LEAD PAINT IN VIETNAM

SURVEY ON LEAD CONCENTRATIONS IN SOLVENT-BASED PAINTS AND THE SITUATION OF LEAD EXPOSURE IN PAINTERS AND PRESCHOOL CHILDREN

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LEAD PAINT IN VIETNAM – OCTOBER 2021

Survey on lead concentrations in solvent-based paints and the situation of lead exposure in painters and preschool children, research in the north and south of Vietnam

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IPEN is a network of over 600 non-governmental organizations working in more than 120 countries to reduce and eliminate the harm to human health and the environment from toxic chemicals.

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CGFED (Research Centre for Gender, Family and Environment in Development) is a Vietnamese civil society organization established in 1993. CGFED works for gender equality on the basis of respect for the right to freedom, diversity and human rights. The main issues CGFED focuses on and prioritize include sexual rights for young people; enhancing and empowerment of minority and poor groups; and protection of people, especially women and children from harmful chemicals. CGFED acts through research, environmental education, community development assistance, training, and advocacy.

http://cgfed.org.vn

NIOEH (The National Institute of Occupational and Environmental Health) is a research unit under the Ministry of Health of Vietnam with functions of scientific research, training, co-ordination of the network, health communication and education, and international cooperation in fields of occupational health and environmental health. Since its establishment in 1982, NIOEH has carried out scientific studies on specialized fields, including studies on occupational and environmental toxicology. In particular, studies on lead poisoning on workers exposed to lead and lead poisoning on children have provided recommendations for the prevention of lead poisoning, contributing to minimizing the negative impacts of lead on health Vietnamese workers and children.

http:/nioeh.org.vn

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LIST OF ABBREVIATIONS

ALAD	Delta-aminolevulinic acid dehydratase
ATSR	Disease and Toxicology Registry
BLL	Blood lead levels
CDC	Centers for Disease Control and Prevention
CGFED	Research Centre for Gender, Family and Environment in Development
EPA	United States Environmental Protection Agency
ICP-MS	Inductively coupled plasma mass spectrometry
IPEN	International Pollutants Elimination Network
IQ	Intelligence Quotient
MOIT	Ministry of Industry and Trade
NIOEH	National Institute of Occupational and Environmental Health
POPs	Persistent Organic Pollutants
QCVN	Vietnam National Technical Regulation
SAICM	Strategic Approach to International Chemicals Management
SD	Standard Deviation
TCVN	Vietnam National Standards
UNDP	United Nations Development Programme
UNEP	United Nations Environment Program
VINACHEMIA	Vietnam Chemical Agency
VPIA	Vietnam Paint and Ink Association
VS	Vietnam Standard
WHO	World Health Organization

INTRODUCTION

According to the World Health Organization, lead is one of the ten heavy metals that need most attention to human health, especially children. It is estimated that in 2000, around 120 million people worldwide were exposed to lead, of which mainly children[1], each year an additional 600,000 children were recorded intellectually affected and 143,000 deaths were reported, due to lead exposure, especially in developing countries[2]. Children are at risks of lead poisoning from a variety of sources such as leaded gasoline, leaded paint, toys, mining activities, battery recycling, environmental pollutions, etc. Lead poisoning can cause multiple and complex damages on most organs and systems in the body such as: nervous, circulatory, cardiovascular, skeletal, and urinary. In the world, there have been studies on lead poisoning in children and lead poisoning prevention activities for children in some countries have achieved many successes. In Vietnam, there are a number of studies on lead poisoning in children, focusing on children living in high-risk areas such as craft villages, lead-containing product recycling areas, etc. Research on lead in children's toys and school supplies at the two kindergartens in Hanoi showed that 9.7% of children's toys contained lead with an average content of 625.3 ppm and one out of 61 wall paints contained lead[3].

To have more scientific information on the risk of lead contamination from paint, the Research Centre for Gender, Family and Environment in Development (CGFED) cooperates with the Department of Environmental and Community Health, Institute of Occupational and Environmental Health to implement the: *"Survey on lead concentrations in paints and the situation of lead exposure in painters and preschool children"*.

1 Prüs-Ustün A., Fewtrell L., Landrigan P.J., Ayuso-Mateos J.L. Lead Exposure. In: Ezzati M., Lopez A.D., Rodgers A., Murray C.J.L., editors. Comparative Quantification of Health Risks: Global and Regional Burden of Disease Attributable to Selected Major Risk Factors. Volume 1. World Health Organization; Geneva, Switzerland: 2004. pp. 1495–1542

2 USCPSC (2001), Ban of Lead - Containing Paint and Certain Consumer Products Bearing Lead - Containing Paint 16 C. F. R. 1303, accessed 22/2/2008, from http://www.cpsc.gov/businfo/regsumleadpaint.pdf

3 Lo Van Tung, Doan Ngoc Hai, Nguyen Duc Son, Le Thai Há (2018). The real situation of lead contamination in toys, learning supplies of preschool children in 2 kindergatern Hanoi city. The 5th International Scientific Conference and the 9th National Scientific Conference on Occupational Health and Environment, page 254-257.

SUBJECTS AND METHODS OF RESEARCH

Subjects of research on lead concentration in paint

Subjects of study: the concentrations of lead in solvent-based paints currently sold in the market.

Research area:

- In the North: Hanoi City
- In the South: Binh Duong Province (for paint factory), Ho Chi Minh City and some southern provinces for the paints sold online

Research duration: From July 2020 to March 2021

Research content: Determination of lead content in solvent-based decorative, anticorrosive, and industrial paints being produced and sold in the Northern and Southern markets of Vietnam.

Research methodology: EPA 3050B (analysis of lead in paint)

Research design: Descriptive cross-sectional study

Research sample size: Collecting and testing to determine lead content in 40 solvent-based paints that are currently sold in the North and South markets of Vietnam.

From July 2020 to January 2021, CGFED has purchased a total of 40 solvent-based paints including 19 decorative paints, 18 industrial paints, and three anticorrosive paints from stores in Hanoi City, Ho Chi Minh City, and Binh Duong Province, Vietnam. The paints represented 14 different brands produced by 13 manufacturers—10 locally owned and three foreign-owned companies. Twenty paints were manufactured by three foreign companies while the other 20 paints were manufactured by 10 local companies. The selected paints are mostly brightly colored such as yellow, red, orange, green, violet, and blue. Paints in white, brown, grey, and black colors were also selected by the research team. The selected paints in this study not only includes decorative paints for residential use, but also anticorrosive and industrial paints which are covered under the National Technical Regulation on lead concentration in paint adopted in December 2020.

Among the 40 paints selected in this study, 17 paints were purchased in the market in North Vietnam and 23 paints were purchased in South Vietnam. The purchase of paints online was made after IPEN's sugges-

tion to ensure the safety of the research team in the context of outbreak of COVID-19 in Vietnam as follows:

- 4 paints were purchased directly from the construction project in Hanoi;
- 13 paints were bought in the market, from stores specializing in selling all kinds of paint in Hanoi;
- 9 paints were purchased from paint manufacturing company in Binh Duong Province; and
- 14 paints were purchased online, most of them are sold in the southern market (Ho Chi Minh City, Binh Thuan Province) through the Shopee website.

In terms of color, paints selected are quite diverse, of which:

- 19 decorative paints include four brown paints, four colorless paints, three black paints, three blue paints, three white paints, one orange paint, and one red paint.
- 18 industrial paints include four yellow paints, three black paints, three green paints, three red paints, two blue paints, one brown paint, one orange paint, and one violet paint.
- 3 anticorrosive paints include two white paints and one grey paint.

Sampling and analysis techniques:

Buy paints in the northern market (Hanoi):

- For 4 paints purchased directly from a construction project in Hanoi: CGFED has prepared necessary sampling tools such as 500 mL plastic containers, measuring hoppers, plastic liquid measuring tools, gloves, and masks to take samples. The test samples are carefully taken from large paint cans used by painters in three apartments, minimizing samples of dirty items and other materials. Each container of sampled paint is tightly closed and clearly marked with the name and product code on the outside. Packaging and important information on original paint cans were noted down.
- 13 paints were directly purchased by CGFED at some stores in the famous paint street in Hanoi—Hang Hom street.

Buy paints in the southern market:

- For nine paints purchased directly at a paint manufacturing company (Sherwin-Williams Binh Duong): The paints are stored at special glass bottles with a capacity of 500 mL. Each container of sampled

paint is tightly closed and has a specific, clear name and product code on the outside, ensuring safe transportation from the south to the north to collect samples for lab analysis. Packaging and important information on original paint cans were noted down.

- 14 paints were purchased online by CGFED from stores in the Central and the South through the Shopee website/app.

The availability of these paints in retail establishments and online retail stores suggested that they were intended to be used for a variety of consumer purposes including within home environments. During the paint sample preparation, information such as color, brand, manufacturer, place of manufacture, product number, date of manufacture, batch number and other details on the packaging were recorded. Generic paint colors were recorded, e.g., "brown" instead of "cockroach" and "blue" instead of "turquoise." For paints that do not have a color code on the package and whose details are unavailable online, these will be classified as "colorless."

Paint details for each paint were recorded and codes were assigned before sending to the laboratory of the Center for Analysis and Testing 1—Vinacontrol in Hanoi for analysis according to EPA 3050B method, i.e., through acid digestion of the samples, followed by the atomic absorption spectrometry as recognized by World Health Organization as appropriate for the research purposes. In Vietnam, this is a popular method for analysis of lead content in paints used by Vinacontrol.

Research on lead exposure in painters and preschool children

Research subjects: Blood lead concentrations of painters and preschool children

Research location:

- Tan Hiep commune preschool, Long Thanh district, Dong Nai Province
- Ha Noi City
- Ho Chi Minh City

Reseach duration: From March 2020 to March 2021

Research contents:

- Study the risks and determine blood lead levels of painters
- Study the risks and determine blood lead levels of preschool children

Figure 1. Paint stores along the famous Hang Hom street in Hanoi.

Research methodology

Research design: Cross-sectional descriptive studies

Sample size:

- Employees: 60 persons
- Children: 48 children

Sampling and analysis techniques: Venous blood samples were taken with a disposable medical syringe. Before taking blood samples, the skin surface was wiped with alcohol swab to avoid contamination of the blood sample leading to false results, and to ensure safety for children. Blood taken into the cylinder is divided into and preserved in anticoagulant tubes. The blood volume and anticoagulant composition depend on the purpose of the test.

Lead concentrations were determined by Inductively Coupled Plasma Mass Spectrometry (ICP-MS). Criteria for diagnosis of lead poisoning are based on Decision No.1548/QD-BYT dated 10th May 2012 of the Minister of Health on promulgating guidelines for diagnosis and treatment of lead poisoning[4] (children lead poisoning when blood lead concentrations > 10µg/dL), as follows:

4 The Ministry of Health. 2012. Decision guiding diagnosis, treatment of lead poisoning; Number: 1548/QĐ-BYT; May 10, 2012

- Mild toxicity: Blood lead concentration of 10 to < 45 μg/dL .
- Average level: Blood lead concentration of 45 to 70 μg/dL.
- Severity: Blood lead concentration > 70 μg/dL.

The study results were also compared with the 2012 US CDC guidelines for lead poisoning in children with the lead poisoning level determined to be > 5 μg/dL and the time children had to use medication is when the blood lead test results is ≥ 45 μg/dL[5].

Study the risk of lead poisoning in children:

- Survey tools: Prepared questionnaires
- Survey technique: Instructing preschool teachers on how to answer questions in the questionnaire.
- Kindergarten teachers directly guide parents of children to answere and collect questionnaires.
- Research members check the questionnaire again, when there is an unknown issue or a question has not been answered, and send it back to the child's parents to fully answer the questionnaire.

