REPORT

ON EVALUATION OF BLOOD LEAD LEVELS AND IDENTIFICATION OF SOME RISK FACTORS FOR LEAD EXPOSURE OF CHILDREN IN TAN HIEP COMMUNE, LONG THANH DISTRICT, DONG NAI PROVINCE

October 2022

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PREFACE

In 2021, the Research Centre for Gender, Family and Environment in Development (CGFED), in collaboration with the Faculty of Environmental and Community Health, the Institute of Occupational and Environmental Health (NIOEH), carried out a study titled, "Survey on lead content in paint and lead exposure status in painters and preschool children". In the survey, the research team conducted blood samples to determine blood lead levels (BLLs) in 48 preschool children at Tan Hiep commune's kindergarten in Long Thanh district, Dong Nai province. Evaluation results showed that 23 children had BLLs in the range of 5.26 – 20.72 µg/dL, 1.5 to 6.5 times higher than the US CDC's preference limit (3.5 µg/dL).

In 2022, CGFED and NIOEH conducted a follow-up study to survey lead concentrations in the living environment (wall paint and toys) of the 23 children mentioned above and re-evaluate their BLLs with the following goals:

General objective: To determine the correlation between the child's blood lead content and the lead content in the surrounding environment and plastic toys from which the child is exposed.

Specific objectives:

- Re-evaluate the blood lead levels of 23 children in the 2021 study whose blood lead levels ranged from 5.26 – 20.72 µg/dL;
- Identify risk factors for lead exposure related to the surrounding environment and living habits of the family and children.

1. RESEARCH SUBJECTS AND METHOD

1.1. Research subjects and locations

Research subjects

- Blood lead levels of preschool children;
- Lead concentration in the surrounding environment, children’s toys/equipment at home and in preschool.

Research locations

- Tan Hiep commune, Long Thanh district, Dong Nai province;
- Private homes of 20 children who participated in the research study (More details are found in Appendix 1);
- Tan Hiep Commune’s Kindergarten (The list of surveyed classrooms is found in Appendix 2).

Research period: 2 months, from August to September 2022.

1.2. Research content

Determination of blood lead levels in children in Tan Hiep commune, Long Thanh district, Dong Nai province

- Take blood samples from children in Tan Hiep commune, Long Thanh district, Dong Nai province and analyze the lead content at the Institute of Occupational and Environmental Health (NIOEH);

- Directly interview the father/mother or relatives living with the child about the risk factors for lead exposure and the child's living habits at home to determine the child's risk of lead exposure.

Determination of lead content in children's living environment and toys

- Conduct a rapid measurement of lead content in plastic toys and some plastic items in children's homes and classrooms at Tan Hiep Commune Kindergarten that children attended since 2021.
- Conduct a rapid measurement of lead content in wall paint in children's homes and classrooms at Tan Hiep Commune Kindergarten that children attended since 2021.

Evaluation of the correlation between blood lead levels in children with the lead content in children's environment and toys

- Based on the results of blood lead levels combined with the qualitative results of assessment on children's risks of lead exposure, refer to the result of rapid measurement of lead content in the environment and plastic toys of children to evaluate the correlation between children's blood lead levels and lead content in environment and plastic toys.

1.3. Research methods

Research design: A cross-sectional descriptive study

Research sample size:

Total blood samples: 20 blood samples from 20 children whose blood lead concentrations in the 2021 study were > 5 µg/dL; the children were selected among 48 children who were part of the initial study in 2021;

Total number of interviewees: 20 people—mothers, fathers, or relatives of the 20 children whose blood samples were taken;

Total number of rapid measurement samples:

- Inside homes of 20 children who participated in this study: the minimum number of rapid measurement samples are 3 x 20 children = 60 samples. In addition, based on the practical situation and risk factors of lead exposure when directly interviewing the children's parents or relatives, the research team can quickly assess the lead content on some other plastic items at home such as plastic doors, plastic wardrobe, plastic tables/chairs, etc.
- At Tan Hiep Commune Kindergarten: the minimum number of rapid measurement samples are 5 samples x 8 classrooms = 40 samples (The list of surveyed classrooms is found in Appendix 2).

1.4. Techniques applied in the research

Children's blood sampling technique: Collecting blood samples using the correct technique will ensure the safety of the child and yield results with the highest accuracy. The procedure for extracting blood samples from a child is applied as follows:

- Ask the respondent's name who participated in the blood sample collection and compare with the provided list, and then write the name and age of the respondent on the sample tube;
- Research respondent must sit upright and straighten their arms on the table;
- Guide the research respondent to make a fist. Tie the tourniquet on the inner arm, about 5-8 cm above the elbow;

- Disinfect many times and in one way from top to bottom or from bottom to top along the selected area for blood extraction. Each cotton pad is only used to disinfect once;
- Wait for the alcohol to dry, check the needle by pulling and pushing the plunger to ensure that the plunger moves smoothly in the inside of the syringe;
- Stretch the skin as the vein needs to be drawn for blood, hold the syringe at an angle of 60 degrees from the skin surface, beveling the needle up;
- Press the tip of the needle into the vein, pull the plunger gently and withdraw 2 mL of blood;
- The blood drawn into the syringe is stored and preserved with an EDTA (ethylenediaminetetraacetic acid, a chemical that binds lead) anticoagulant tube.

Methods for analyzing blood lead levels in the laboratory: the lead content in blood was determined via inductively coupled plasma mass spectrometry (ICP-MS).

