NOT SUITABLE FOR CHILDREN

Toxic Chemicals in Plastic Toys Sold in Bangladesh and the Philippines

BAN TOXICS

ESDO

DISCLAIMER

Concept and Editorial Guidance
Dr. Shahriar Hossain
Secretary General, ESDO
shahriar25@gmail.com

Siddika Sultana
Executive Director, ESDO
siddika@esdo.org

Jashaf Shamir Lorenzo
Deputy Executive Director, BAN Toxics
jlorenzo@bantoxics.org

Authors
Jashaf Shamir Lorenzo, BAN Toxics
Myra Vieta Mabilin, BAN Toxics
Winona Keane Garcia, BAN Toxics
Siddika Sultana, ESDO
Shanon Iffat Alam, ESDO

Field Researchers
Thony Dizon, BAN Toxics
Julius Velicaria, BAN Toxics
Shanon Iffat Alam, ESDO
Sadmeen Sadaf Jahan, ESDO
Noshin Naila, ESDO
Sara Anwar Tethy, ESDO
Foijun Nahar, ESDO
Khalijur Rahman, ESDO
Shenjuti Rahman, ESDO

Cover Design and Layout
RJ Mabilin, BAN Toxics

Publishers:

Name of Organization **BAN Toxics**
Country **Philippines**
Website **www.bantoxics.org**
Contact Information
Reynaldo San Juan
Executive Director
reysan1@bantoxics.org

Jashaf Shamir Lorenzo
Deputy Executive Director
jlorenzo@bantoxics.org

Name of Organization **Environment and Social Development Organization**
Country **Bangladesh**
Website **www.esdo.org**
Contact Information
Dr. Shahriar Hossain
Secretary General
shahriar25@gmail.com

Siddika Sultana
Executive Director
siddika@esdo.org

RECOMMENDED CITATION:

Lorenzo, J., Mabilin, M., Garcia, W., Hossain, S., Sultana, S., Alam, S.I. (2024). **Not suitable for children: Toxic Chemicals in Plastic Toys Sold in Bangladesh and the Philippines.** Published by BAN Toxics and Environment and Social Development Organization.

I. PREFACE

A. Executive Summary

Children are highly vulnerable from environmental hazards. Within the human climate, notable chemicals of concern permeate across extensive product value chains, to which unfortunately does not exclude the toys that kids love. Childhood exposure to such environmental toxicants pose adverse health impacts that may lead to detrimental and lasting outcomes. As those within the younger demographic have little to none control of their environments and exhibit different behaviors than their adult counterparts, children only have limited agency to protect themselves from the hazards that can put them in grave danger. While policies have been set in place by global and national authorities, it remains that there exists a greater room for the improvement and harmonization of regulatory safeguards for children's toys across the globe.

Through the partnership of BAN Toxics and Environment and Social Development Organization, the study sought to explore the existing legal frameworks and current status of plastic toy commodities within their own communities. Results reveal that a significant number of the sampled toys do not adhere to various safety standards at the national and/or global levels of highly hazardous heavy metals, potentially subjecting children who interact with such toys at high risk. The alarming levels of toxicity in children's toys found in Bangladesh and the Philippines shed light on the issues in the regulation of consumer toy products despite the comprehensive policies currently in place. Thus, the establishment of stricter policies focused on the regulation of the chemicals used in plastic toys must be the course of action; firmly underscoring the need to review and strengthen current measures and regulations, and to further probe into the present mechanisms within the transboundary movement of toys.

B. Table of Contents

C. List of Acronyms and Abbreviations

AO	Administrative Order
As	Arsenic
ASTM	American Society for Testing and Materials
Ba	Barium
BBP	Benzyl butyl phthalate
BD	Bangladesh
Br	Bromine
BSTI	Bangladesh Standards and Testing Institution
CAGR	Compound Annual Growth Rate
CCO	Chemical Control Order
Cd	Cadmium
Cl	Chlorine
CN	China
Cr	Chromium
DAO	Department Administrative Order
DBP	Dibutyl phthalate
DEHP	Di(2- ethylhexyl) phthalate
DIDP	Di-isodecyl phthalate
DINP	Di-isononyl phthalate
DNA	Deoxyribonucleic acid
DNOP	Di-n-octylphthalate
DOH	Department of Health
DTI	Department of Trade and Industry
ESDO	Environment and Social Development Organization
FDA	Food and Drug Administration
HBCD	Hexabromocyclododecane
Hg	Mercury
IRR	Implementing Rules and Regulations
ISO	International Organization for Standardization
Pb	Lead
PBBD/F	Polybrominated dibenzo-p-dioxin and furan
PBDE	Polybrominated diphenyl ether
PH	Philippines
PNS	Philippine National Standard
POP-BFR	Persistent Organic Pollutant-Brominated Flame Retardant
ppm	Parts per million
PVC	Polyvinyl chloride
RA	Republic Act
Sb	Antimony
Se	Selenium
TCCA	Toys and Childcare Article
TTBPA	Tetrabromobisphenol A
XRF	X-ray fluorescence

II. ORGANIZATIONAL INFORMATION

This study is published jointly by BAN Toxics and the Environment and Social Development Organization (ESDO).