Methods of data analysis: The collected data was encoded using Excel 2007 software and the data was processed using SPSS 20.0 software. The statistical indicators were median, mean, standard deviation, minimum, maximum, and percentage. The statistical tests used were t-test, Anova test, Turkey test to compare mean value, and χ^2 test (to compare percentages).

Ethical issues in the research

- Schools and parents of children were clearly informed about the purpose, content, benefits, and possible disadvantages in the research process. Only children whose families voluntarily signed consent to participate in the study were included in the list of study subjects.
- Research subjects had their rights to refuse participation in the study at any point in the research process.
- Absolute safety, especially biosafety for all research subjects in the process of participating in the study was ensured.
- Test results were sent to each study participant. Once signs of abnormal blood lead levels were detected, parents of children were notified and advised about preventive and therapeutic measures.

5 USA' blood lead concentration limits in 2012 (https://www.cdc.gov/nceh/lead/data/blood-lead-reference-value.htm)

1. OVERVIEW

1.1 RESEARCH AROUND THE WORLD

1.1.1 Lead in paint

Since before the 1950s, lead-based paint has been quite popular in home paints. The most common places to use lead paint are walls, doors, door frames, windows, wooden and furniture. Lead-based paint becomes a hazard when it begins to wear, chip or flake off, or while it is removed by shaving or sanding.

After leaded gasoline, leaded paint is a huge source of lead exposure for children. Lead poisoning from lead paint has been recorded since 1892 in Australia. Children are exposed to lead when painted surfaces at home is cracked, damaged and released into their learning and playing environments in the form of dust and sand. In home renovations and repainting, the painted surface is often sanded to create adhesion to the new paint. As a result, lead in old paint will flake off and be widely dispersed in the air as small lead contaminated dust[6]. Children also get lead from a habit of putting their hands in their mouths or ingesting dry pieces of paint directly from toys, furniture or other objects painted with lead-based paint. This is a common behavior among children aged six and under. A typical one- to six-year-old child ingests between 100 and 400 mg of dust and sand per day[7]. To prevent lead poisoning for children, in 1987, the United States banned the use of paints with lead content > 0.06% (600 ppm) to paint toys, appliances, walls, and building constructions for public use. In 2008, the US enacted the Consumer Product Safety Improvement Act of 2008 which states that "the concentration of lead must not exceed 90 ppm in paints and similar coating materials for consumer use (e.g., decorative paint for homes), used on toys and other artciles intended for children, and on certains items of furtniture for consumer use." The new 2009 US standard requires that products designed for children under 12 years of age be prohibited from using paints with a lead content of > 300 ppm in any part of the product. In South Africa, limits for lead concentrations in paints below 600 ppm have been in place since 2009[8] but work is currently being done to revise this limit to 90 ppm.

6 Research Centre for Gender, Family and Environment in Development (CGFED). 2016. Research Report on "Lead in solvent paint used in home decoration in Vietnam", Hanoi.
7 WHO (2010), Childhood lead poisoning, Services, WHO Document Production, Geneva, Switzerland.
8 As above

Although the ban on the use of leaded paint has been enacted and applied in many parts of the world, many studies show that lead concentrations in paints are still high. In the Russian Federation, interior paint containing lead has been restricted by the laws of the former Soviet Union and by the Russian Federation in recent times. But independent studies show that in Russia, lead-containing paints can be easily found on the market[9].

According to IPEN's Global Report on lead in paint published in October 2020, updated lead levels in paints in 59 countries show that 57 countries had paints with lead levels in excess of 600 ppm: Colombia and Kazakhstan with 66% (2016), Taiwan 63% (2016), Kyrgyz Republic 56% (2016), Vietnam 54% (2016), Russia 49% (2016); and the same 57 countries had paints with lead levels exceeding 90 ppm, the highest being Tajikistan with 94% (2016), India with 91% (2020), Peru 90% (2009), Nepal 87% (2015), Senegal 86% (2009), Indonesia 83% (2015), and Lebanon 80% (2015)[10].

1.1.2 The situation of lead poisoning in children around the world

Lead in paint and house dust remains an important source of lead exposure. In the United States, lead in old paint is a well-documented source of lead expousure for young children[11]. In the US, the importance of low-grade house dust for infant blood lead level (BLL) is evident in the NHANES data analysis[12]. The importance of lead-containing paint as a major cause of high indoor lead concentrations is described in a recent national representative study of house dust in urban homes across Canada[13].

According to the Disease and Toxicology Registry (ATSR-1988) Report on the prevalence of lead poisoning, blood lead accumulation in the United States can reach 5.9 to 11.7 million children[14].

Analysis of the National Health and Nutrition Survey 2 (1980) showed that about 85% of American children before school age have lead absorption and blood lead concentration above 10µg/dL[15].

9 As above
10 https://ipen.org/sites/default/files/documents/ipen-global-lead-report-2020-v1_3a-en.pdf
11 Jacobs DE, Clickner RP, Zhou JY, Viet SM, Marker DA, Rogers JW, et al. The prevalence of lead-based paint hazards in US housing. Environ Health Perspect. 2002;110: A599–A606
12 Dixon SL, Gaitens JM, Jacobs DE, Strauss W, Nagaraja J, Pivetz T, et al. Exposure of US children to residential dust lead, 1999-2004: II. The contribution of lead-contaminated dust to children's blood lead levels. Environ Health Perspect. 2009; 117:468–474
13 Rasmussen PE, Beauchemin S, Chénier M, Levesque C, MacLean LC, Marro L, et al. Canadian house dust study: lead bioaccessibility and speciation. Environ Sci Technol. 2011; 45:4959–4965
14 Agency for Toxic Substances and Disease Registry (ATSDR) (1998). The nature and extend of lead poisoning in children in the United States. A report to Congress
15 Morri Markowitz. (2000) Lead Poisoning. Pediatrics in Review (21) 327-335

According to Brody D.J et al. (1994), synthetic data from the 3rd National Health and Nutrition Survey, 8.9% equivalent to 1.7 American children aged 1 to 5 years old had blood lead levels (BLLs) from 0.48 mmol/L (10μg/dL) or more[16].

The study was conducted in the US State of Vermont (1995) on 350 2-year-old children which found that 9% of children had BLLs >10 μg/dL; 2.7% of children had BLLs in the range of 15-20 μg/dL and 1.5% had BLLs > 20μg/dL, which meant 13.2% of children in the high risk group[17].

In Russia (1997), the risk assessment of the harmful effects of lead on children was conducted according to the bio-kinetic models of lead penetration into the body[18]. In cities with low environmental lead levels, the average lead level in children's blood is close to non-dangerous levels (10μg/dL). In cities with developed industries, this index could be twice as high. Risk calculation using the CDC scale shows that about 44% of children in big cities may develop behavioral and educational problems due to the effects of lead, nearly 9% require medical intervention; 0.2% of children are in danger and about 0.01% need urgent medical intervention and prompt treatment[19].

According to research results from many centers in Europe (Bulgaria, Denmark, Greece, Hungary, Italy, Romania, Germany, and Yugoslavia), the majority of school-aged children have BLLs ranging from 5 to 60μg/dL[20].

According to the examination results of 199 children aged three to six years old in Wolcele, Birmingham district, UK (1988), the BLLs ranged from 4.1 to 33.5 μg/dL and the average was 9.74 μg/dL[21].

Studies conducted in South Africa show a rather unfavorable picture: more than 90% of children have BLLs > 10 μg/dL[22].

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16 Brody D.J., Pirkle J.L., Kramer R.A., Flegal K.M., Matte T.D., Gunter E.W. et al (1994) Blood lead levels in the US population: Phase 1 of the third National Health and Nutritional Examination Survey (NHANES III, 1988 to 1991). JAMA 272,277-83. [PUBMED]

17 Paolozzi L.J. et al, (1995). Prevalence of lead poisoning among two-year-old children in Vermont. Pediatrics, 96, 78-81

18 Розанов В.А. (1999). Насущные проблемы нейротоксического влияния свинца на детей - международный опыт контроля и предупреждения неблагоприятного воздействия. Метеорология, климатология и гидрология, 37, 6-14.

19 Снакин В. В. (1999). Загрязнение биосферы свинцом – маштабы и перспективы для России". Медицина труда и пром. Экология, 5, 21-27

20 Winneke G. et al. (1990). Result from the European multicenter study on lead neurotoxicity in children: implication for risk assessment, Neuro toxicol. Teratol., 553-559

21 Singal G.M. et al, (1988). Blood lead, ethnic origin, and lead exposure. Arch. Of Disease in Childhood, 63, 973-975

22 Гнидой И. И. др. (1999). Результаты пилотного исследования по оценке накопления свинца в крови детей в Одессе. Метеология, климатология и гидрология, 37, 6-14

A survey conducted in Jakarta, Indonesia on 397 children from six to 12 years old showed that 35% of children in study subjects had BLLs ≥10 μg/dL, of which 2.4% had BLLs ≥20 μg/dL[23].

In Dakar, Senegal, from November 2007 to March 2008, 18 children died from diseases on the central nervous system. The causes of death is lead poisoning from recycling lead batteries in the community. The results of a subsequent investigation showed that mass lead poisoning occured due to the inhalation or ingestion of heavily lead-contaminated soil and dust from illegal and unsafe lead battery recycling[24].

According to studies in China, the average BLLs in children is 9.29 μg/dL and there are 33.8% of children with BLLs ≥ 10 μg/dL, with male children averaging BLLs of 9.64 μg/dL, significantly higher than that of females (8.94 μg/dL)[25]. The study was conducted on 165 children in the city of electronic waste recyclin—Guiyu (2007)—which showed that the number of children with BLLs ≥ 10μg/dL accounted for 81.8% (135/165)[26]. According to the results of another study in Guiyu (2008), 79.8% of children (109/135) had BLLs ≥ 10μg/dL. The authors attributed the elevated blood lead level in children in Guiyu to environmental pollution from the recycling of lead-containing electronics[27].

The above figures are evidence of a dangerous reality and intensity of lead poisoning in children in the world and in Vietnam. The control of blood lead levels in children in many countries has become a critical issue. Many countries around the world such as the US, Germany, Denmark, Austria, Mexico, and Thailand have implemented national programs to reduce the environmental pollution caused by lead and to limit the adverse effects of lead on children's health[28].

23 Rachel Albalak et al (2002). Blood lead levels and risk factors for lead poisoning among children in Jakarta, Indonesia. J. The Science of the Total Environment

24 Pascal Haefliger et al (2009). Mass Lead Intoxication from Informal Used lead-acid battery recycling in Dakar, Senegal. J. Environmental Health Perspectives.

25 Wang S, Zhang J (2006) Blood lead levels in children, China. Environ Res 101: 412-418.

26 Xia Huo, Lin Peng et al (2007). Elevated blood lead levels of Children in Guiyu, an electronic waste recycling Town in China. Environmental Health Perspectives, 15, 1113-1117

27 Liangkai Zgeng and Kusheng Wu et al (2008), "Blood lead and cadmium levels and relevant factors among children from an e-waste recycling town in China", Environmental Research, pp. 15-20

28 Розанов В.А. (1999). Насущные проблемы нейротоксического влияния свинца на детей - международный опыт контроля и предупреждения неблагоприятного воздействия. Метеорология, климатология и гидрология, 37, 6-14.