Methods of determining the risk of lead exposure of children: questionnaires were used to directly interview the child's parents/guardians about the risk factors for lead exposure and the children's living habits at school.

Rapid measurement of lead content in the environment and plastic toys

- Use portable metal analyzer (also known as PMI device, X-ray fluorescence device, fluorescence spectrophotometer, or portable PMI device) to conduct a quick check of the chemical composition of the metal elements, quick classification of alloys, and RoHS safety test.
- X-MET8000 Expert is a handheld X-ray fluorescence (XRF) metal analyzer that provides fast, non-destructive analysis and accurate results for production quality control and assurance. The combination of a high-performance X-ray tube and transducer provides the efficiency required for OA/OQ applications. X-MET8000 gives accurate results within seconds.
- A CMR test sample is included to confirm the device's stable and correct operation at all times.

1.5. Standards for comparison and reference

The diagnostic criteria for lead poisoning are based on Decision No.1548/QĐ- BYT dated May 10, 2012, of the Minister of Health on promulgating guidelines for diagnosis and treatment of lead poisoning (children with lead poisoning once having blood lead level >10 µg/dL). The details are as follows:

- Mild poisoning level: Blood lead level from 10-45 µg/dL
- Moderate poisoning level: Blood lead level between 45-70 µg/dL
- Severe poisoning level: Blood lead level > 70 µg/dL[1]

The United States Centers for Disease Control and Prevention (US CDC) reference values for blood lead levels in children and guidelines for different children blood lead levels were also used for comparison. Guidelines for when to re-test blood lead levels are as follows:

Table 1: Guidelines for when to re-test blood lead levels[2]

No.	Blood lead levels (µg/dL)	Time to re-test within
1	from ≥ 3.5 -9	3 months
2	from 10-19	1 month
3	from 20-44	2 weeks
4	≥ 45	48 hours

[1] Decision No.1548/QĐ- BYT dated May 10, 2012, of the Minister of Health on promulgating guidelines for diagnosis and treatment of lead poisoning

[2] https://www.cdc.gov/nceh/lead/prevention/testing-children-for-lead-poisoning.htm

1.6. Methods of data analysis

After being collected, data are entered and processed using Excel 2016 software. Statistical indicators are mean, median, standard deviation, maximum, and minimum. Statistical tests.

1.7. Research ethics

The school and children's parents were clearly informed about the purpose, content, benefits, and possible disadvantages in the research process by the research team.

Absolute safety, especially biological safety for all subjects in the process of participating in the research, was ensured.

Test results were sent to each study participant. When there are abnormal signs of lead levels in the blood, the family will be informed and advised on preventive and treatment measures.

The results of wall painting and toys samples in the classrooms in the Tan Hiep Commune Kindergarten were sent directly to the kindergarten's management board and the kindergarten will notify the parents of the children attending the kindergarten.

2. RESULTS AND DISCUSSIONS

2.1. Evaluation of children's blood lead levels in Tan Hiep commune, Long Thanh district, Dong Nai province

2.1.1. General information about research respondents

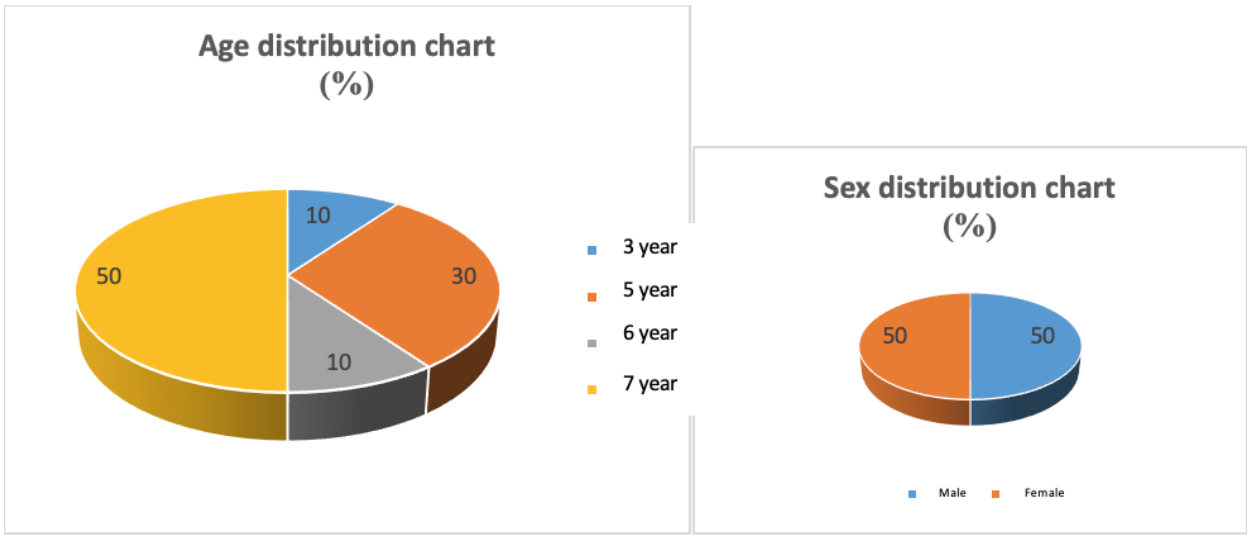

Figure 1: Age and sex distribution chart

Based on actual surveys and previous study results published in 2021 by CGFED and NIOEH conducted among 48 preschool children in Tan Hiep commune, Long Thanh district, Dong Nai province, the research team has identified 20 children with blood lead levels (BLLs) > 5 µg/dL to participate in this study with their parental consent. The number of children with BLLs > 5 µg/dL in the 2021 study was 23 in total, but three children could not be reached as their families moved back to their hometowns. (See list of children in Annex 1).