BAN Toxics

BAN Toxics is a Philippine-based independent non-government environmental organization that works for the advancement of environmental justice, health, and sustainable development in the area of chemicals and wastes with a special focus on women, children, and other marginalized sectors.

The organization works closely with government agencies, communities, and civil society at the local, national, and international levels to reduce and eliminate the use of toxic chemicals and support global sustainable development goals through education campaigns, community grassroots interventions, training and capacity-building, policy research and development, and advocacy programs.

Over its decades-long existence, the organization has worked on pressing chemicals issues such as e-waste, plastics, toxic chemical pollution, and waste trade. As a toxics watchdog, BAN Toxics has been instrumental in raising public awareness on the harmful chemicals found in plastic toys and other children's products.

Environment and Social Development Organization

ESDO is a non-profit and non-government action research organization in Bangladesh. It works to disseminate messages about the need for environmental conservation, committed to protecting biological diversity and ensuring ecological balance.

Since its formation in 1990, ESDO has focused on generating knowledge amongst the broader community about how anthropogenic activities negatively impact the environment. ESDO strives to improve the livelihoods, socio-economic status, and environmental education of some of the most vulnerable communities in Bangladesh, and the organization invests in people who care for the environment by providing essential inputs and capacity building. As a pioneer organization in banning Plastic Bags in Bangladesh, ESDO contributes to ensuring self-reliant urban and rural communities who live in harmony with their healthy environment.

ESDO has been instrumental in raising public awareness on toxic chemicals in children's products such as plastic toys. In its latest report, the organization highlighted the hidden risks associated with toxic chemicals found in toys such as lead, arsenic, cadmium, and mercury.[i]

Signing of Memorandum of Agreement between BAN Toxics and ESDO on October 3, 2024, at ESDO's head office in Dhaka, Bangladesh.

III. BACKGROUND OF THE STUDY

"Toys" are defined as tools used in the performance of actions involving fun and learning, otherwise known as the act of "playing."[ii] Toys, in general, play important roles in everyday life regardless of age – children play and use toys to learn and practice skills needed for their development and growth while adults play to enrich social bonds, exercise, and develop skills associated with their toys of choice.[iii]

The earliest toys were developed during prehistoric times, with objects formed in the shape of humans and animals being found in deposits from ancient Sumer dating back to at least 2600 BC.[iv] The earliest known written mention of toys is linked to ancient Greece, with a reference to the yo-yo made in historical artifacts. However, the yo-yo is believed to originate from China at a much earlier date.

Ancient civilizations such as the Egyptian, Greek, and Roman civilizations played similar games to the ones played today.[v] Children during these times were known to play with dolls, toy soldiers, wooden animals, and balls, with the materials used in such toys being dependent on the available resources at the time. As an example, children in ancient Greece played ball games with inflated pig bladders, while children in ancient Rome played with wooden or clay dolls.

The emergence of the modern toy can be traced back to the industrial revolution, where mass production led to wider accessibility and affordability of toy products.[vi] This coincided with the introduction of modern toy inventions such as jigsaw puzzles, clockwork trains, mass-produced bicycles and roller skates, and playing cards (among others). The era also saw the use of more modern materials for toy production such as when **plasticine** was introduced in 1897.[vii]

A. Overview of the Toy Industry

In the past decade, global toy sales have steadily increased, with a **compound annual growth rate** (CAGR) of +3% since 2018.[viii] During the height of the COVID-19 pandemic, the industry experienced exceptional growth, posting an increase of more than USD 10 billion from 2020 to 2020. Table 1[ix] summarizes the global toy market size from 2018.

Table 1. Global Toy Market Size

	2018	2019	2020	2021	2022	2023	2023 vs 2022 %change	CAGR (2018 to 2023)
Total (Billion USD)	$92.7	$92.9	$98.5	$108.9	$110.8	$108.7	-2%	+3%

Source: Circana, 2024.

China is considered the largest manufacturer of toy products, with the country producing as much as 75% of the global toy supply[x]. This is reflected in the Figure 1 below, which summarizes the top exporters of toys, games, and sport requisites.[xi]

Figure 1. Export Value in USD

Finally, Table 2 below outlines the top 10 toy importing countries in the world with the United States garnering a market share of more than 30%, followed by Germany, Japan, the United Kingdom, and France, respectively.[xii]

Table 2. Top 10 Global Importers of Toys, Games, and Sports

Country	Market Share
United States of America	30.7%
Germany	6.38%
United Kingdom	4.66%
Japan	4.59%
France	3.64%
Canada	3.49%
Netherlands	3.18%
Mexico	2.38%
Spain	2.3%
Poland	1.95%

Source: The Observatory of Economic Complexity. 2022.