1.2 RESEARCH IN VIETNAM

1.2.1 Lead in paint and children's toys

A study in Vietnam in October 2015 by the Research Centre for Gender, Family and Environment in Development (CGFED) showed that solvent-based paints for household use contained very high levels of lead and were widely used in the paint market in Vietnam. The study investigated and analyzed 26 cans of solvent-based paint representing 11 paint brands produced by 11 paint manufacturers and were widely sold in many stores in Hanoi. The survey results showed that 14 out of 26 solvent-based paints for home use (54%) had lead concentrations in excess of 600 ppm - lead concentration limits prescribed in some countries such as Singapore, Korea, and Sri Lanka. Moreover, five paints (19%) contained dangerously high lead concentrations above 10,000 ppm. Out of the 11 paint brands tested, 4 paint brands (36%) had at least 1 paint with lead concentration exceeding 10,000 ppm. Red and yellow paints were two colors containing the highest lead concentration greater than 10,000 ppm. Three out of nine red paints (33%), and 2 out of 8 yellow paints (25%) contained lead concentration above 10,000 ppm. In addition, none of the 26 paints provided information about lead on their label and most paints contained very little information about the paint's ingredients. Most warning symbols on the paint cans only mention the flammability of the paints but no precautionary warnings on the effects of lead dust to children and pregnant women were provided[29].

Children's toys imported from China predominate the inexpensive children's toys market in Vietnam and may pose the same risk of lead contamination as toys in the US. Vietnam has set a limit below 90 μg/g (mg/kg) for lead concentrations in all clay and hand-painted toys (TCVN 6238-3:2011)[30]. However, the implementation of the standard on lead in childen's toys faces many difficulties, especially in terms of the quality of toys commonly sold in the market, predominated by cheaper imported toys from China. The authors have not found any research on lead content in children's toys in Vietnam.

Study results of Lo Van Tung (2018) on the situation of lead contamination in paint and toys in two kindergartens in Hanoi showed that 9.7% of toys contained lead with an average content of 625.3 ppm, seven times higher than the TCVN 6238-3:201 standard on the safety of children's

29 Research Centre for Gender, Family and Environment in Development (CGFED). 2016. Research Report on "Lead in solvent paint used in home decoration in Vietnam", Hanoi.

30 Ministry of Science and Technology (2008), Vietnam Standard 6238-3: 2008 on Children's toy safety – Part 3: The limit of invasion of toxins.

toys. In addition, the study found a painted wall which contained 1,800 ppm of lead[31].

A study by CGFED and NIOEH found that 40% of paint samples collected from painted surfaces in several preschools and households contained lead. The average lead concentration in these samples was 541.27 (390.19 – 852.05) mg/kg. In addition, the study found that 37.5% of toy samples at preschools contained lead. The average lead content of these toys was 2,207.83 (193-4,895) ppm[32].

1.2.2 Lead exposure status in Vietnamese children

In Vietnam, there were recent studies on the status of lead poisoning in children but have not focused on the risk of lead poisoning in children due to exposure from the use of lead paints and lead-containing toys.

According to studies by Havens et al (2012) on 311 children in the Ho Chi Minh City, and Dong Nai, Binh Duong, Binh Phuoc, and Ba Ria - Vung Tau Provinces showed that 92.9% of children had blood lead levels <10 µg/dL, 7.1% of children had blood lead levels ≥10 µg/dL, only 2.9% (9 children) had blood lead levels >20 µg/dL, and 0.96% (3 children) had blood lead levels > 35 µg/dL[33].

A study by Dang Anh Ngoc implemented in Chi Dao commune, Van Lam district, Hung Yen province (2008) showed that the rate of school pupils having concentration of delta – ALAD urinary over 10mg/L was quite high, accounting for 45.0%; at 5-10 mg/L accounting for 40.4%; and less than 5 mg/L accounting for 14.6%. This shows that the lead poisoning of children in the village with lead recycling industry is very high[34].

The study of Lo Van Tung et al. conducted on 109 children under 10 years old in Dong Mai craft village (2011) showed that 100% of children under 10 years of age had higher blood lead levels over 10 µg/dL, and of the 24

31 Lo Van Tung, Doan Ngoc Hai, Nguyen Duc Son, Le Thai Há (2018). The real situation of lead contamination in toys, learning supplies of preschool children in 2 kindergatern Hanoi city. The 5th International Scientific Conference and the 9th National Scientific Conference on Occupational Health and Environment, page 254-257

32 Research Centre for Gender, Family and Environment in Development (CGFED), Department of School Hygiene and Health, National Institute of Occupational and Environmental Health (INOEH) (2019), Report on Survey on the situation of lead exposure from paint, toys and risks of lead exposure of preschool children.

33 Deborah Havens (2012). Childhood Blood Lead Levels and Associated Risk Factors in Vietnam. A thesis submitted in partial fulfillment of the requirements for the degree of Master of Public Health. University of Washington

34 Dang Anh Ngoc (2008), Assessment of school environmental sanitation conditions, hygiene learning conditions in craft villages and the impact on school pupils' health. Proposing some solutions to improve, Report on scientific research at grassroot level: The Institute of Labor Medicine and Environmental Hygiene

children having repeated blood vein test, there were 19 children who had blood lead levels over 45 μg/dL[35].

Research on children from 3-14 years old living near the lead zinc mining area in Ban Thi commune, Bac Kan showed that the rate of lead poisoning (children with blood lead levels >10μg/dL) is 79.49%[36]. The percentage of children ages 3-14 years old with history of using lead poisoned "orange" herbal supplement (a kind of traditional herbal detox medicine for kids) in Bac Giang province and Quang Ninh province are 2.8% and 7.0% respectively[37].

The study of Doan Ngoc Hai et al. (2018) on the risk of lead contamination in children in two preschools in Hanoi showed that the average lead concentration in the hair of children is 4.8±4.7μg/g, and the proportion of children at risk of exposure to lead accounted to 30.4%, while serious lead exposure accounted to 1.0%. Lead in hair highly increases due to children living with relatives exposed to lead at work[38].

The study on 30 preschool children in Hai Hau, Nam Dinh showed that the average blood lead concentration in children was 2.87±1.22 μg/dL, lower than the CDC recommendation. There are no children with lead poisoning according to the lead poisoning diagnosis and treatment guidelines of the Ministry of Health of Vietnam[39].

1.3 HEALTH EFFECTS OF LEAD ON CHILDREN

Children are exposed to lead through a variety of sources at home—mostly from chipped off lead-based paint on walls, windows, doors, and on surfaces that were once coated with lead-based paint. Once painted surfaces

35 Lo Van Tung et. Al (2012). Survey on the blood lead concentration of children in Dong Mai craft village, Chi Dao commune, Van Lam district, Hung Yen province. The 8th National Scientific Conference and 4th International Workshop on Occupational Medicine and Environmental Hygiene, Practical Medicine Journal No. 849a + 850a, 2012

36 Doan Ngoc Hai, Lo Van Tung, Duong Khanh Van, Ta Thi Binh, Ha Lan Phuong, Nguyen Dinh Trung, Nguyen Duc Son, Hoang Thi Giang, Nguyen Minh Hung and Pham Minh Khue (2018). Lead Environmental Pollution and Childhood Lead Poisoning at Ban Thi Commune, Bac Kan Province, Viet Nam. J. Biomed research International. Volume 2018. Article ID 516812, 7 pages. http://doi.org/10.1155/2018/515812

37 Doan Ngoc Hai (2019) Research on real situation of lead poisoning in children in Vietnam and effectiveness of some interventions. Report on synthesis of results of science and technology – State level independent topic, Code No. ĐTĐL.CN-48/15.

38 Doan Ngoc Hai, Lo Van Tung, Ta thi Binh, Chu Van Ngoc (2018). Lead content in hair and risk of lead poisoning in children at two preschools in Hanoi, the 5th International Scientific Conference and 9th National Specific Conference on Occupational Health and Environment, page 209-213

39 Research Centre for Gender, Family and Environment in Development (CGFED), Department of School Hygiene and Health, National Institute of Occupational and Environmental Health (INOEH) (2019), Report on Survey on the situation of lead exposure from paint, toys and risks of lead exposure of preschool children.

deteriorate over time, lead will contaminate children's learning and playing environment in the form of lead dust and lead in soil.

The hand-to-mouth behavior is very common among children from six-years of age and younger, and this group is very susceptible to lead exposure. Each typical one to six years old child ingests between 100 and 400 miligrams of house dust and soil each day[40]. There is no safe threshold for lead in blood in children. Even low levels of lead in blood greatly affects children more than adults because children are more susceptible to lead toxicity[41]. Blood lead level as low as 2 μg/dL affects the development of the nervous system in children[42].

Symptoms of encephalopathy and even death may occur at blood lead levels ≥100 μg/dL. The central nervous system becomes greatly affected when blood lead levels reach 40-60 μg/dL, while neurological dysfunction and neurotransmitter deceleration may occur when blood lead levels reach 30-50 μg/dL. Recent studies have also shown behavioral disorders in children with blood lead levels below 10 μg/dL[43].

Lead causes digestive disorders in children, including abdominal pain, constipation, nausea, vomiting, loss of appetite, and weight loss when blood lead levels reach 60-100 μg/dL[44]. Lead infiltration can lead to anemia due to a decrease in hemoglobin synthesis and a decrease in the number of red blood cells. Reduced hemoglobin synthesis can occur when blood lead levels reach 50 μg/dL for adults and 40 μg/dL for children.

At low doses, lead can decrease peripheral neurotransmitter rates[45], hearing impairment[46], impared IQ[47], and confusion of linguistic function, a disorder of the ablility to accept educational programs and the ability to adapt to the school environment[48]. Lead also affects children's physical

40 WHO (2010), Childhood lead poisoning, Services, WHO Document Production, Geneva, Switzerland
41 Staudinger K. C., Roth V. S. (1988), Occupational lead poisoning. American Family Physician. The American Academy of Family Physicians. http://www.aafp.org/afp/980215ap/index.html
42 EFSA (European Food Safety Authority) (2010), Panel on Contaminants in the Food Chain (CONTAM), Scientific Opinion on Lead in Food. EFSA Journal 2010; 8(4): 1570. 2010.
43 Agency for Toxic Substances and Disease Registry (ATSDR) (2007), Toxicological Profile for Lead. US Department of Health and Human Services: Atlanta, US
44 International Programme on Chemical Safety (IPCS). Lead. Monograph for UK PID: London
45 Schwartz J, Otto D. (1987), "Blood lead, hearing thresholds, and neurobehavioral development in children and youth". Archives of environmental health, 42,153-160
46 Robinson G. S. et al. (1985), Effects of low to moderate lead exposure on brainstem auditory evoked potentials in children. In: Neurobehavioural methods in occupational and environmental health. WHO Regional Office for Europe, 1985: 177 (Environmental Health Series No. 3).
47 Bellinger D.C.; Stiles K.M.; Needleman H.L. (1992) "Low-level lead exposure, intelligence and academic achievement: A long-term follow-up study". Pediatrics, 90,855-561
48 Needleman H. L., Gunnoe C., Leviton A., et al. (1979), "Deficits in psychologic and classroom performance of children with elevated dentine lead level". New.Engl. J. Med, 300, 689-695

development, including decreasing height, bust size, and head circumference[49].

1.4. PAINT MARKET IN VIETNAM AND THE REGULATORY FRAMEWORK FOR LEAD CONCENTRATION IN VIETNAMESE PAINTS.

1.4.1. Paint market in Vietnam

According to latest statistics, Vietnam has 600 paint industry enterprises, including 70 foreign-owned enterprises. In 2018, the Vietnam Paint and Ink Association (VPIA) said that in the past five years, foreign-owned or imported paints account for more than 65% of the Vietnamese market, while domestic paints only account for 35%.

Some of the well-known imported paint brands include Sherwin-Williams, Jotun, AkzoNobel, Nippon Paint, 4 Oranges, and PPG. These multinational brands carry all types of paints (decorative, anticorrosive, industrial, and specialty paints) and are widely advertised in various print, radio and television media.