The children participating in this study ranged in age from 3 to 7 years old (50% boys and 50% girls). Compared to 2021, 60% of children participating in this study moved to primary school and transferred schools.

2.1.2. Blood lead level of children in Tan Hiep commune, Long Thanh district, Dong Nai province in 2022

Table 2: Blood lead levels of children participating in the 2022 study

Research respondents	Blood lead levels of children participating in the research (µg/dL)					
	N	Median	IQR[3]	Min	Max	P
Total	20	4.75	1.055	3.59	9.77	
By gender						
Male	10	4.90	0.514	4.13	9.77	>0.05
Female	10	4.39	0.216	3.59	6.35	
By age						
Age 6-7	12	4.95	1.404	3.59	9.77	>0.05
Age 3-5	8	4.39	0.308	4.13	5.72	

The evaluation results showed that the blood lead levels (BLLs) of 20 children in the study ranged from 3.59 to 9.77 µg/dL, which is a normal threshold according to the guideline limit for diagnosis and treatment of lead poisoning (≥ 10 µg/dL) of the Ministry of Health as based on Decision No.1548/QĐ-BYT dated May 10, 2012. However, it was higher than the new reference limit for normal BLLs in children (< 3.5 µg/dL) of the United States Centers for Disease Control and Prevention (US CDC) which was adopted in 2021. This means that the 20 children in this study are all at risk of exposure to lead, and there is a need to investigate the risk factors in the children's living environment and repeat their blood lead analyses within 2 months. The above data warns about the level of lead poisoning of children in Tan Hiep commune, Long Thanh district, Dong Nai province.

According to Table 2, out of 20 children participating in the study, 10 are boys and 10 are girls. The median BLL among boys was 4.90 µg/dL, higher than girls' median BLL at 4.39 µg/dL. The difference was not statistically significant with p> 0.05. Similarly, when comparing the BLLs of children by age, for the age group who attended primary schools (from 6 to 7 years old), the BLLs of children who have attended primary school has a median value of 4.95 µg/dL, higher than the 4.39 µg/dL median BLL of the preschool age group (from 3 to 5 years old). However, this difference was not statistically significant (p>0.05).

[3] IQR = Interquartile range

2.1.3. Blood lead levels of children in Tan Hiep commune, Long Thanh district, Dong Nai province by time

Table 3: Rate of comparison among children's blood lead levels in 2021 and 2022 by sex

Research respondents		BLL from 3.5-5 µg/dL		BLL > 5 µg/dL	
		2021	2022	2021	2022
Male	N	0	6	7	1
	%	0	30%	35%	5%
Female	N	0	7	13	6
	%	0	35%	65%	30%
Total	N	0	13	20	7
	%	0	65%	100%	35%

Table 3 shows that 100% of children who participated in the 2021 study have BLLs greater than 5 µg/dL, of which boys accounted for 35% and girls accounted for 65%. By 2022, the proportion of children with BLLs ranging from 3.5-5 µg/dL accounted for 65% and only 35% of the 20 children had BLLs > 5 µg/dL. The highest BLL was 9.77 µg/dL.

Table 4: Comparison of blood lead levels among children in Tan Hiep commune in 2021 and 2022

Research respondents	BLL of children participating in the research (µg/dL)					
	N	Median	IQR	Min	Max	P
2022	20	4.75	1.055	3.59	9.77	<0,05
2021	20	5.96	1.350	5.26	20.72	

When comparing the BLLs of 20 children in 2021 and 2022, it was found that the children's BLLs significantly decreased in 2022 compared to 2021, with a reduction rate of 7.4% to 56.6%, except for two children's BLLs slightly increasing from 1.2% to 4.5% in 2022.