Japan remains the only Asian country listed as a top importer of toys. A closer look at data within the region shows that Japan accounts for 22.3% of all toy imports in the Asia Pacific region, shown in Table 3. **Philippines** and **Bangladesh**, respectively, are not listed in the top 10 but account for **3.62% (USD 1.23B)** and **0.34% (USD 115M)** of toy imports in the region.[xiii]

Table 3. Top 10 Importers of Toys, Games, and Sports (Asia Pacific Region)

Country	Market Share
Japan	22.3%
South Korea	8.76%
China	7.49%
Hong Kong	6.42%
Malaysia	5.38%
Vietnam	5.09%
Saudi Arabia	5.01%
United Arab Emirates	4.76%
Singapore	4.24%
Thailand	3.74%

Source: The Observatory of Economic Complexity. 2022.

B. Toys and Child Development

With the global toy market continuously expanding, it is important to highlight its role in child development. As discussed in previous sections, **toys contribute significantly to the acquisition of valuable social skills** – Dag, N. et. al., in their 2021 study titled "Children's only profession: playing with toys"[xiv] note that toys and games contribute to the development of cognitive, motor, psychosocial, emotional, and linguistic skills of children. Furthermore, **playing with toys contribute to raising critical attributes such as self-confidence, creativity, and happiness.**

As an example, learning to grasp and manipulate toys effectively allows children to practice and refine their motor skills to improve hand-eye coordination. Toys also contribute to cognitive development in various ways. Playing with toys help stimulate concentration levels and enhance attention span and memory, while also providing children with opportunities to use their creativity and imagination especially when forming narratives while playing.[xv]

Several studies have noted that the educational benefit of toys is a key consideration for parents looking to purchase toys for their children. In a 2017 study[xvi] titled "Investigating the factors influencing parent toy purchase decisions: reasoning and consequences," the results indicated that the majority of parents who purchased toys considered the many benefits children can gain from them such as entertainment, educational, and physical development. An example cited in the study is that parents may choose toys to build creativity and foster education, such as when buying toys designed to mimic engineering tools.

Another study conducted by Richards, M., et. al. in 2021 also echo the same results, suggesting that the educational qualities of a toy is a top priority for parents. This is reflective of the value placed by parents in unstructured play as venues for a child's social and intellectual development.[xvii]

"Learning to grasp and manipulate toys effectively allows children to practice and refine their motor skills to improve hand-eye coordination. Toys also contribute to cognitive development in various ways."

Table 4. Common toxic additives in plastic products

Additive	Associated Health Risk
Antimony	■ Endocrine-disrupting (estrogen) ■ breast cancer
Aluminum	■ Endocrine-disrupting (estrogen) ■ breast cancer
Bromine	■ Apoptosis ■ genotoxicity
Cadmium	■ Changes in the metabolism of calcium, phosphorus and bone ■ Osteomalacia and bone fractures in postmenopausal women ■ Lipid peroxidation and in the promotion of carcinogenesis ■ Cellular apoptosis ■ DNA methylation
Mercury	■ Mutagen or carcinogen ■ Induction of the disruption of DNA molecular structure and brain damage
Arsenic	■ Congenital disabilities ■ Lung, skin, liver, bladder, and kidney cancer ■ Gastrointestinal damage ■ Death
Lead	■ Anemia ■ Hypertension ■ Miscarriages ■ Disruption of nervous systems and brain damage ■ Infertility, oxidative stress, and cell damage
Barium	■ Endocrine-disrupting (estrogen) ■ Cardiovascular and kidney diseases ■ Metabolic, neurological, and mental disorders

C. Toys and Associated Hazards

The **important role of toys and games in the development and growth of children highlight the need to ensure that these products are safe.** Providing spaces where children can play comfortably and safely are essential in reducing toy-related accidents.[xviii] Ensuring that toys themselves are safe is also of utmost importance due to children's unique vulnerabilities.

Children should not be considered "small adults," and **the developmental changes they experience throughout their growth makes them more vulnerable to environmental factors when compared to adults.**[xix] The way children act around and interact with the physical environment – distinctly different from the ways adults do – makes them more susceptible to toxic hazards such as when placing toys in their mouths, noses, or even ear canals.[xx] Aside from the risks of choking or injury, this also opens exposure pathways such as inhalation and accidental digestion.[xxi]

Given these conditions, unsafe toys can lead to the exposure of children to various toxic chemicals. A wide-scale study covering 15 countries showed that children were contaminated with **endocrine disrupting chemicals** such as phthalates, having average concentrations of at least twice more than their mothers.[xxii] Another study conducted by Behnisch, et. al.[xxiii] showed that more than 60% of the toys purchased in 26 countries across Africa, Asia, Europe, and America contained unsafe levels of polyhalogenated dioxins including endocrine-disrupting chemicals such as Polybrominated dibenzo-p-dioxins and furans (PBBD/Fs) and Tetrabromobisphenol A (TTBPA).