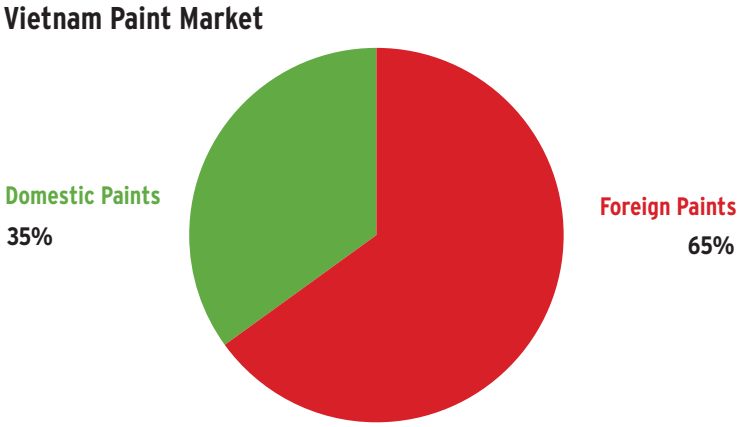

Figure 2. Vietnam paint market (VPIA, 2018). Source: https://odclick.com/chuyen-san/phan-tich-nganh/tong-quan-thi-truong-son-viet-nam/

49 Frisancho A R. and Ryan A. S. (1991), "Decreased Stature Associated with Moderate Blood Lead Concentrations in Mexican-American Children". American J Clinical Nutrition,3, 516-519. http://findarticles.com/p/articles/mi_m0887/is_n9_v10/ai_11389331

Despite having good quality, lower prices, and compliant with lead paint standards, more than 500 domestic paint companies, ranging from large-scale to "unknown" paint enterprises, are relatively unknown to consumers due to their limited competitiveness in terms of product advertising compared to multinational brands.

In 2018, VPIA said that decorative paints accounted for 61% of the total estimated annual production of 650 million liters, followed by wood paints at 20%, protection paints at 7%, powder coating at 4%, coil paints at 3%, marine paints at 2%, and other paints at 3%.

Based on paint production technology in 2018, VPIA statistics showed that:

- Manufacturers still give high priority to performance more than public health and environmental effects, as demonstrated by 1) market's concern for the functionality and beauty of coatings; 2) a lack of emphasis on consumer health and safety and environmental protection (low VOC content, formaldehyde free, lead free) even though most manufacturers have already started formulations using environmental-friendly raw materials amidst market orientation towards green technology.
- The paint market wants to become environmentally responsible as seen in the high increase in the application of water-based and UV technology to wood coatings.

These observations are reflected in this report's analysis of results of paints purchased in the northern and southern markets of Vietnam in 2020-2021.

1.4.2. Regulations on lead concentration in paint in Vietnam:

In recent years, Vietnam has increasingly become interested in controlling lead concentrations in chemical products, especially in paints. The Vietnam Chemical Agency (Vinachemia), which is under the management of the Ministry of Industry and Trade's (MOIT), is the State regulator in this field/sector, and has supported the enactment of a regulation on lead concentrations in paint in Vietnam. The roadmap of activities advocating for technical regulations on lead content in paint in Vietnam from 2016 to present is as follows:

2016: Results of the study on lead content in 26 solvent-based paints from 11 paint companies on the market was publicized, which showed that 54% of paints contained lead concentrations greater than 600 ppm, and

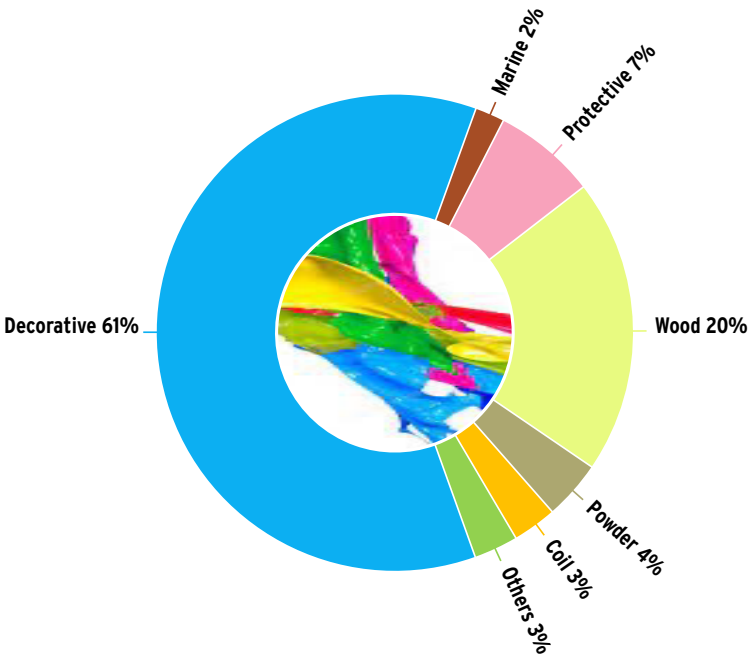

Figure 3. Structure of Vietnam's paint industry by volume
(Estimated: 650 million liters, VPIA, 2018)

the highest lead concentration is 21,000 ppm. This study was conducted by CGFED with technical and financial support from IPEN.

2017: On September 7th, the Chemcial Department had a meeting with experts from the United Nations Environment Program (UNEP) and the US Environmental Protection Agency (US EPA) to start collaborative activities on lead in paint in Vietnam. The meeting was attended by representatives from VPIA, some paint manufacturing companies, and CGFED.

2018:

- The MOIT's Chemical Department—the focal agency for the Strategic Approach to International Chemicals Management (SAICM)—in coordination with the United Nations Environment Program (UNEP) & the US Environmental Protection Agency (US EPA) implemented international collaborative activities to regulate the use of lead in paint in Vietnam.
- In April, the UNDP and the Chemcial Department launched the project "Applying green chemicals in Vietnam" to support green growth,

reduce the use and emissions of POPs & hazardous chemcial through introductory activities on green chemistry approaches in six industries in Vietnam: crome plating, pulp & paper production, plastics, textiles, pesticides, and solvents in paint. The project is implemented from 2018-2021.

2020:

- On April 14th, the Minister of Industry and Trade issued Decision No. 1111/QD-BCT on the establishment of the Circular Drafting Team promulgating the National Technical Regulation on lead content limit in industrial paint. This drafting team included 12 members who are representatives of the Ministry of Industry and Commerce, VPIA, paint manufacturers, universities, and the Vietnam National Chemical Group.
- In April, the first draft of the Technical Regulation was developed under the name of National Regulation on Lead Content Limits in Industrial Paints. The name of the draft still focused on industrial paints since the regulation's title had been registered by the Ministry of Industrial and Commerce in accordance to its missions and functions, but in the definition of the Technical Regulation, the scope of coverage included all types of paints in general.
- After a series of consultation, the second draft of the regulation had significant changes compared to the first draft. The biggest change is in the scope of the draft regulation, which now included general paint products, and not just industrial paints. In addition, the explanations of terms, references, packaging regulations and labeling, sampling methods, regulations on management, validity of regulations, responsibilities of implementing organizations, individuals and organizations, the appendix specifying methods of testing lead content in paint were either revised, changed, or supplemented with additional details. The total lead limit in paints in the second draft also changed compared to the first draft.
- In November, the third draft of the Technical Regulation included the most significant change on the total lead limit in paint compared to the previous drafts. Table 1.1 shows a summarized comparision of the changes and adjustments on the total lead limit in paint.

TABLE 1.1. COMPARISON ON THE THREE DRAFT VERSIONS OF THE VIETNAM TECHNICAL REGULATION ON LEAD CONTENT IN PAINT

	1st Draft		2nd Draft		3rd Draft	
No	Lead Content (ppm)	Application roadmap	Lead Content (ppm)	Application roadmap	Lead Content (ppm)	Application roadmap
1	≤ 600	The time this circular takes effect	≤ 600	The time this circular takes effect	≤ 600	The time this circular takes effect
2	≤ 300	Within 3 years from the date this circular takes effect	≤ 200	Within 3 years from the date this circular takes effect		
3	≤ 100	Within 6 years from the date this circular takes effect	≤ 90	Within 5 years from the date this circular takes effect	≤ 90	Within 5 years from the date this circular takes effect

- On 21st December 2020, the Government of Vietnam approved the Vietnamese National Regulation on the limit of lead content in paint at levels of:
    - ≤ 600 ppm right after the circular takes effect; and
    - ≤ 90 ppm after 5 years since the circular takes effect.

The Technical Regulation covers paint manufacturers and individuals, importers, traders of paints as specified in Appendix A of the Techncial Regulation, state management agencies, and other relevant organizations and individuals.

TABLE 1.2. LIST OF PAINTS THAT MUST MEET THE REQUIREMENTS ACCORDING TO QCVN 08:2020/BCT

No.	Types of paint	Code of imported, exported goods (HS)
1	Paints made from synthetic polymers or chemically modified natural polymers, dispersed or dissolved in a non-aqueous medium.	3208.10.90 3208.20.90 3208.90.90
2	Paints made from synthetic polymers or chemically modified natural polymers, dispersed or dissolved in an aqueous medium.	3029.10.40 3029.10.90 3029.10.00
3	Other paints; mixed watercolors for skin finishing	3210.00.20 3210.00.30 3210.00.99

As of writing this report, the draft circular promulgating the National Technical Regulation on lead content limit in paint has been approved (on 21st December 2020) and Vietnam has sent a notice on the ratification of the Draft National Technical Regulations on lead content limit in paints. However, guidance documents for the implementation of the regulations have yet to be issued.

2. RESULTS OF SURVEY ON LEAD CONTENT IN PAINTS

2.1. TOTAL LEAD CONTENT ANALYSIS

A total of 40 paints—19 decorative paints, 18 industrial paints, and three anticorrosive paints—were analyzed for total lead content.

All 19 analyzed decorative paints contained lead concentrations below 600 ppm. The highest lead concentration is 29.3 ppm while the lowest is < 0.20 ppm.

Among 18 analyzed industrial paints, seven paints contained lead concentrations greater than 600 ppm—the standard threshold in paints in Vietnam. The highest lead concentration is 92,400 ppm while the lowest is < 0.20 ppm. Notably, three yellow paints contained lead concnetrations greater than 10,000 ppm. These paints were:

- AXP Paint, manufactured by a Vietnamese paint manufacturer: 92,400 ppm;
- Lobster Paint, manufactured by a Thai paint manufacturer in Vietnam: 37,900 ppm; and
- Indu Paint, manufactured by a Vietnamese paint manufacturer: 16,100 ppm.

All three anticorrosive paints contained lead concentrations below 600 ppm, ranging from < 0.20 ppm to 0.85 ppm.

Of the seven industrial paints containing lead concentrations greater than 600 ppm, four paints were manufactured by foreign-owned paint manufacturers, while three paints were manufactured by domestic paint manufacturers. This shows that some foreign-owned paint manufacturers still produce paint with high lead content.

The paints with the highest lead concentrations, all of which were industrial paints, were bright colors like yellow, orange, and green.

The paints with the highest lead concentrations are mostly industrial or specialized paints. This suggests that regulations or policies that will limit

and control lead content in all types of paints, including industrial paints in the domestic market, needs to be established.