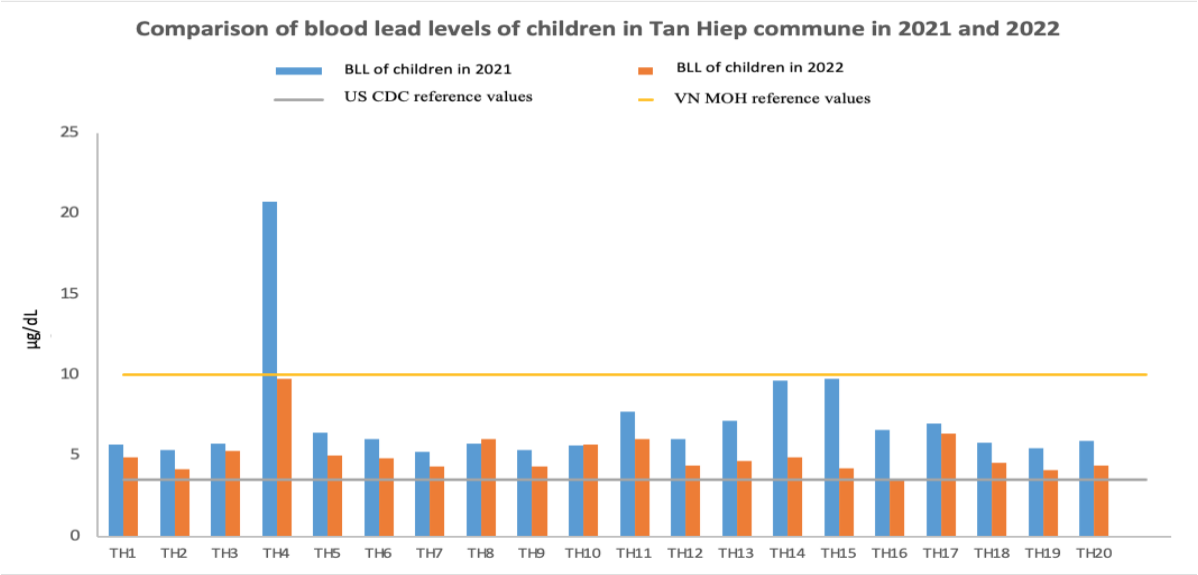

Figure 2: Blood lead levels among children in Tan Hiep commune kindergarten

Figure 2 shows a decreasing trend on the BLLs among majority of the 20 children in the 2022 study. This was the result after parents and relatives were informed about the risk factors for exposure to lead, and eating and living habits among children who participated in the 2021 study. This is especially true for the child with the highest blood lead concentration in 2021 whose 20.72 µg/dL BLL was due to the use of orange herbal supplement by the family—the main source of the child's exposure to lead. More than one year after discontinuing the administration of lead-containing orange herbal supplement to the child, the child's BLL decreased to 9.77 µg/dL.

When comparing BLLs among children in Tan Hiep commune by sex, it was found that BLLs in male children in 2022 decreased significantly ($p < 0.05$) compared to 2021, the reduction rate ranged from 7.4% to 49.0%. The results were statistically significant.

Table 5: Comparison of blood lead levels among boys and girls in 2021 and 2022

Research respondents	**BLL of children participating in the research (µg/dL)**					
	N	**Median**	**IQR**	**Min**	**Max**	P
Boy child						
2022	10	4.90	0.514	4.13	9.77	<0.05
2021	10	6.23	0.903	5.34	20.72	
Girl child						
2022	10	4.39	0.216	3,59	6.35	<0.05
2021	10	5.87	0.970	5,26	9.79	