These findings are supported by a recent report published by the PlastChem project, which reveals that over 16,000 chemicals are used in the manufacture of plastic products.[xxiv] Furthermore, the study notes that at least 4,200 or 26% of these chemicals are of concern, posing significant risks to human health and the environment. Table 4 provides a list of some commonly used toxic chemical additives in plastic products and the associated health risks.[xxv]

D. Legislative Framework

In the last few decades, global emphasis on the quality and safety of toys increased due to the mass production of toys, growing public concern over toy-related injuries and fatalities, and increasing research on the potential harms of chemicals in toys and the impacts of technology on toy safety. Led by the United States in the 1970s, countries began to implement regulations and standards to protect children from the dangers posed by unsafe toys.

Current toy safety standards and regulations differ by region or country. The three referenced standards are **International Organization for Standardization (ISO) 8124, European Standard EN 71, and American Society for Testing and Materials (ASTM) F963.** ASTM F963 is the U.S. Toy Safety Standard, introduced in 1983 and made mandatory nationwide in 2008.[xxvi] EN 71 is the European Union's Toy Safety Directive 2009/48/EC,[xxvii] which outlines the safety criteria of toy products, guidelines on conformity assessment, testing, and the CE marking. ISO 8124[xxviii] is largely adopted from the latter two standards. It was developed by the ISO to establish a comprehensive set of testing methods and uniform standards for toy products, aiming to minimize potential hazards associated with toys. ISO 8124's goal is to harmonize global key standards, and it has been adopted by about 20 nations, including the Philippines.

Chemicals in toys in ISO 8124 is covered under Parts 3, 5, and 6. Part 3: Migration of certain elements, which specifies maximum acceptable levels of the elements Antimony (Sb), Arsenic (As), Barium (Ba), Cadmium (Cd), Chromium (Cr), Lead (Pb), Mercury (Hg) and Selenium (Se) from toy materials and from parts of toys. **Clause 1 of ISO 8124 Part 3** provides more information on materials and products where the standards are applicable:[xxix]

1. Toy Materials

- Coatings of paints, varnishes, lacquers, printing inks, polymers and similar coatings,
- Polymeric and similar material, including laminates, whether textile reinforced or not, but excluding other textiles and non-woven textiles
- Paper and paperboard,
- Natural, artificial, or synthetic textiles,
- Glass/ceramic/metallic materials, excepting lead solder when used for electrical connections,
- Other materials, whether mass-colored or not (e.g. wood, fiberboard, hardboard, bone, and leather),
- Materials intended to leave a trace (e.g., the graphite materials in pencils and liquid ink in pens,
- Pliable modelling materials, including modelling clays and gels,
- Paints to be used as such in the toy, including finger paints, varnishes, lacquers, glazing powders, and similar material in solid or liquid form,

2. Toys and toy components of toys and toy materials

- All intended food and oral contact toys, cosmetic toys, and writing instruments categorized as toys, irrespective of any age grading or recommended age labelling,
- All toys intended for or suitable for children under 72 months of age
- Accessible coatings, irrespective of any age grading or recommended age labelling,
- Accessible liquids, pastes, and gels (e.g., liquid paints, modelling compounds), irrespective of any age grading or recommended age labelling.

Furthermore, Clause 4 of the same document outlines the maximum acceptable element migration from toy materials, shown in Table 5.

Table 5. Maximum acceptable element migration from toy materials (ISO 8124), in mg/kg of toy material

Toy Material	Element							
	Sb	As	Ba	Cd	Cr	Pb	Hg	Se
Any toy material given in Clause 1, except modelling clay and finger paint	60	25	1000	75	60	90	60	500
Modelling clay	60	25	250	50	25	90	25	500
Finger paint	10	10	350	15	25	25	10	50

Part 5: Determination of total concentration of certain elements of toys is related to Part 3 as it defines a method for determining the total concentration of the elements specified in Part 3. Part 6 covers phthalate esters in toys and products.

As ISO 8124 is voluntary, these standards do not replace national laws, and meeting them does not automatically guarantee compliance in every country[xxx]. **Each country develops its own national safety regulations to define market compliance.**

PHILIPPINES AND BANGLADESH: OVERVIEW OF REGULATIONS

The overarching national policy that governs consumer products in the Philippines is Republic Act (RA) No. 7394, known as the Consumer Act of the Philippines, which states that toys must not contain hazardous materials. The country has promulgated its toy safety standards that adopt ISO 8124 as the Philippine National Standard (PNS) on Safety of Toys. The PNS covers safety aspects including related to mechanical and physical properties, flammability, migration of certain elements in toys, determination of total concentrations of certain elements in toys, certain phthalate esters in toys, and age determination guidelines.