TABLE 2.1. LIST OF PAINTS CONTAINING THE HIGHEST LEAD CONTENT

No.	Sample Code	Brand Name	Country Headquarters of Manufacturer	Type of Paint	Color	Total Lead Content (ppm)
1	P9	AXP	Vietnam	Industrial Paint	Yellow	92,400
2	P14	Lobster	Thailand	Industrial Paint	Yellow	37,900
3	P32	Indu	Vietnam	Industrial Paint	Yellow	16,100
4	P15	Lobster	Thailand	Industrial Paint	Orange	8,170
5	P47	NewPab	Vietnam	Industrial Paint	Green	6,710
6	P13	Lobster	Thailand	Industrial Paint	Green	4,480
7	P12	Lobster	Thailand	Industrial Paint	Green	2,350

Thirty-three out of 40 paints (82% of paints) contained lead concentrations below 600 ppm. Among these are 19 decorative paints (100% of decorative paints), 11 out of 18 industrial paints (61% of industrial paints), and all three anticorrosive paints (100% of anticorrosive paints). These suggest that a great majority of decorative, industrial, and anticorrosive paints in the market can be manufactured without added lead.

TABLE 2.2. LIST OF PAINTS CONTAINING THE LOWEST LEAD CONTENT

No.	Sample Code	Brand Name	Country Headquarters of Manufacturer	Type of Paint	Color	Lead Content Label	Total Lead Content (ppm)
1	P24	Valspar	USA	Decorative Paint	Corlorless	None	< 0.20
2	P25	Valspar	USA	Anticorrosive Paint	White	None	< 0.20
3	P30	Valspar	USA	Decorative Paint	Corlorless	None	< 0.20
4	P34	Pine	Vietnam	Industrial Paint	Blue	None	< 0.20
5	P36	Creative Life	Vietnam	Decorative Paint	Orange	None	< 0.20
6	P31	Indu	Vietnam	Industrial Paint	Red	None	0.20
7	P27	Valspar	USA	Anticorrosive Paint	White	None	0.24

No.	Sample Code	Brand Name	Country Headquarters of Manufacturer	Type of Paint	Color	Lead Content Label	Total Lead Content (ppm)
8	P49	C-30	Vietnam	Industrial Paint	Black	None	0.24
9	P46	Propan	Vietnam	Decorative Paint	Brown	None	0.26
10	P18	Maxilite	Nether-lands	Industrial Paint	Yellow	No added lead	0.29
	P37	1K	Vietnam	Decorative Paint	Brown	None	0.29

2.2. PAINT BRAND ANALYSIS

A total of 14 brands were selected in this study. The distribution of lead concentrations by brand is shown in Table 2.3.

All six decorative paint brands contained lead concentrations below 600 ppm, ranging from < 0.20 ppm to 29.3 ppm. These brands include: 1K (black, blue, and brown); Creative Life (blue and orange); Dulux (blue and white); Propan (brown); Son Ta (brown); and Valspar (black, red, and colorless).

All two anticorrosive paint brands contained lead concentrations below 600 ppm, ranging from < 0.20 ppm to 0.85 ppm. These brands include Kim Long (grey) and Valspar (white).

Among industrial paints, AXP (yellow) contained the highest lead concentration at 92,400 ppm, while four paints from the Thai-owned Lobster paint brand contained lead concentrations ranging from 2,350 ppm to 37,900 ppm. On the other hand, at least one paint from each of the following brands contained lead concentrations below 600 ppm: AXP (black, blue, brown, and violet); C-30 (black); Indu (red); Maxilite (black, red, and yellow); and Pine (blue and red).

The brands Dulux and Maxilite are manufactured by AkzoNobel, the world's third largest paint producer. The results demonstrate Akzo Nobel's commitment to eliminate lead in paint since 2011 when they "announced that they have removed lead from all their paint product lines"[50].

Furthermore, the market availability of paints with lead concentrations below 600 ppm indicates that the technology to produce paints without

50 The 2020 Progress Report on Global Lead Removal in Paint, Page 7

added lead exists in Vietnam. This includes not only decorative and anti-corrosive paints, but also industrial paints and other paints for specialized purposes such as chalkboard paint, epoxy paint, and galvanized iron paint.

TABLE 2.3. THE DISTRIBUTION OF LEAD CONCENTRATIONS BY BRAND

No.	Brand	Type of Paint*	No. of Samples	No. of Samples Below 600 ppm	No. of Samples Above 600 ppm	No. of Samples Above 10,000 ppm	Lowest Lead Content (ppm)	Highest Lead Content (ppm)
1	1K	D	3	3	0	0	0.29	29.3
2	AXP	I	5	4	1	1	0.33	92,400
3	C-30	I	1	1	0	0	0.24	0.24
4	Creative Life	D	2	2	0	0	< 0.20	4.23
5	Dulux	D	4	4	0	0	0.49	2.02
6	Indu	I	2	1	1	1	0.20	16,100
7	Kim Long	A	1	1	0	0	0.85	0.85
8	Lobster	I	4	0	4	1	2,350	37,900
9	Maxilite	I	3	3	0	0	0.29	1.78
10	NewPab	I	1	0	1	0	6,710	6,710
11	Pine	I	2	2	0	0	< 0.20	9.86
12	Propan	D	2	2	0	0	0.26	0.60
13	Son Ta	D	1	1	0	0	18.3	18.3
14	Valspar	D	7	7	0	0	< 0.20	13.8
		A	2	2	0	0	< 0.20	0.24

**Type of Paint: D = decorative; I = industrial; A = anticorrosive.*

2.3. PAINT COLOR ANALYSIS

This study included six black paints, five blue paints, five brown paints, five white paints, four red paints, four yellow paints, three green paints, two orange paints, one grey paint, one violet paint, and four colorless paints. Yellow, orange, and green paints—all bright-colored paints—contained the highest lead concentrations.

Three out of four yellow paints (75% of yellow paints) contained lead concentrations above 10,000 ppm, while one out of two orange paints

(50% of orange paints) and all three green paints (100% of green paints) contained lead concentrations above 600 ppm. The distribution of lead concentrations by color is shown in Table 2.4.

TABLE 2.4. THE DISTRIBUTION OF LEAD CONCENTRATIONS BY COLOR

No.	Color	Type of Paint*	No. of Samples	No. of Samples Below 600 ppm	No. of Samples Above 600 ppm	No. of Samples Above 10,000 ppm	Lowest Lead Content (ppm)	Highest Lead Content (ppm)
1	Black	D	3	3	0	0	0.35	0.71
		I	3	3	0	0	0.24	1.95
2	Blue	D	3	3	0	0	1.02	29.3
		I	2	2	0	0	< 0.20	87.6
3	Brown	D	4	4	0	0	0.26	18.3
		I	1	1	0	0	0.33	0.33
4	Green	I	3	0	3	0	2,350	6,710
5	Grey	A	1	1	0	0	0.85	0.85
6	Orange	D	1	1	0	0	< 0.20	< 0.20
		I	1	0	1	0	8,170	8,170
7	Red	D	1	1	0	0	13.8	13.8
		I	3	3	0	0	0.20	9.86
8	Violet	I	1	1	0	0	3.22	3.22
9	White	D	3	3	0	0	0.49	2.02
		A	2	2	0	0	< 0.20	0.24
10	Yellow	I	4	1	3	3	0.29	92,400
11	Colorless	D	4	4	0	0	< 0.20	1.86

**Type of Paint: D = decorative; I = industrial; A = anticorrosive.*

2.4. LABELING

In general, most paint can labels did not carry meaningful information about lead content or the hazards of lead paint.

Only three out of 40 paints (8% of paints) provided information about lead on their labels and most paint can labels carried little information about any ingredients. Three Maxilite paints which bears “no added lead” mark on their labels contained lead concentrations below 2 ppm.

Most paints were merely labeled as "solvents, pigments, resins, and other additives" with no further details on the type of solvents, pigments (organic or inorganic), and other additives provided on paint can labels.

Manufacturing dates or batch numbers were included on the labels of 25 out of 40 paints (63% of paints) included in this study. Manufacturing date or batch number information written in a comprehensible manner can help consumers in avoiding purchase of older products that may still contain lead additives. Most warning symbols on the paint cans indicated flammability of the paints, but no precautionary warnings on the effects of lead dust to children and pregnant women were provided.

Among the seven paints with the highest lead concentrations, four paints contained general description of ingredients such as "solvents, pigments, resins, and other additives" but none pertaining to its lead content. Also, only two of the seven lead paints contained warning labels pertaining to flammability and irritant characteristics.

2.5 COMPARISON WITH RESULTS FROM AN EARLIER STUDY

Comparing with CGFED's 2016 paint study on 26 household decorative paints, there is a significant decrease in lead-containing paints: in 2016, 54% of decorative paints contained lead concentrations above 600 ppm, while in 2021, none of 19 decorative paints contained lead concentrations above 600 ppm. Moreover, 19% of decorative paints in 2016 contained lead concentrations greater than 10,000 ppm, as compared to none in 2021. The highest lead levels have also significantly dropped from as high as 21,000 ppm in 2016 to below 30 ppm in 2021.

No anticorrosive or industrial paints were included in the 2016 study.

TABLE 2.5. COMPARISON ON LEAD CONTENT IN SOLVENT-BASED DECORATIVE PAINTS FROM AN EARLIER STUDY

Data	2016 Study	2021 Study
Number of decorative paints	26	19
Percentage of paints with lead ≥ 600 ppm (number of paints)	54% (14)	0% (0)
Percentage of paints with lead ≥ 10,000 ppm (number of paints)	19% (5)	0% (0)
Maximum concentration, ppm	21,000	29.3

3. THE CURRENT SITUATION OF LEAD EXPOSURE AMONG PAINTERS AND PRESCHOOL CHILDREN

3.1. RISKS OF LEAD EXPOSURE IN PAINTERS AND PRESCHOOL CHILDREN

This study surveyed a total of 108 research subjects—60 painters and 48 preschool children—for presence of lead in their blood. Majority of the surveyed preschool children were aged 4-5 years old (77% of surveyed preschool children), while a majority of surveyed painters were aged 26-40 years old (70% of surveyed painters). Table 3.1 shows the characteristics of the surveyed research subjects.

TABLE 3.1. RESEARCH SUBJECTS

Subjects	N	Rate/Percentage, %
Preschool children	**48**	
Kindergarten (< 2 years old)	3	6.3
Seed class (3 years old)	8	16.7
Bud class (4 years old)	15	31.2
Leaf class (5 years old)	22	45.8
Painters	**60**	
17-25 years old	6	10.0
26-40 years old	42	70.0
Over 40 years old	12	20.0
Total	**108**	

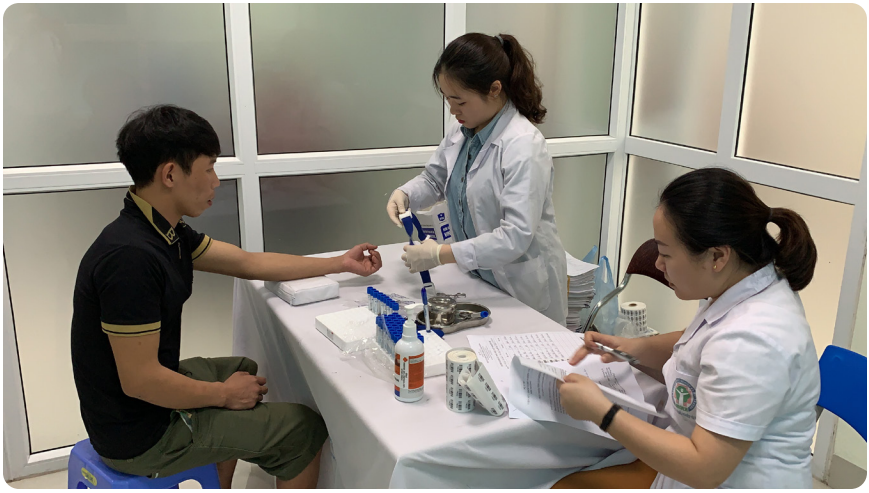

Figure 4. Extraction of a painter's blood sample for blood lead analysis.