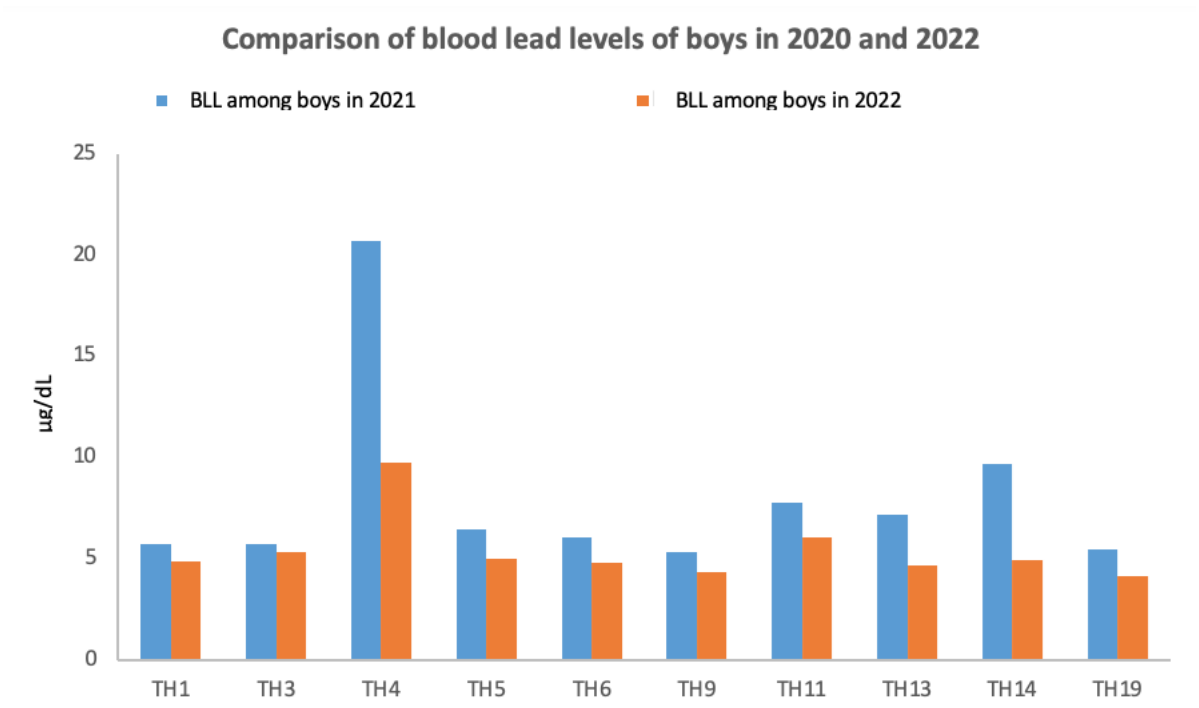

Figure 3: Comparison of blood lead levels among boys in 2021 and 2022

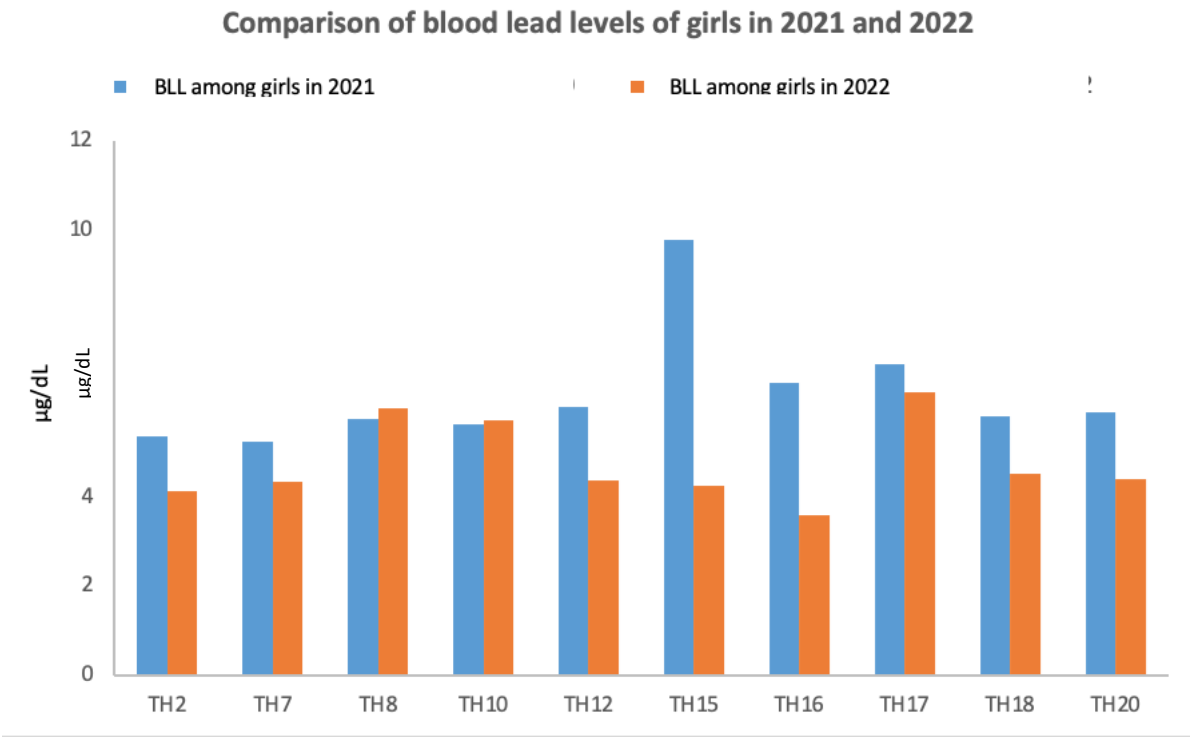

Figure 4: Comparison of blood lead levels among girls in 2021 and 2022

Similarly, BLLs among female children in 2022 also decreased significantly compared to 2021 with $p<0.05$ and the rate of decrease ranged from 9.2% to 56.6%. However, there were two cases of slight BLL increase compared to 2021. The cause of the increase and its corresponding effects on the risk of lead exposure in children is discussed on Section 2.2.

When comparing BLLs in children in Tan Hiep commune by age, the table and figure below showed that although there is a slight increase in BLLs in both age groups, in general, BLLs in children among kindergarten age (3-5 years old) and primary school age (6-7 years old) in 2022 were significantly reduced compared to 2021 ($p<0.05$). The reduction rate in the two age groups was 17.3% to 56.6% and 9.2% to 52.8% respectively.

Table 6: Comparison of blood lead levels among children in 2021 and 2022 by age

Research respondents	**BLL of children participating in the research (µg/dL)**					
	N	**Median**	**IQR**	**Min**	**Max**	**P**
Children aged from 3-5						
2022	8	4,39	0,308	4,13	5,72	<0,05
2021	8	5,87	1,330	5,26	9,79	
Children aged from 6-7						
2022	12	4,95	1,404	3,59	9,77	<0,05
2021	12	6,23	1,310	5,34	20,72	

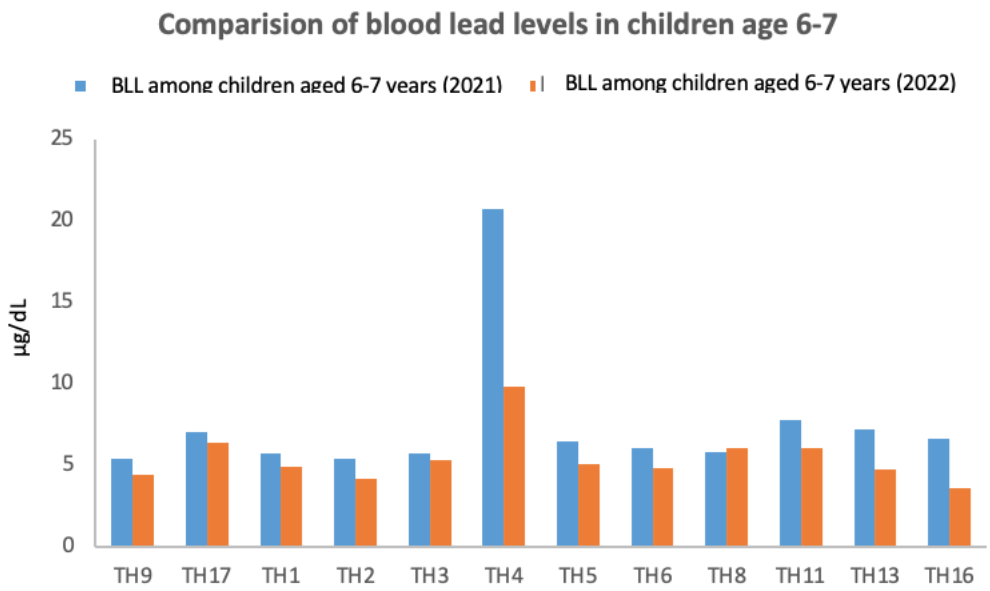

Figure 5: Comparison of blood lead levels among children aged 6-7 years in 2021 and 2022