The Department of Trade and Industry's (DTI) PNS provides guidance to manufacturers, traders, regulators, and users on toy safety, aiming to "minimize potential hazards associated with toys resulting from their normal use (intended play mode) as well as reasonably foreseeable abuse (unintended play mode).[xxxi]

Building on the Consumer Act and the PNS for Toys, the Department of Health (DOH) enacted relevant regulations governing health products, particularly toys for children. It issued Administrative Order (AO) No. 2007-0032, entitled, "Regulations on the Issuance of a License to Operate to Companies that Manufacture, Import, or Distribute Toys for the Philippine Market," which was amended and supplemented by AO 2009-0005, laying out the procedures and health and safety requirements for toys marketed in the Philippines.[xxxii] An addendum to AO 2009-0005 was implemented in 2011, to include the prohibition on the sale of certain products containing phthalates.[xxxiii]

Based on the existing regulatory framework for toys in the Philippines, PNS ISO 8124-3:2008: Safety of Toys[xxxiv] mandates that toys shall be tested for the following requirements: Part 1 – Safety aspects related to mechanical and physical properties, Part 2 – Flammability; and Part 3 – Migration of certain elements. These standards must be satisfied before any toy product can have market authorization.

Owing to complex regulations and requirements seen as "barriers to trade and innovative technology," the Food and Drug Administration (FDA) of the DOH further streamlined the regulations to allow a simplified regulatory procedure through the electronic notification scheme for toys and childcare articles (TCCAs).[xxxv] This market-oriented approach has shifted the responsibility for ensuring compliance with the standards to the establishments engaged in the sale

of TCCAs, placing the burden of ensuring that toys are toxic-free on the due diligence of the establishments.

The primary regulatory control of the FDA is to monitor compliance through post marketing surveillance (PMS) activities on establishments and products, replacing the earlier procedure of checking that sample toys comply with the PNS and DOH rules and regulations before issuing the Certificate of Conformity or the Clearance for Conditional Release, which is required before distributing toys to the market.

In 2019, the Implementing Rules and Regulations (IRR) of RA 10620, known as the "Toy and Game Safety Labeling Act of 2013," introduced special labeling requirements for toys and games found in the PNS for toys.[xxxvi] While the policy draws particular attention on labeling requirements, non-conformity has been widely documented by advocacy groups.[xxxvii] [xxxviii]

In terms of related chemicals legislation, Republic Act No. 6969, known as the "Toxic Substances and Hazardous and Nuclear Wastes Control Act," and its corresponding Rules and Regulations through Department Administrative Order (DAO) No. 1992-29, serve as the primary legislation of the Philippines that regulates and restricts the use, storage, transportation, processing, manufacture, import, or export of chemical substances.[xxxix] Pursuant to the provisions of this law, the environmental department issues Chemical Control Orders (CCOs) for priority chemicals that pose an unreasonable risk to public health and the environment, and are determined to be regulated, phase-out, or banned. These regulations are considered the most stringent of the chemical management systems in the country. Among the eight specified elements under the ISO 8124, the Philippines has issued CCOs for arsenic, lead, mercury, cadmium, and chromium (VI).

The CCO for Lead and Lead Compounds (DAO 2012-24)[xl] has been in effect since December 2013, prohibiting the production and manufacturing of these substances, including in toys and children's products. It sets a maximum limit of 90 ppm for lead in all paints and provides a phase-out period for lead-based paints. The Revised CCO for Mercury and Mercury Compounds includes the phase-out of a range of mercury-added products but does not mention mercury-containing toys and children's products. Meanwhile, the CCO for Cadmium and Cadmium Compounds states that any cadmium in products and materials not considered as chemical substance or mixture, such as toys, are not covered by the scope of RA 6969 but may be addressed by other regulatory agencies,[xli] in this case, the DTI under the provisions of the PNS for Toys Safety. Notably, the draft CCO for benzene[xlii] currently under development will prohibit the use of the chemical in toys and other children's products. Another draft CCO for vinyl chloride,[xliii] used primarily in the manufacture of polyvinyl chloride (PVC), is also under development as of 2022.

Regulatory agencies are currently reviewing the existing regulatory framework for toys and articles and have presented the draft Order to stakeholders in January 2024. **This review identified several gaps, including the need to update labeling requirements to align with the IRR of RA 10620, address inconsistencies in certification requirements for exempted toys, and revise standards to enhance the safety of toys and childcare articles[xliv].**

In Bangladesh, there are no specific policies related to toy safety.[xlv] [xlvi] [xlvii] Toy manufacturing factories are regulated by the Department of Environment only for pollution control, specifically issuing clearance based on air quality and chemical removal in water but they do not monitor the chemicals used in toy production.[xlviii]

The Bangladesh Standards and Testing Institution (BSTI) is currently developing the country's standards for the safety of toys that are identical to ISO 8124, specifically Parts 3, 5, and 6, which all relate to chemicals in toys and children's products.[xlix] As discussed in the previous section, Part 3 sets the maximum acceptable element migration from toy materials for elements such as Sb, As, Ba, Cd, Cr, Pb, Hg, and Se. Part 5 covers the determination of total concentration of certain elements in toys, and Part 6 pertains to certain phthalate esters in toys and children's products.

Table 6 provides a summary of relevant global standards in comparison with existing regulatory frameworks in the Philippines and Bangladesh.