The average blood lead level (BLL) among all 108 research subjects is 4.51 µg/dL, the lowest BLL is 1.29 µg/dL, and the highest BLL is 20.72 µg/dL. The average BLLs among 48 preschool children and 60 painters are 5.27 µg/dL and 3.90 µg/dL, respectively. The BLL difference between the two subjects is statistically significant, with a p-value of < 0.01.

TABLE 3.2. THE BLOOD LEAD LEVELS (BLLS) OF RESEARCH SUBJECTS

		Blood Lead Level (µg/dL)					Comparative Difference (p-value)
Subjects	No.	Median	Average	SD	Min	Max	
Painters	60	3.68	3.90	1.50	1.29	10.31	
Children	48	4.73	5.27	2.83	2.11	20.72	p < 0.01
Total	108	4.13	4.51	2.29	1.29	20.72	

Most of the preschool children in this study had BLLs lower than the Ministry of Health's allowable BLL standard of < 10 µg/dL, and only one child had a mid-level toxicity BLL of 20.72 µg/dL[51].

51 The level of mid lead poisoning is regulated at 10-45 µg/dL for children and from 40 - 69 µg /dL for adults (Decision No.1548/QĐ-BYT dated 10th May 2012 of the Ministry of Health about Guidelines for the diagnosis and treatment of lead poisoning).

However, if we use the 2012 standard of the United States Centers for Disease Control and Prevention (US CDC) as reference value, the average BLL in 23 out of 48 preschool children (48% of preschool children in this study) was higher than the allowable US BLL standard of 5 µg/dL. This is the warning level for lead poisoning in children that has been prescribed by the US CDC since 2012 which is currently in the process of review for further reduction.

3.1.1. Risks of lead exposure in painters

Painters are professionals or individuals who constantly touch and use paint in their daily work. Therefore, the risk of lead exposure by workers in the painting profession is quite high.

Table 3.3 shows survey results of BLLs in painters categorized according to geographical locations, age groups, and length of time at work.

TABLE 3.3. AVERAGE BLOOD LEAD CONCENTRATION IN PAINTERS

		Blood Lead Level (µg/dL)				
Subjects	**No.**	**Avg**	**SD**	**Min**	**Max**	**Comparative Difference (p-value)**
Geographical locations						
Painters in Hanoi (Northern Provinces)	30	3.89	1.91	1.29	10.31	p > 0.05
Painters in Southern Provinces	30	3.91	1.00	1.54	5.96	
Age groups						
17 - 25 years old	6	3.25	0.58	2.53	3.93	p > 0.05
26 - 40 years old	42	3.97	1.58	1.54	10.31	
Over 40 years old	12	3.97	1.61	1.29	6.09	
Length of working experience						
Below 5 years	41	3.95	1.28	1.29	7.74	p > 0.05
5-10 years	12	4.06	2.20	1.54	10.31	
Over 10 years	7	3.31	1.49	1.76	5.66	
Total	**60**	**3.90**	**1.51**	**1.29**	**10.31**	

The average BLL among painters from the North is 3.89 ± 1.91 μg/dL and the average BLL among painters from the South is 3.91 ± 1.00 μg/dL. These results show that there is no statistically significant difference ($p > 0.05$) in the BLLs of painters according to geographical locations.

The average BLL among painters aged 17-25 years is 3.25 ± 0.58 μg/dL, the average BLL among painters aged 26-40 years is 3.97 ± 1.58 μg/dL, while the average BLL among painters aged over 40 years is 3.97 ± 1.61 μg/dL. These results show that there is no statistically significant difference ($p > 0.05$) in the BLLs of painters according to age groups.

The average BLL among painters under five years of working experience is 3.95 ± 1.28 μg/dL, the average BLL among painters with 5-10 years of working experience is 4.06 ± 2.20 μg/dL, while the average BLL among painters with over 10 years of working experience is 3.31 ± 1.49 μg/dL. These results show that there is no statistically significant difference ($p > 0.05$) in the BLLs of painters according to length of working experience.

TABLE 3.4. DISTRIBUTION OF BLOOD LEAD LEVELS AMONG PAINTERS

	Blood Lead Levels (μg/dL)						Total
	Under 5		From 5-10		From 11-30		
Age Groups	n	%	n	%	n	%	
Age							
17-25 years old	6	100.0	0	0.0	0	0.0	6
26-40 years old	33	78.6	8	19.0	1	2.4	42
Over 40 years old	8	66.7	4	33.3	0	0.0	12
Length of Working Experience							
Below 5 years	32	78.0	9	22.0	0.0	0.0	41
5-10 years	10	83.4	1	8.3	1	8.3	12
Over 10 years	5	71.4	2	28.6	0	0.0	7
Total	**47**	**78.3**	**12**	**20.0**	**1**	**1.7**	**60**

Among painters aged 17-25 years old, 100% of painters had BLLs below 5 μg/dL. Among painters aged 26-40 years old, 78.6% of painters had BLLs below 5 μg/dL, 19% had BLLs ranging from 5-10 μg/dL, and only 2.4% had BLLs ranging from 11-30 μg/dL. Among painters aged over 40 years old, 66.7% of painters had BLLs below 5 μg/dL and 33.3% had BLLs ranging from 5-10 μg/dL. Among painters with working experience below five years, 78% of painters had BLLs below 5 μg/dL and 22% had

BLLs ranging from 5-10 μg/dL. Among painters with working experience between 5-10 years, 83.4% of painters had BLLs below 5 μg/dL, 8.3% had BLLs ranging from 5-10 μg/dL, and 8.3% had BLLs between 11-30 μg/dL. Among painters with working experience over 10 years, 71.4% of painters had BLLs below 5 μg/dL and 28.6% had BLLs between 5-10 μg/dL.

These results show that majority of painters across all age groups and length of working experience had BLLs below 5 μg/dL, while a few painters had BLLs ranging from 5-10 μg/dL. Only one painter aged between 26-40 years old and with 5-10 years of working experience had BLL ranging from 11-30 μg/dL.

TABLE 3.5. SOME RISK FACTORS FOR LEAD EXPOSURE AMONG PAINTERS

		Blood lead level (μg/dL)				Comparative Difference (p-value)
Risk factors	**No.**	**Average**	**SD**	**Min**	**Max**	
Working time						
Regularly	57	3.95	1.52	1.29	10.31	p > 0.05
Sometimes	3	3.21	0.93	2.55	3.86	
Dust						
Less	43	3.79	1.61	1.29	10.31	p > 0.05
Much	17	4.16	1.24	2.88	7.74	
Change clothes before going home						
Regular	25	3.79	1.34	1.29	7.74	p > 0.05
Sometimes	6	4.68	0.82	4.02	5.96	
No	29	3.85	1.74	1.54	10.31	
Total	**60**	**3.93**	**1.51**	**1.29**	**10.31**	

According to the degree of exposure to paint, painters who frequently worked had an average BLL of 3.95 μg/dL, slightly higher than the 3.21 μg/dL average BLL of painters who only occasionally worked. The difference was not statistically significant ($p > 0.05$).

Painters who were exposed to less dust while working had a lower average BLL of 3.79 ± 1.61 μg/dL as compared to painters who were exposed to a lot of dust while working with an average BLL of 4.16 ± 1.24 μg/dL. The difference was not statistically significant ($p > 0.05$).

The post-work hygiene or exposure to paint is also a factor in reducing or increasing the risk of lead exposure, depending on the frequency of painters' habit of changing clothes before going home, bathing, and washing. Painters who regularly changed clothes before going home had an average BLL of 3.79 ± 1.34 μg/dL, slightly lower than painters who only sometimes changed clothes before going home with an average BLL of 4.68 ± 0.82 μg/dL, and and almost the same average BLL of 3.85 ± 1.74 μg/dL as those painters who do not change their clothes after work. The difference is not statistically significant, with $p > 0.05$. However, if a painter regularly changes clothes and cleans after working or getting exposed to paint, results show that their BLLs will be lower.

3.1.2. Risks of lead exposure in children

As previously discussed, children are the most vulnerable to lead in paint from their contact with toys, playgrounds, floors, etc. Table 3.6 shows survey results on the BLLs in children.

TABLE 3.6. BLOOD LEAD LEVELS IN CHILDREN

Groups of Subjects	Blood lead concentration/level (μg/dL)					Comparative Difference (p-value)
	No.	Average	SD	Min	Max	
Gender						
Boys	25	5.72	3.73	2.11	20.72	p > 0.05
Girls	23	4.79	1.20	2.47	6.99	
Class						
Kindergarten class (< 2 years old)	3	5.59	0.21	5.45	5.83	p > 0.05
Seed class (3 years old)	8	6.05	2.57	2.65	9.79	
Bud class (4 years old)	15	4.05	1.24	2.11	6.77	
Leaf class (5 years old)	22	5.78	3.61	2.72	20.72	
Total	**48**	**5.27**	**2.83**	**2.11**	**20.72**	

The average BLL among boys is 5.72 μg/dL, slightly higher than the 4.79 μg/dL average BLL among girls. The difference was not statistically significant, with $p > 0.05$.

The average BLL among different children age groups range from as low as 4.05 μg/dL (4 years old) to as high as 6.05 μg/dL (3 years old), but the differences were not statistically significant ($p > 0.05$). There is only one child with an unusually higher than normal BLL at 20.72 μg/dL.

TABLE 3.7. DISTRIBUTION OF BLOOD LEAD LEVELS AMONG CHILDREN

Groups of Subjects	Blood Lead Levels (μg/dL)						Total
	Below 5		From 5-10		From 11-30		
	n	%	n	%	n	%	
Gender							
Male	12	48.0	12	48.0	1	4.0	25
Female	13	56.5	10	43.5	0	0.0	23
Class							
Kindergarten class	0	0.0	3	100.0	0	0.0	3
Seed class	2	25.0	6	75.0	0	0.0	8
Bud class	12	80.0	3	20.0	0	0.0	15
Leaf class	11	50.0	10	45.5	1	4.5	22
Total	**25**	**52.1**	**22**	**45.8**	**1**	**2.1**	**48**

The proportion of boys with BLLs ≥ 5 μg/dL is 52.0%, slightly higher than that of girls (43.5%). The proportion of children with BLLs ≥ 5 μg/dL is 47.9%, majority of which were children aged five years old.

TABLE 3.8. SOME RISK FACTORS FOR LEAD EXPOSURE IN CHILDREN

Risks factors	Blood Lead Level (μg/dL)					Comparative Difference (p-value)
	No.	Average	SD	Min	Max	
1. House wall						
No paint, no whitewash	3	4.60	1.64	2.72	5.73	
Whitewashed	11	5.66	1.93	3.46	9.79	p > 0.05
Painted	30	5.38	3.29	2.47	20.72	
Others (no answers)	4	3.91	1.53	2.11	5.82	
2. Hand wash before meal						
Sometimes	7	6.17	2.08	4.09	9.79	p > 0.05
Frequently	41	5.10	2.96	2.11	20.72	
Total	**48**	**5.27**	**2.83**	**2.11**	**20.72**	

Children living in houses with painted walls had an average BLL of 5.38 μg/dL, a little higher than the average BLL among children living in houses with non-painted walls (4.60 μg/dL) and children living in other walled homes (3.91 μg/dL). On the other hand, children living in limestone houses had the highest average BLL at 5.66 μg/dL. The differences were not statistically significant (p>0.05).