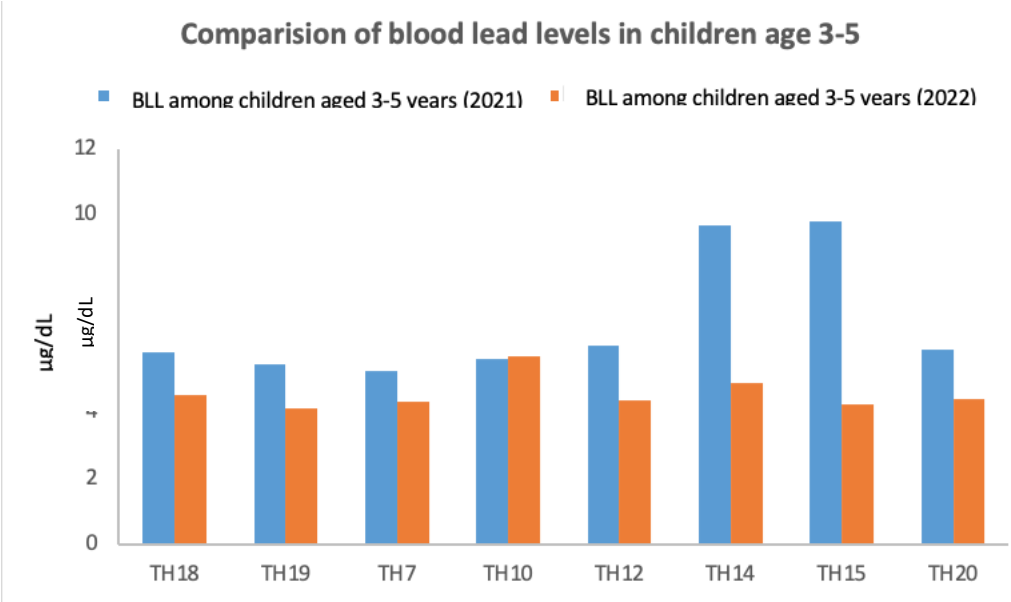

Figure 6: Comparison of blood lead levels among children aged 3-5 years in 2021 and 2022

2.2. Some risk factors for lead exposure in children

To assess the risk of children's lead exposure in the environment, the research team combined actual observations with the use of questionnaires to interview parents or guardians about some information related to their habits such as hand washing behaviour, playing style, water source, etc. In addition, the research team conducted a rapid measurement of lead content on items accessed by children at home and in the classroom such as plastic toys, plastic desks/chairs, school equipment, or plastic room doors, etc.

Assessment results of the risk factor of children's lead exposure are list out below.

2.2.1. Risk of lead exposure from objects around children

According to the results of rapid measurement of lead content in some plastic items (including plastic doors) within children's homes, plastic items at homes of eight children had an average lead content ranging from 10 mg/kg to 27, 4 mg/kg. According to TCVN 6238-3:2011 - Safety of

children's toys - Part 3: Limits of leaching level of some toxic elements, the level of lead leaching from toy materials is calculated as follows:

$$Level\ of\ lead\ leaching = \frac{C_{Pb}\ x\ k_{Pb}}{100}$$

In which:

- Level of lead leaching: the amount of lead that can be released from objects and can enter the human body through contact, etc. Unit: mg/kg
- C_{Pb} is the lead content in the object. Unit: mg/kg
- k_{Pb}: Analytical correction value (%). According to TCVN 6238-3:2011, k_{Pb} = 30%

Thus, the level of lead leaching from plastic items inside homes of eight children mentioned above ranges from 7 mg/kg to 19,2 mg/kg. In addition, plastic items in seven out of 8 children's homes had a level of lead leaching higher than the maximum acceptable level specified in the TCVN 6238-3:2011.

Note: lead content is a measurement of the amount of lead that may be present in an item (plastic or other materials) and the average lead content is the average value of lead values measured inside homes of eight children. Using the average of the measured lead content, it is possible to determine the amount of lead that can enter the human body through skin contact or through the mouth (i.e., ingestion), or also known as the Lead Leaching Level.

Table 7: Risk of lead exposure from objects around children[4]

Research respondents	**BLL of children participating in the research (µg/dL)**					
	N	**Median**	**IQR**	**Min**	**Max**	**P**
Surrounding objects contain lead	8	4.85	1.455	3.59	6.02	>0.05
Surrounding objects without lead	12	4.68	0.664	4.16	9.77	

However, the rapid assessment results of plastic doors (the old door type) in homes of two children were very high, ranging from 22,5 mg/kg to 27,4 mg/kg, equivalent to the lead contamination level of 15,4 mg/kg to 19,2 mg/kg, over 170 to 200 times higher than the maximum acceptable contamination level specified in TCVN 6238-3:2011. Results in Table 7 showed that children exposed to lead-containing objects had slightly higher BLL average than children exposed to non-lead-containing objects (4.85 µg/dL compared to 4.68 µg/dL). This difference is not statistically significant (p>0.05).