Table 6. Comparison of Toy Safety Standards and Requirements

CATEGORY	INTERNATIONAL STANDARDS			Philippines	Bangladesh
	ISO 8124 (ISO)	EN 71 (EU)	ASTM F963 (U.S.)		
Scope	Voluntary	Mandatory in EU	Mandatory in US	Mandatory	N/A
Mechanical and physical properties	✓	✓	✓	✓	X
Material requirements and test method	✓	✓	✓	✓	X
Electrical safety	✓	✓	✓	✓	X
Flammability	✓	✓	✓	✓	X
Chemical requirements	✓	✓	✓	✓	Pending
Warning labeling guidelines and manufacturer's markings	✓ largely generalized	✓	✓	✓ RA 10620	Pending
Age-grading guidelines	✓	✓	✓	✓	X
Conformity assessments	establishes a standard method for conformity assessments	third-party verification	third-party verification	third-party verification	X
Migratory limits for Sb, As, Ba, Cd, Cr, Pb, Hg, Se	✓	✓	✓	✓	X
Content restriction for certain phthalates	✓	✓	✓	✓ Restrictions on contents of DEHP, DBP, BBP, DINP, DIDP, DnOP	X
Additional chemicals legislation related to toys				✓ Chemical Control Orders for As, Hg, Pb, Cd, Cr; CCOs for benzene and vinyl chloride under development	Pending
Development of regulatory mechanisms	regularly updated in multiple parts in recent years	European Commission proposal for a regulation	revised standard on January 2024	Proposal for a revision of RA 10620 (with draft)	BSTI proposal for toy standards (with draft)

Despite current policies, it is important to note that Bangladesh is currently in the process of developing their own regulatory framework for toys. Pending the approval of the BSTI standards, the Philippines and Bangladesh will have identical standards based on ISO 8124.

IV. OBJECTIVES OF THE STUDY

Given the potential adverse impacts to human health and the environment, this study was conceptualized jointly by BAN Toxics Philippines and ESDO Bangladesh to provide a **qualitative assessment of hazardous chemicals found in plastic toys sold** in public markets. Specific objectives of the study include:

- Collect toy samples in major public markets in Metro Manila, Philippines, and Dhaka, Bangladesh with a specific focus on products targeted at low-income communities,
- Conduct an assessment of potential health and environmental risks of collected toy samples based on the presence of toxic chemicals,
- Formulate policy recommendations to improve government capacities to regulate hazardous toys.

V. METHODOLOGY

This section discusses the data-collection methodology employed in the conduct of the study.

Collection of Toy Samples in Dhaka, Bangladesh

A. Collection of Samples

Various types of light and cheap plastic children's toys were collected from markets located in Bangladesh and the Philippines. The samples for the study were purchased from selected toy stores that are easily accessible to the public: the megacity Dhaka for Bangladesh, and the cities Pasay, Manila, and Quezon City for the Philippines.

Qualitative methods were employed in the purchase of toy samples due to limited data on their trade and distribution within local community levels. Primary criteria for the selection of toy samples include **a) perceived popularity of toys,**[1] and **b) the toy's affordability to the public.**[2] A total of 257 toy samples were collected in total from Bangladesh and Philippines, with 150 and 107 samples acquired from the sites accordingly.

B. X-ray fluorescence (XRF) Testing

The samples were tested in the respective ESDO and BAN Toxics offices based in Bangladesh and the Philippines. The toys were tested through the use of an Olympus Vanta C Series HH XRF Analyzer to screen for the presence of heavy metals such as Arsenic, Cadmium, Lead, and Mercury, and other elements such as Bromine and Chlorine. These were selected due to the high concentrations in the tested products, and the known health and environmental impacts associated with them. Mercury, Lead, Arsenic, and Cadmium are listed in the World Health Organizations' 10 chemicals of public health concern.[I]

---

1 Criteria considered include the number of toys per type/category sold in the visited market, gender targeted for specific toy products, visual assessments of toy products (with a specific focus on toys primarily manufactured with plastic), and the researchers' familiarity with toys commonly used in the study areas.

2 A target price range was identified based on average prices of toys in the visited markets. A range of P50 to P150 (around USD 1 to USD 2.5) was used in the Philippines, and TK200 to TK400 (around USD 1.5 to USD 3.5) for Bangladesh.

XRF testing in Bangladesh (left) and the Philippines (right)

The use of XRF technology is an increasingly popular method of providing initial analysis regarding the chemical content of products. It is often used to provide accurate, nondestructive elemental analysis in various industries ranging from metals, chemicals, mining, and food.[li] Results from portable XRF readings are often validated against wet chemistry techniques, but can still provide highly accurate results without conducting laboratory analysis. This approach was utilized in Anjos, et. al.'s[lii] study where soil samples contaminated with urban garbage were analyzed in Brazil. Using XRF, the presence of various chemicals such as lead, copper, and barium were detected. A similar process was employed in Kodom et. al.'s[liii] study in Kumasi, Ghana, where soils near industrial and residential areas were found to have elevated levels of Nickel, Cadmium, Mercury, Zinc, and Arsenic, among others. A review of guidelines for the use of XRF technology published by manufacturer Olympus[liv] also assert that the tool is effective for detecting harmful chemicals in products and other applications.