The average BLL in children with a habit of frequent hand washing (5.10 μg/dL) is slightly lower as compared to children who only occasionally washes their hands before meals (6.17 μg/dL). However, the difference was not statistically significant (p > 0.05).

In Vietnam, a traditional "orange medicine" - an herbal detox supplement believed to be able to cure many children's diseases - is among the leading causes of lead poisoning in children. The survey showed an increased BLL in children using traditional orange medicine.

TABLE 3.9. RISKS OF LEAD EXPOSURE FROM TRADITIONAL ORANGE MEDICINE

	Blood Lead Level (µg/dL)				
Use of orange medicine	**No.**	**Average**	**SD**	**Min**	**Max**
No[1]	23	4.95	2.03	2.47	9.79
Yes[2]	4	8.55	8.18	3.41	20.72
Did not remember, did not answer[3]	21	5.01	1.36	2.11	7.75
Total	**48**	**5.27**	**2.83**	**2.11**	**20.72**
Comparative differences among the groups	$p^{1,2}$= 0.048; $p^{1,3}$ =0.997; $p^{2,3}$= 0.053				

The average BLL in children using traditional orange medicine is 8.55 µg/dL, almost twice as high as that of children who did not use traditional orange medicine (4.95 µg/dL) and of children who did not remember or did not provide answers (5.01 µg/dL). These results show that the difference is statistically significant, with $p < 0.05$.

3.2. DISCUSSION

A total of 108 persons—48 children and 60 painters—participated in this study. The average BLL among all 108 study subjects was 4.51 µg/dL, the lowest was 1.29 µg/dL, and the highest was 20.72 µg/dL. The average BLL among children at 5.27 µg/dL was higher than the average BLL among painters at 3.90 µg/dL. The difference was statistically significant, with $p < 0.01$).

3.2.1. Risks of lead exposure among painters

The average BLL among Northern painters was 3.89 ± 1.91 µg/dL is slightly similar with the average BLL among Southern painters at 3.91 ± 1.00 µg/dL. Thus, there was no statistically significant difference ($p > 0.05$).

The average BLL among painters aged 17-25 years is 3.25 ± 0.58 µg/dL, slightly similar with the average BLL among painters between the age of 26-40 years (3.97 ± 1.58 µg/dL) and among painters aged over 40 years (3.97 ± 1.61 µg/dL). The BLLs tend to increase with age, but the difference was not statistically significant between age groups ($p > 0.05$).

The average BLL among painters under five years of working experience was 3.95 ± 1.28 µg/dL, slightly similar with the BLLs among painters with

working experience between 5-10 years (4.06 ± 2.20 μg/dL), and with BLLs among painters with over 10 years of working experience (3.31 ± 1.49 μg/dL). Results show that there was no statistically significant difference ($p > 0.05$).

Majority of painters across all age groups and length of working experience had BLLs below 5 μg/dL, while a few painters had BLLs ranging from 5-10 μg/dL. Only one painter aged between 26-40 years old and with 5-10 years of working experience had BLL ranging from 11-30 μg/dL.

Painters who spend more time at work had an average BLL of 3.95 μg/dL, slightly higher than the 3.21 μg/dL average BLL of painters who spend less time at work. The difference was not statistically significant ($p > 0.05$).

Painters who were exposed to less dust while working had a corresponding lower average BLL (3.79 ± 1.61 μg/dL) as compared to painters who were exposed to more dust while working (4.16 ± 1.24 μg/dL). The difference was not statistically significant ($p > 0.05$).

The post-work hygiene or exposure to paint is also a factor in reducing or increasing the risk of lead exposure, depending on the frequency of painters' habit of changing clothes before going home. Painters who regularly changed clothes before going home had an average BLL of 3.79 ± 1.34 μg/dL, slightly lower than painters who rarely changed clothes before going home (4.68 ± 0.82 μg/dL), and and almost the same as those painters who do not change their clothes after work (3.85 ± 1.74 μg/dL). The difference was not statistically significant, with $p > 0.05$. However, if a painter regularly changes clothes and cleans after working or getting exposed to paint, results show that their BLLs will be lower.

3.2.2. Risks of lead exposure in children

The average BLL among boys is 5.72 μg/dL, slightly higher than the average BLL among girls (4.79 μg/dL). The difference was not statistically significant, with $p > 0.05$.

The average BLL among different children age groups range from as low as 4.05 μg/dL (4 years old) to as high as 6.05 μg/dL (3 years old), but the differences were not statistically significant ($p > 0.05$). There is only one child with an unusually higher than normal BLL at 20.72 μg/dL.

The proportion of boys with BLLs ≥ 5 μg/dL is 52.0%, slightly higher than that of girls (43.5%). The proportion of children with BLLs ≥ 5 μg/dL is 47.9%, majority of which were children aged five years old.

In this study, most children had BLLs less than Vietnam Ministry of Health standard of 10 μg/dL. However, 47.9% of children had BLLs greater than the US CDC standard of 5 μg/dL.

Children living in houses with painted walls had an average BLL of 5.38 μg/dL, a little higher than that of children living in houses with non-painted walls (4.60 μg/dL) and children living in other walled homes (3.91 μg/dL). On the other hand, children living in limestone houses had the highest average BLL at 5.66 μg/dL. The differences were not statistically significant ($p>0.05$).

The average BLL in children with a habit of frequent hand washing (5.10 μg/dL) is slightly lower as compared to children who only occasionally washes their hands before meals (6.17 μg/dL). However, the difference was not statistically significant ($p > 0.05$).

The average BLL in children using traditional orange medicine is 8.55 μg/dL, almost twice as high as that of children who did not use traditional orange medicine (4.95 μg/dL) and of children who did not remember or did not provide answers (5.01 μg/dL). These results show that the difference is statistically significant, with $p < 0.05$.

Among children who were subjects of this study, one children had high BLL (20.72 μg/dL). The survey results show that this child may have been treated with traditional orange medicine, a traditional herbal powder believed to be able to cure many children's diseases. Among the health problems that children with high BLLs encounter are anorexia, anemia, growth retardation and poor learning - typical symptoms of childhood lead poisoning.

4. CONCLUSIONS AND RECOMMENDATIONS

4.1. ABOUT LEAD CONTENT IN PAINT

This study demonstrates that solvent-based decorative paints with high concentrations of lead have significantly decreased in Vietnam since 2016. The enactment of the National Technical Regulations in December 2020, which set a 600 ppm limit on lead in paint, and the continuous efforts by key stakeholders from the government, industry, and civil society to push for compliance will, hopefully, encourage more paint manufacturers to continue reformulation efforts and shift to non-lead ingredients. The fact that 100% of decorative and anticorrosive paints, and 61% of industrial paints contained lead concentrations below 600 ppm—with 33 out of 40 total paints containing lead concentrations below 90 ppm—indicates that the technology to produce paints without added lead exists in Vietnam. On the other hand, the fact that seven out of 18 industrial paints (39% of industrial paints) had lead content exceeding 600 ppm—with three of these paints containing extremely high lead concentations above 10,000 ppm—points to the need to ensure compliance of all paint manufacturers to the 600 ppm regulatory limit. The study results provide a good barometer of the overall capacity of the domestic paint industry to comply with the National Technical Regulations. The study results further provide a strong justification to constantly monitor the lead content of paints sold in the market to ensure full compliance to the country's lead paint regulatory limits.

4.2. ABOUT BLOOD LEAD EXPOSURE

At the same time, this study corroborates the results of blood lead testing among 60 painters in Vietnam wherein their average blood lead levels (BLLs) fall within the Vietnamese standard (10 µg/dL) and the US CDC reference value (5 µg/dL)—meaning most of the paints they use at work do not contain added lead.

The average blood lead levels (BLLs) among painters is 3.9±1.51 µg/dL. There is no clear association found between BLLs and occupational factors such as age, number of years spent working as a painter, presence of

workplace dust, and proper hygiene and use of personal protective equipment.

The average BLLs among prechool children is 5.27 ± 2.83 μg/dL. Nearly half (47.9%) of preschool children had BLLs higher than the US CDC reference value (5 μg/dL). A child whose BLL is at 20.72 μg/dL may have been treated with orange medicine, a traditional herbal powder believed to be able to cure many children's diseases, and is a common source of childhood lead exposure in Vietnam.

4.3. RECOMMENDATIONS

For goverment agencies and organizations, such as the Chemical Department - Ministry of Industry and Trade:

- Issue specific directions and guidance documents attached to the Circular, explaining which types of paints are covered by the 2020 National Technical Regulations on lead content in paints.
- Require paint manufacturers to display sufficient information on the lead content on paint can labels and provide clear warnings about the risks of lead exposure to children when painted surfaces are damaged and disturbed.
- Implement end-to-end management policy throughout the supply chain, which includes the suppliers of raw materials, the manufacturing enterprises, the units responsible for processing, and the end user, to minimize harmful impacts on the environment.
- Strengthen paint quality control to ensure that lead content in paint is compliant with the regulatory limit.
- Conduct communications activities to raise public awareness, especially among children, students, and workers, about the health effects of lead and preventive measures to minimize, if not avoid, exposure to lead in paint. Strengthen awareness raising materials to help consumers make informed decisions in purchasing safer paint products.

For the paint industry:

- Prove lead-free products through supervision, management and certification by an independent third party. This organization must be reputable and help consumers trust the paint they use is completely lead-free.

- Specify on the product packaging important information related to the product, the lead content and other heavy metals including information on paint composition, lead content, and health hazard warnings towards people's health and the environment.
- For the Vietnam Paint and Printing Ink Association (VPIA):
    - Support and promote the process of compliance on the Vietnam National Technical Regulation on Lead Content in Paint among its members, especially domestic paint manufacturing companies and enterprises in Vietnam.
    - Promote a commitment to eliminating lead in paint and promote lead-free paint certification programs so businesses can participate, demonstrating their products are completely lead-free and safe for human health.

For consumers from individuals, households and other institutions:

- As Vietnamese people gradually increase their personal income, the awareness and preference for paints with lead-safe certifications, green labels, and other ecological labels also increases. Therefore, individual or institutional consumers must demand for paints that do not contain lead or paints that provide clear information about its ingredients and warnings on its proper use, handling, storage, and disposal to minimize adverse effects on human health and the environment. When purchasing paint products, consumers should carefully read product labels, and find out information about the ingredients and origin of the product. Only use lead-safe paints when decorating homes, schools, health centers, parks, or children's playgrounds.

Organizations and expert groups

- International organizations, public health organizations, consumer organizations, and other relevant agencies should jointly assist and take action to remove lead-containing paints; develop practical action plans to protect children from lead exposure through lead paint, lead in dust and soil, and other sources of lead such as toys and school supplies.