[4] Surrounding objects include toys, learning equipment, plastic chairs, plastic room doors

Table 8: Risks of lead exposure from contaminated sources

Risk factors	N	Median	IQR	Min	Max
1. Lead-related activities nearby the living area?					
Yes	3	-	-	4.16	5.31
No	17	-	-	3.59	9.77
2. Source of water used					
Bore-well water	20	4.75	1.055	3.59	9.77
3. Cohabitants exposed to lead?					
Yes	3	-	-	4.16	5.31
No	17	-	-	3.59	9.77

According to the results of the field survey and information provided by the parents or guardians, there were only three children living in potentially lead-related environments due to their families working as mechanics (metalworking at home) or in the wooden furniture (with wood polish) industry. Comparison of BLLs from the three children showed no significant difference from others. In fact, the BLLs of these three children were lower than the BLLs of other children. When compared with BLLs in 2021, the BLLs of children whose families work in the metalworking industry showed less decrease as compared to children whose families do not work in metalworking industry (the reduction rate was only 7.4%). Similarly, the average BLLs of children living with relatives/family members who once had exposure to lead (4.58 µg/dL) were lower than that of children living with relatives/family members who had no exposure to lead (5.18 µg/dL). The difference was not statistically significant ($p>0.05$).

In addition, according to the research team's survey, all 20 households participating in the study use bore-well water for domestic use and drinking.

Table 9: Risk of lead pollution from living habits

Risks of lead exposure from contaminated sources (µg/dL)						
Risk factors	**N**	**Median**	**IQR**	**Min**	**Max**	**Compare the difference (P-values)**
1. Do children often wash their hands before eating?						
Frequent	18	4.85	1.055	4.13	9.77	
No or sometimes	2	-	-	3.59	4.16	
2. Do the children put their hands or toys in mouth?						
No	15	4.82	1.646	4.16	9.77	p >0.05
Yes	5	4.54	1.244	3.59	5.72	
3. Do children have a habit of crawling on the yard?						
No	12	4.85	1.467	4.25	6.35	p >0.05
Yes	8	4.47	1.397	3.59	9.77	

Table 9 shows that children who frequently wash their hands (18 children) have higher BLLs than children who sometimes or do not wash their hands after playing or before eating (2 children, one of which belongs to a family with mechanical processing business at home).

The average BLLs of children who had the habit of putting their hands or toys in mouth and children who did not have the habit of putting their hands or toys in mouth were approximately the same (4.47 µg/dL and 4.85 µg/dL respectively).
For children who have a habit of playing in the yard, the BLLs of these children (8 children) are in the range of 4.13 µg/dL to 9.77 mg/dL, which is higher than that of children who do not have the habit of loitering in the yard (3.59 µg/dL to 6.02 µg/dL). The results showed that the difference was not statistically significant with $p>0.05$.
The research team conducted a rapid measurement of the lead content in wall paint in the families of 20 children and classrooms in Tan Hiep Commune Kindergarten, Long Thanh district, Dong Nai province (See list of classrooms in Annex 2) and no lead was detected in the wall paint and plastic toys (in the classrooms of the Tan Hiep Commune kindergarten).

2.3. Discussion

The number of study participants are 20 children (10 boys and 10 girls) having BLLs > 5 µg/dL selected from a total of 48 children who have participated in the 2021 study.

The average BLLs among male children is 4.90 µg/dL, which is slightly higher than the average BLLs among female children (4.39 µg/dL). This result is completely consistent with the 2021 study on 48 children at preschool conducted by CGFED and NIOEH. Similarly, when compared by age, there is no difference between BLLs among children of preschool age (3-5 years old) and that of children who have transferred into primary school (6-7 years old).

When assessing risk factors for lead exposure in children based on information provided by parents or guardians and on rapid measurement of lead content in plastic items or wall paints at children's homes and classrooms, there were no statistically significant differences shown. Thus, the correlation between risk factors related to the surrounding environment and living habits of children and families has not been discovered. One reason may be that the sample size (N=20) is not sufficient to represent and evaluate the correlation.

However, there are some points to keep in mind when assessing BLLs in children as follows:

- Regarding children's families who still use (old) plastic doors, results of rapid measurement show that the lead content is high, up to 27,4 mg/kg, equivalent to the leaching level that can reach 19,2 mg/kg, much higher than the maximum acceptable level specified in TCVN 6238-3:2011. The findings show one child whose BLL is slightly higher in 2022 compared to the result in 2021, which can be attributed to possible exposure from new sources of lead from painted items inside the home.
- When assessing according to risk factors, the families of three children worked in mechanical processing activities (metal processing) at home. One child had the lowest rate of BLL reduction in 2022 as compared to other children.

When assessing the overall BLLs among 20 children participating in the study, the results showed that the BLLs among children in 2022 decreased significantly compared to 2021 (the rate of reduction ranges from 7.4% to 56.6%), the difference is statistically significant. This was the result after parents and relatives were informed about the risk factors for exposure to lead, and eating and living habits among children who participated in the 2021 study. This is notably true for the child who had the highest BLL of 20.72 µg/dL in 2021 due to the use of orange herbal supplements by the family—the main source of the child's exposure to lead. More than one year after

discontinuing the administration of lead-containing orange herbal supplements to the child, the child's BLL decreased to 9.77 µg/dL.

