.6)	26 (66.7)	238 (84.7)	
Child plays outside home||				
Yes	48 (20.5)	11 (28.2)	59 (21.6)	0.28
No	186 (79.5)	28 (71.8)	214 (78.4)	
Child goes to school				
Yes	31 (12.9)	6 (15.8)	37 (13.3)	0.63
No	209 (87.1)	32 (84.2)	241 (86.7)	
Mother smokes				
Yes	71 (29.3)	13 (33.3)	84 (29.9)	0.61
No	171 (70.7)	26 (66.7)	197 (70.1)	
Exposure to passive smoking¶				
Yes	161 (66.8)	29 (74.4)	190 (67.9)	0.59
No	80 (33.2)	10 (25.6)	90 (32.1)	
Potential for father's occupational exposure to lead††				
Low	164 (67.8)	18 (47.4)	182 (66.2)	0.008
Moderate-High	73 (30.8)	20 (52.6)	93 (33.8)	
Mother's hobbies with potential Pb exposure‡‡				
Yes	10 (4.1)	2 (5.1)	12 (4.3)	0.78
No	232 (95.9)	37 (94.9)	269 (95.7)	
Father's hobbies with potential Pb exposure‡‡				
Yes	73 (30.2)	14 (35.9)	87 (31.0)	0.47
No	169 (69.8)	25 (64.1)	194 (69.0)	

Note: Missing data in some variables. † Bottled water, Springs. ‡ For cooking or serving food §Child seen eating clay, dirt, paint, plaster, or material from the floor. || Outside home, such as playground, street, parking lot, or garden. ¶Any smoker (father, mother, or other resident) at home. †† Based on job title. ‡‡ Hobbies such as painting, hunting, or fishing.

tions, due to other sources of exposure [9,10]. This is also true, although not consistent, in the less advantaged countries, where children are still exposed to lead from leaded gasoline, traditional cosmetics, lead water pipes, and lead-soldered food cans. The reported B-Pb in these countries ranged from a concentration as low as a mean of 19.6 μg/L in Jordan [12], to as high as 50–87% of children having

B-Pb ≥ 100 μg/L in Cape Peninsula, South Africa [13], and Dhaka, Bangladesh [14].

Risk factors

In this study, living in a traffic-jammed area more than quadrupled the children's risk for an elevated B-Pb. This finding is consistent with previous reports [14–16], and is attributed to the fact that, at the time of the study, 85–90% of a relatively old fleet of vehicles in Lebanon was operating on leaded gasoline, in the absence of any emission control program [7]. Young children, who spent most of their time at home, may have been exposed to lead through direct inhalation, or by ingesting deposited lead dust. However, perceived dustiness of the home and low frequency of dusting were not found to be associated with elevated B-Pb. This is consistent with the findings of Haynes et al. [17] who reported no significant effect of dust control on the proportion of children with B-Pb ≥ 100 μg/L. Dust control was only effective in reducing the proportion of children with B-Pb ≥ 150 μg/L or B-Pb ≥ 200 μg/L.

Another risk factor found to be strongly associated with elevated B-Pb is the manual job of the father, which presents an important health warning in a country with a low priority for work-related health and safety issues [18]. This association has been previously reported and linked to the exposure of children to the contaminated clothes at home [19,20]. Our study questionnaire, however, did not probe into how work clothes were handled or washed at home.

There was a clear seasonal effect on B-Pb, with the highest proportion of children with elevated B-Pb detected in summer and fall. This association could be explained by the relatively warmer periods and higher outdoor activities in these seasons, as suggested by Yiin et al. [21] although their study was substantiated by indoor and outdoor environmental samples.

The association between use of hot tap water for cooking or milk preparation and elevated B-Pb strongly suggests possible exposure to lead from lead pipes or lead-soldered pipes. A national study on all groundwater sources used in Lebanon reported non-detectable lead content, or lead concentrations that were within international standards [22]. Lead content, however, has not been assessed in the household, or within the old distribution network, which has been maintained or replaced only recently.

Other risk factors associated with higher B-Pb, but with less strength, were identified. These could have been overshadowed by the effect of lead in gasoline, or by the exposure to contaminated clothes. The use of kohl on the eyes or umbilical cords of children is one such factor. In Lebanon, this practice is much lower than what is reported from other countries, such as the Gulf Arab countries or India [23,24]. However, the 15% prevalence in our study is high and is another health flag that needs to be addressed. As for living in older buildings, also found to be associated with an increased risk for elevated B-Pb after adjusting for other risk factors, this finding may be due to the leaded paint used in these buildings, or due to chance.

A few risk factors for elevated B-Pb deserve mentioning although they did not make it into the regression model. These include the presence of small industries in residential buildings, which is very common in Beirut and its suburbs. Proximity to industrial activity is a known risk factor [19], mostly explained by exposure to lead particles in the air or dust. They also include father's and mother's low education, low income (< $ 500 a month), and being an outpatient department client. These are socioeconomic indicators whose effects might have been mediated through other variables, such as father's occupation.