C. Data Processing and Analysis

Data was consolidated through a digital spreadsheet software and was interpreted and analyzed on the same platform. Information pertaining to available production and distribution details of the toys were encoded into a centralized database for further reference. Each toy sample was classified and categorized based on location it was obtained, available information labels, manufacturing details and XRF results.

VI. DISCUSSION OF TESTING RESULTS

This section discusses the results of the XRF analysis conducted in the study areas and provides information on the potential health and environmental risks of the chemicals found in the samples. Table 7 provides more information on the toys sampled for the study.

Table 7. Manufacturing Information - Sampled Toys

Country	Number of Toys Sampled	Country of Manufacture/Labelling Information	Total Number/Pct.
Philippines	107	Philippines	13 (12.15%)
		China	67 (62.62%)
		No Label	27 (25.23%)
Bangladesh	150	Bangladesh	53 (35.33%)
		China	97 (64.67%)
		No Label	0 (0%)

Toxic Chemicals in Children's Toys

The study explores the concentration of toxic chemicals found in children's toys, specifically in heavy metals such as Arsenic, Cadmium, Lead, and Mercury, and other elements, Bromine and Chlorine. A total of 257 toys were collected from Bangladesh (150) and the Philippines (107) as the samples for analysis

Table 8 summarizes the percentage of toy samples found to contain the aforementioned chemicals.

Table 8. Number of children's toy samples and corresponding percentages containing elements of concern

Site	Element	Toy Samples Identified	Percentage From Total Toy Samples (n)
Bangladesh n = 150	As	49	32.7%
	Br	54	36.0%
	Cd	37	24.7%
	Cl	46	30.7%
	Hg	33	22.0%
	Pb	34	22.7%
Philippines n = 107	As	25	23.4%
	Br	61	57.0%
	Cd	32	29.9%
	Cl	74	69.2%
	Hg	19	17.8%
	Pb	44	41.1%
Aggregated n = 257	As	74	28.8%
	Br	115	44.7%
	Cd	69	26.8%
	Cl	120	46.7%
	Hg	52	20.2%
	Pb	78	30.4%

Bromine and Chlorine

While no prefaces are needed to underscore the presence of chlorine in plastics, it remains that PVC has been attributed to the high production of dioxins, a highly toxic substance. Dioxins occur during production or burning of chlorine-based chemicals,[lv] and these unintentionally produced compounds can impact human health negatively and are known to cause reproductive, endocrinal, and developmental problems.

Consequently, this further correlates to the emergence of other unintentionally toxic substances such as brominated dioxins and furans (PBDD/Fs). Bromine is manifested in brominated flame retardants (BFRs) in the likes of polybrominated diphenyl ethers (PBDEs) and hexabromocyclododecane (HBCDs).[lvi] As these highly hazardous characteristics affect human health and natural ecosystems, these persistent organic pollutants (POP-BFRs) have emerged in new products such as children's toys despite regulatory initiatives on a global scale. Issues concerning these chemicals are highlighted through life cycle assessment tools that evaluate the extensive plastic value chain.

The presence of POP-BFRs in plastic products may also shed light on the links of the toy market and plastics recycling industries. Especially in products that do not require fire retardance, the presence of POP-BFRs may indicate that toxic flame retardant chemicals were not intentionally-added but were passed on during the recycling of e-waste plastics into new products. This was highlighted by the International Pollutants Elimination Network (IPEN) in a study published in 2022,[lvii] where the network stated that such recycling practices contribute to a toxic loop. Additionally, the recycling of plastics may lead to the shedding of microplastics and the potential contamination of soil, air, and water resources even in controlled environments such as plastic recycling facilities.[lviii]

Toxic Heavy Metals

With regards to Arsenic, Cadmium, Lead, and Mercury as the selected elements of concern for the study, the aforementioned have been regularly associated with the manifestation of metal toxicity in the human body. As heavy metals are retained in the system following absorption, these metals are retained in the body, potentially leading to acute or chronic issues.[lix] The bioaccumulation of these metals results in a myriad of detrimental aftermaths that can be assisted by the many routes of exposure that a child may encounter when playing with toys.

The recorded values of elements detected in children's plastic toys produced varied results. It has been observed that toxic heavy metals were revealed to be at high levels over the safety standards recognized in the countries where the samples were collected from. As reflected in Table 9, the following are the ranges of the levels listed from the highest recorded to the least: Arsenic (5 ppm to 247 ppm); Cadmium (20 ppm to over 100,000 ppm); Lead (11 ppm to 4600 ppm); and Mercury (16 ppm to 4600 ppm). In addition, elements closely linked to hazardous chemicals such as Bromine and Chlorine were observed in most of the toy samples.