In addition, when compared with the US CDC's reference limit for normal BLLs in children (<3.5 g/dL), the 20 children in this research are all at risk for lead exposure. Therefore, it is essential to investigate the risk factors in a child's living environment and repeat the blood lead testing within three months. According to the results of the environmental factor assessment, besides some plastic toy samples with lead detected, another environmental factor related to the household's use of water source, that is, 100% of children's families in the study all uses ground water for domestic purposes. However, by the time of the study, 100% of households never tested and assessed the quality of the water source.

3. CONCLUSIONS AND RECOMMENDATIONS

3.1. Conclusions

Current status of children's lead exposure

- The average BLLs among children participating in the study is 4.75 µg/dL, the lowest is 3.59 µg/dL and the highest is 9.77 µg/dL. 100% of children had BLLs higher than the US CDC recommended threshold (3.5 µg/dL), of which 65% of children had BLLs ranging from 3.5 µg/dL to 5.0 µg/dL, and 35% of children had BLLs ranging from 5.0 µg/dL to a little less than 10.0 µg/dL.
- The average BLLs among male children is 4.90 µg/dL, higher than the average BLLs among female children (4.39 µg/dL).
- The average BLLs among children in 2022 has decreased compared to 2021 (4.75 µg/dL (1.055) and 5.96 µg/dL (1.350), $p<0.05$ respectively).

Assessment of risk factors for lead exposure in children

- Results of the analysis show that children exposed to objects containing lead at home had higher BLLs than those that were not 4.85 µg/dL (1.455) and 4.68 µg/dL (0.664) respectively, but the difference was not statistically significant ($p>0.05$).
- The BLLs among children in this study are higher than the CDC recommended threshold levels, indicating that the children were exposed to other sources of lead (i.e., drinking water, food, or other environmental factors) that were not included in the study. At the same time, the number of research samples is small and not enough for statistical analysis.

3.2. Recommendations

- There is a need for a large-scale follow-up study with sufficient and representative number of samples to be able to clearly assess the correlation between BLLs and lead levels in the children's surrounding environment.
- In addition to the exposure risk factors implemented in the research, it is recommended to assess the lead content in drinking and living water, domestic foods, and other related environmental factors such as air, residential land, etc.

ANNEX 1: BLOOD LEAD LEVELS AMONG 20 CHILDREN IN TAN HIEP COMMUNE, LONG THANH DISTRICT, DONG NAI PROVINCE

No.	Sample code	BLL results in 2021 (µg/dL)	BLL results in 2022 (µg/dL)	Sampling point coordinates
1	TH1	5.69	4.87	10.6880785º0.0'N 107.0440603º0.0'E
2	TH2	5.36	4.16	-
3	TH3	5.73	5.31	10.6873784º0.0'N 107.043925º0.0'E
4	TH4	20.72	9.77	10.6859788º0.0'N 107.0432161º0.0'E
5	TH5	6.42	5.02	10.6870046º0.0'N 107.0468308º0.0'E
6	TH6	6.03	4.82	10.6855777º0.0'N 107.0466863º0.0'E
7	TH7	5.26	4.35	10.6840009º0.0'N 107.0480997º0.0'E
8	TH8	5.75	6.01	10.6840009º0.0'N 107.0480997º0.0'E
9	TH9	5,34	4,36	10.6891473º0.0'N 107.0406599º0.0'E
10	TH10	5.65	5.72	10.6910555º0.0'N 107.0425427º0.0'E
11	TH11	7.75	6.02	10.6924894º0.0'N 107.0461075º0.0'E
12	TH12	6.02	4.37	10.6897453º0.0'N 107.0512391º0.0'E
13	TH13	7.15	4.69	10.6897453º0.0'N 107.0512391º0.0'E
14	TH14	9.66	4.92	10.6921164º0.0'N 107.0549947º0.0'E
15	TH15	9.79	4.25	10.6918981º0.0'N 107.0548737º0.0'E
16	TH16	6.58	3.59	10.6786021º0.0'N 107.0375781º0.0'E
17	TH17	6.99	6.35	10.6789092º0.0'N 107.040454º0.0'E
18	TH18	5.83	4.54	10.6690415º0.0'N 107.0321383º0.0'E
19	TH19	5.45	4.13	10.7220857º0.0'N 107.0451324º0.0'E
20	TH20	5.9	4.41	10.6888103º0.0'N 107.0423118º0.0'E

ANNEX 2: LIST OF CLASSROOMS ASSESSED AT TAN HIEP COMMUNE KINDERGARTEN, LONG THANH DISTRICT, DONG NAI PROVINCE

No.	Code	Name of class
1	TH21.1-TH21.6	Bud class 3
2	TH21.7-TH21.12	Bud class2
3	TH21.13-TH21.18	Seed class 1
4	TH21.19-TH21.24	Leaf layer 4
5	TH21.25-TH21.30	Leaf layer 3
6	TH21.31-TH21.35	Leaf layer 2
7	TH21.36-TH21.40	Leaf layer 1
8	TH21.41-TH21.46	Bud class 1

ANNEX 3: SOME PICTURES DURING FIELD SURVEY

Field pictures at Tan Hiep Commune Kindergarten

Measuring lead in toys and surroundings at Tan Hiep preschool

Gathering survey information at Tan Hiep, Long Thanh, Dong Nai

Pictures during extraction of blood samples at Tan Hiep, Long Thanh, Dong Nai

Measuring lead content in toys and environment surroundings the households using a portable X-ray fluorescence device