Other potential risk factors for elevated B-Pb among children, such as male gender, the use of glazed pottery, passive smoking, or eating canned food [2,3], were not found to be significant in this study. No differences were noted in the mean B-Pb or proportion of elevated B-Pb between boys and girls. An elevated B-Pb among boys is usually attributed to more exploratory activities, which was not assessed in this study. Only 7% of the mothers reported using glazed pottery to cook or serve food, and it was more common among the families of children with B-Pb within the permissible limits. This suggests that better-quality glazed pottery were being used [25], or that children were not eating from food served in pottery. As for passive smoking, the fact that 68% of the children were exposed may have reduced the power of detecting a significant difference. The lack of association between serving canned food and elevated B-Pb may reflect the success of an ongoing policy to ban lead-soldered food cans in Lebanon.

Methodological issues

There are certain limitations to this study that merit discussion. This study is cross-sectional in design. Habits and exposures may differ by season and age, especially among young children, thus affecting the blood lead concentration. The study sample, which is based in a medical center that also serves as a primary care provider, may not be representative of the population as a whole. Accounting for failure to show for the appointment and ineligibility, we estimated the participation rate to be approximately 70%, however no information was collected on the children whose mothers refused to participate. The study sample size did not provide enough statistical power to compare the distribution of different variables between the two

Table 4: Logistic regression analysis: Adjusted odds ratio (OR) and 95 % confidence intervals (CI) for potential risk factors for lead poisoning (Blood lead concentration >= 100 μg/L) among children 1–3 year old

Risk factors	OR (95% CI)
Father's occupation (ref. Non-manual)	
Manual	4.74 (1.82 – 12.31)
Season (ref. Winter)	
Spring	1.07 (0.22 – 5.22)
Summer	4.39 (1.15 – 16.81)
Fall	2.88 (0.94 – 8.84)
Age of building (ref. <= 20 years)	
> 20 years	2.01 (0.88 – 4.60)
Traffic jam in area (ref. Rarely)	
Often/Always	4.59 (1.61 – 13.06)
Use hot tap water for cooking (ref. No)	
Yes	3.96 (1.17 – 13.44)
Ever applied kohl on child (ref. No)	
Yes	2.40 (0.92 – 6.28)

(n = 244; χ^2 (8 degrees of freedom)= 45.76; P < 0.001)

groups of children. In addition, exposures and health outcomes were self-reported. The standardized questionnaire, which was introduced by a well-trained interviewer, might have reduced the bias but did not resolve the innate limitations of recall information. This was most striking with the questions about health outcomes, where contrary to our expectations, children with higher B-Pb were reported to have less health complaints (fatigue, lack of appetite). Such a finding could be attributed to a perception issue, as mothers of children with lower B-Pb were more educated, and perhaps, had higher expectations or stricter standards regarding the health and nutrition of their children.

Conclusions

The main question to be addressed here is whether there is a need for universal lead screening of children in Lebanon. The cost of universal screening, and of children's anxiety, which are cited by opponents [26], is overweighed by the short and long-term savings of medical care, special education, and losses in productivity reported by proponents [27–29]. Caution should be exerted in using a cross-sectional clinic-based study to make a recommendation. However, the detection of no children in this study with a B-Pb above 160 μg/L and only 1% with a B-Pb of 150–160 μg/L, and the lack of reported cases of severe childhood poisoning favor targeted screening, addressed at high risk children. The limited resources within the country and the recent decision to ban leaded gasoline further support this recommendation. Pediatricians could provide general hygienic recommendations and screen high-risk children for lead. Children, whose fathers work in occupations with potential exposure to lead, and whose families use kohl, glazed pottery for food preparation, or hot tap water for milk preparation, may be at a higher risk for lead exposure. The use of low cost kits to test for lead in the home environment could supplement the pediatrician's effort to manage elevated B-Pb, especially in the absence of a national lead prevention program. Future research should document the expected drop in B-Pb among children at a national level and examine the contribution of sources, such as tap water, paint and kohl, to elevated B-Pb.

Competing interests

None.

Authors' contributions

IN designed the study, supervised data collection, performed the statistical analysis, and drafted the manuscript. MN participated in data collection, statistical analysis, and drafting of manuscript. SM participated in study design, data collection and analysis. SK participated in design of questionnaire, data collection and analysis. GS participated in the conception of the study and study design. MM participated in the study conception and design. MA participated in study design, data analysis, and drafting of manuscript. All authors read and approved the final manuscript.

List of abbreviations

B-Pb, blood lead concentration; AUBMC, American University of Beirut Medical Center; OR, odds ratio; CI, confidence interval.

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