ANNEX 1
LIST OF ANALYZED PAINTS

Sample No.	Brand Name	Name of Manufacturer	Type of Paint*	Country of Brand HQ**	Country of Manufacture	Color	Lead Content Label	Lead Content (ppm)
P1	Dulux	Akzo Nobel Vietnam Paint Company Limited	D	Neitherlands	Vietnam	White	None	0.49
P2	Dulux	Akzo Nobel Vietnam Paint Company Limited	D	Neitherlands	Vietnam	White	None	2.02
P3	Dulux	Akzo Nobel Vietnam Paint Company Limited	D	Neitherlands	Vietnam	White	None	1.49
P4	Dulux	Akzo Nobel Vietnam Paint Company Limited	D	Neitherlands	Vietnam	Blue	None	1.02
P7	AXP	Xuan An Company Limited	I	Vietnam	Vietnam	Brown	None	0.33
P8	AXP	Xuan An Company Limited	I	Vietnam	Vietnam	Blue	None	87.6
P9	AXP	Xuan An Company Limited	I	Vietnam	Vietnam	Yellow	None	92,400
P10	AXP	Xuan An Company Limited	I	Vietnam	Vietnam	Violet	None	3.22
P11	AXP	Xuan An Company Limited	I	Vietnam	Vietnam	Black	None	1.95
P12	Lobster	U.R URAI Paint Company (Vietnam)	I	Thailand	Vietnam	Green	None	2,350
P13	Lobster	U.R URAI Paint Company (Vietnam)	I	Thailand	Vietnam	Green	None	4,480
P14	Lobster	U.R URAI Paint Company (Vietnam)	I	Thailand	Vietnam	Yellow	None	37,900
P15	Lobster	U.R URAI Paint Company (Vietnam)	I	Thailand	Vietnam	Orange	None	8,170
P16	Maxilite	Akzo Nobel Vietnam Paint Company Limited	I	Neitherlands	Vietnam	Black	Yes. "No added lead"	1.78
P17	Maxilite	Akzo Nobel Vietnam Paint Company Limited	I	Neitherlands	Vietnam	Red	Yes. "No added lead"	0.71
P18	Maxilite	Akzo Nobel Vietnam Paint Company Limited	I	Neitherlands	Vietnam	Yellow	Yes. "No added lead"	0.29
P19	Son Ta	Hoang Long Company Limited	D	Vietnam	Vietnam	Brown	None	18.3

Sample No.	Brand Name	Name of Manufacturer	Type of Paint*	Country of Brand HQ**	Country of Manufacture	Color	Lead Content Label	Lead Content (ppm)
P22	Valspar	Sherwin-Williams Company Limited (Vietnam)	D	US	Vietnam	Color-less	None	0.48
P23	Valspar	Sherwin-Williams Company Limited (Vietnam)	D	US	Vietnam	Red	None	13.8
P24	Valspar	Sherwin-Williams Company Limited (Vietnam)	D	US	Vietnam	Color-less	None	< 0.20
P25	Valspar	Sherwin-Williams Company Limited (Vietnam)	A	US	Vietnam	White	None	< 0.20
P26	Valspar	Sherwin-Williams Company Limited (Vietnam)	D	US	Vietnam	Black	None	0.71
P27	Valspar	Sherwin-Williams Company Limited (Vietnam)	A	US	Vietnam	White	None	0.24
P28	Valspar	Sherwin-Williams Company Limited (Vietnam)	D	US	Vietnam	Color-less	None	1.86
P29	Valspar	Sherwin-Williams Company Limited (Vietnam)	D	US	Vietnam	Black	None	0.56
P30	Valspar	Sherwin-Williams Company Limited (Vietnam)	D	US	Vietnam	Color-less	None	< 0.20
P31	Indu	Sao Viet Nam Joint Stock Company	I	Vietnam	Vietnam	Red	None	0.20
P32	Indu	Sao Viet Nam Joint Stock Company	I	Vietnam	Vietnam	Yellow	None	16,100
P33	Pine	Thanh Tung General Paint Company Limited	I	Vietnam	Vietnam	Red	None	9.86
P34	Pine	Thanh Tung General Paint Company Limited	I	Vietnam	Vietnam	Blue	None	< 0.20
P35	Creative Life	TCK Production Joint Stock Company	D	Vietnam	Vietnam	Blue	None	4.23
P36	Creative Life	TCK Production Joint Stock Company	D	Vietnam	Vietnam	Orange	None	< 0.20
P37	1K	Yes Paint Vietnam Company Limited	D	Vietnam	Vietnam	Brown	None	0.29
P38	1K	Yes Paint Vietnam Company Limited	D	Vietnam	Vietnam	Blue	None	29.3
P39	1K	Yes Paint Vietnam Company Limited	D	Vietnam	Vietnam	Black	None	0.35

Sample No.	Brand Name	Name of Manufacturer	Type of Paint*	Country of Brand HQ**	Country of Manufacture	Color	Lead Content Label	Lead Content (ppm)
P45	Propan	ALKANA Vietnam Company Limited	D	Vietnam	Vietnam	Brown	None	0.60
P46	Propan	ALKANA Vietnam Company Limited	D	Vietnam	Vietnam	Brown	None	0.26
P47	NewPab	NewPab Company Limited	I	Vietnam	Vietnam	Green	None	6,710
P49	C-30	Cau Vong Production and Trading Company	I	Vietnam	Vietnam	Black	None	0.24
P50	Kim Long	Son Ha Paint Production, Trading and Service Co., Ltd	A	Vietnam	Vietnam	Grey	None	0.85

**Type of Paint: D=decorative; I=industrial; A=anticorrosive*
***HQ=headquarters*

ANNEX 2

TEST REPORT ON 48 PRESCHOOL CHILDREN AT TAN HIEP PRESCHOOL, TAN HIEP COMMUNE, LONG THANH DISTRICT, DONG NAI PROVINCE

No.	Code	Class	Result (µg/dL)
1	52340	Leaf layer 5	6.99
2	52339	Leaf layer 5	2.88
3	52338	Seed class 2	9.66
4	52334	Seed class 2	3.46
5	52337	Seed class 2	2.65
6	52336	Seed class 2	9.79
7	52333	Kindergarten class	5.49
8	52332	Kindergarten class	5.83
9	52331	Kindergarten class	5.45
10	52330	Buds class 2	3.06
11	52329	Buds class 2	3.66
12	52328	Buds class 2	3.56
13	52327	Buds class 2	4.13
14	52335	Seed class 2	6.02
15	52328	Buds class 2	3.41
16	52325	Seed class 1	5.65
17	52324	Seed class 1	5.26
18	52323	Seed class 1	5.90
19	52322	Leaf layer 4	4.31
20	52321	Leaf layer 4	4.81
21	52320	Leaf layer 4	5.69
22	52319	Leaf layer 4	5.36
23	52318	Buds class 1	5.82
24	52317	Buds class 1	2.11
25	52316	Buds class 1	3.62

No.	Code	Class	Result (µg/dL)
26	52315	Buds class 1	3.41
27	52314	Buds class 1	4.61
28	52313	Leaf layer 2	2.72
29	52312	Leaf layer 2	7.75
30	52311	Leaf layer 2	4.14
31	52310	Leaf layer 2	4.03
32	52309	Leaf layer 2	4.09
33	52308	Leaf layer 2	6.03
34	52307	Leaf layer 1	20.72
35	52306	Leaf layer 1	6.58
36	52305	Leaf layer 1	5.75
37	52304	Leaf layer 1	4.55
38	52303	Leaf layer 1	3.50
39	52302	Buds class 3	6.77
40	52301	Buds class 3	2.47
41	52300	Buds class 3	4.15
42	52298	Buds class 3	5.34
43	52299	Buds class 3	4.65
44	52297	Leaf layer 3	4.23
45	52296	Leaf layer 3	3.76
46	52295	Leaf layer 3	6.42
47	52294	Leaf layer 3	5.73
48	52293	Leaf layer 3	7.15

ANNEX 3

TEST REPORT ON 60 PAINTERS IN HANOI AND BINH DUONG

No.	Code	Gender	Age	Years of Exposure at Work	Result (µg/dL)	Date	Place
1	74018	Male	30	8	2.74	28/5/2020	Hanoi
2	74019	Male	27	5	2.76	28/5/2020	Hanoi
3	74020	Male	29	3	2.56	28/5/2020	Hanoi
4	74021	Male	36	11	2.91	28/5/2020	Hanoi
5	74022	Male	56	4	4.70	28/5/2020	Hanoi
6	74023	Male	48	11	2.55	28/5/2020	Hanoi
7	74024	Female	32	4	< 2.50	28/5/2020	Hanoi
8	74025	Male	29	2	7.74	28/5/2020	Hanoi
9	74026	Female	46	2	< 2.50	28/5/2020	Hanoi
10	74027	Male	27	1	3.54	28/5/2020	Hanoi
11	74028	Male	26	4	3.34	28/5/2020	Hanoi
12	74029	Male	27	1	5.82	28/5/2020	Hanoi
13	74030	Male	17	1	3.86	28/5/2020	Hanoi
14	74031	Male	51	15	5.66	28/5/2020	Hanoi
15	74032	Male	52	5	5.58	28/5/2020	Hanoi
16	74033	Male	18	1	2.83	28/5/2020	Hanoi
17	74034	Male	31	5	4.53	28/5/2020	Hanoi
18	74035	Male	35	15	3.06	28/5/2020	Hanoi
19	74036	Male	40	5	2.53	28/5/2020	Hanoi
20	74037	Male	56	5	6.09	28/5/2020	Hanoi
21	74038	Male	30	4	4.75	28/5/2020	Hanoi
22	74039	Male	38	10	4.08	28/5/2020	Hanoi
23	74040	Male	21	2	2.93	28/5/2020	Hanoi
24	74041	Male	38	7	10.31	28/5/2020	Hanoi
25	74042	Male	34	7	3.69	28/5/2020	Hanoi

No.	Code	Gender	Age	Years of Exposure at Work	Result (µg/dL)	Date	Place
26	74043	Male	58	10	2.81	28/5/2020	Hanoi
27	74044	Male	33	10	3.04	28/5/2020	Hanoi
28	74045	Male	32	15	< 2.50	28/5/2020	Hanoi
29	74046	Female	36	12	< 2.50	28/5/2020	Hanoi
30	74047	Male	39	19	5.10	28/5/2020	Hanoi
31	0664	Male	42	6	5.60	17/7/2020	Binh Duong
32	0665	Male	37	6	3.63	17/7/2020	Binh Duong
33	0666	Male	47	6	4.25	17/7/2020	Binh Duong
34	0667	Male	37	6	< 2.50	17/7/2020	Binh Duong
35	0668	Male	27	6	3.58	17/7/2020	Binh Duong
36	0669	Male	24	6	3.42	17/7/2020	Binh Duong
37	0670	Male	24	5	3.93	17/7/2020	Binh Duong
38	0671	Male	35	5	4.90	17/7/2020	Binh Duong
39	0672	Male	24	5	2.53	17/7/2020	Binh Duong
40	0673	Male	29	5	3.07	17/7/2020	Binh Duong
41	0674	Male	27	5	2.89	17/7/2020	Binh Duong
42	0675	Male	46	5	< 2.50	17/7/2020	Binh Duong
43	0676	Male	29	5	5.05	17/7/2020	Binh Duong
44	0678	Male	31	5	3.07	17/7/2020	Binh Duong
45	0679	Male	45	5	4.17	17/7/2020	Binh Duong
46	0680	Male	38	5	4.02	17/7/2020	Binh Duong
47	0681	Male	37	5	5.03	17/7/2020	Binh Duong
48	0682	Male	37	5	3.78	17/7/2020	Binh Duong
49	0683	Male	34	5	5.96	17/7/2020	Binh Duong
50	0684	Male	28	5	4.12	17/7/2020	Binh Duong
51	0685	Male	35	5	4.14	17/7/2020	Binh Duong
52	0686	Male	36	4	2.88	17/7/2020	Binh Duong
53	0687	Male	36	4	5.02	17/7/2020	Binh Duong
54	0688	Male	31	4	4.33	17/7/2020	Binh Duong
55	0689	Male	37	4	4.42	17/7/2020	Binh Duong

No.	Code	Gender	Age	Years of Exposure at Work	Result (μg/dL)	Date	Place
56	0690	Male	39	4	3.66	17/7/2020	Binh Duong
57	0693	Male	36	4	3.58	17/7/2020	Binh Duong
58	0696	Male	37	4	3.77	17/7/2020	Binh Duong
59	0697	Male	36	4	3.25	17/7/2020	Binh Duong
60	0698	Male	30	4	5.21	17/7/2020	Binh Duong

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