Table 9. Range of total toy samples and distribution of toy samples non-compliant to ISO standards

Site	Element	Minimum Range (ppm)	Maximum Range (ppm)	Non-Compliant Toy Samples	Non-Compliance Rate of Foreign Origin (China)
Bangladesh	As	5	247	12	83.3%
	Cd	20	>10%	15	46.7%
	Hg	18	270	23	78.3%
	Pb	11	1370	15	53.3%
Philippines	As	14	121	18	50.0%
	Cd	30	350	23	65.2%
	Hg	53	2700	18	77.8%
	Pb	16	4600	37	56.8%

ARSENIC [As]

Naturally occurring within the earth's crust, arsenic is commonly distributed in the environment — present throughout land, water and air. Due to its widespread existence in nature and prominence in industrial processes, its reach of exposure to humans has been expansive through various pathways, commonly administered through ingestion or inhalation[lx]. Notoriously toxic, arsenic has been observed to manifest endocrine-disrupting problems; its toxicity mechanisms exhibiting the replacement of phosphate molecules in adenosine triphosphate (arsenolysis) and also effectual inhibiting factors on key enzymes, to which accounts thiamine pyrophosphate[lxi]. Furthermore, studies have shown that neurodevelopment in children aged between 5 to 15 years of age are impacted negatively by means of arsenic exposure[lxii].

Toy sample with highest concentration of arsenic: Children's Cup with Pacifier	
Country of Origin:	China
Country of Purchase:	Bangladesh
As (ppm):	247

Results

As reflected in Table 9, a number of toys detected with Arsenic have been observed to surpass the accepted limits set for the element. Bangladesh (pending adoption of the BSTI standards) and the Philippines adhere to ISO standards (8124-3:2010), wherein the maximum acceptable element migration for arsenic has been limited at 25 milligrams per kilogram of toy material. Within the 257 toy samples, 74 were identified to have a notable presence of Arsenic, with 30 of the toys surpassing the recognized ISO standards. The toy with the highest value at 121 ppm was obtained in Bangladesh, originating from the Republic of China.

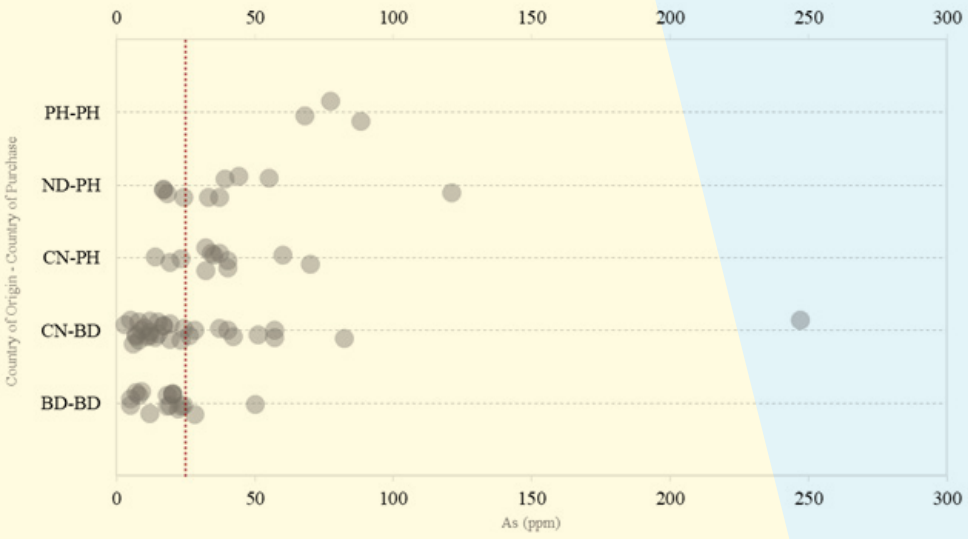

Figure 2. Arsenic levels in children's toy samples distributed by country of origin

CADMIUM [Cd]

Distributed through means of natural and human-induced activities, cadmium is usually ingested or inhaled as its mechanism of exposure. To children, it has been identified that this expands to other exposure methods such as biting, mouthing or sucking jewelry with traces of cadmium, potentially through means of hand-to-mouth contact[lxiii]. A notable anthropogenic exposure pathway is through industrial processes, to which cadmium is purposed for nickel-cadmium batteries, and even implemented in coating, plating, and pigments. It is also used as a plastic stabilizer and for other components such as non-ferrous alloys, photovoltaic devices and semiconductors[lxiv]. Consequently, it has been determined that the disposal and recycling of electronic waste (e-waste) is a critical key source of cadmium vulnerability towards children[lxv]. Further bioaccumulation and exposure to this chemical can detrimentally impact organs such as the bones, kidneys, lungs and the nervous system[lxvi].

Toy sample with highest concentration of cadmium: Golden Jewelry (Locket)	
Country of Origin:	Bangladesh
Country of Purchase:	Bangladesh
Cd (ppm):	>10% (over 100,000)

Results

The levels of Cadmium obtained from the children's toy samples present overwhelming results. Out of the toys tested, 69 were discovered to have traces of cadmium, to which 38 have been determined to exceed the given ISO standard at 75 milligrams per kilogram of toy material to be considered acceptable for safety measures. One prominent sample purchased in Bangladesh had a recorded value of over 10% (100,000 ppm).

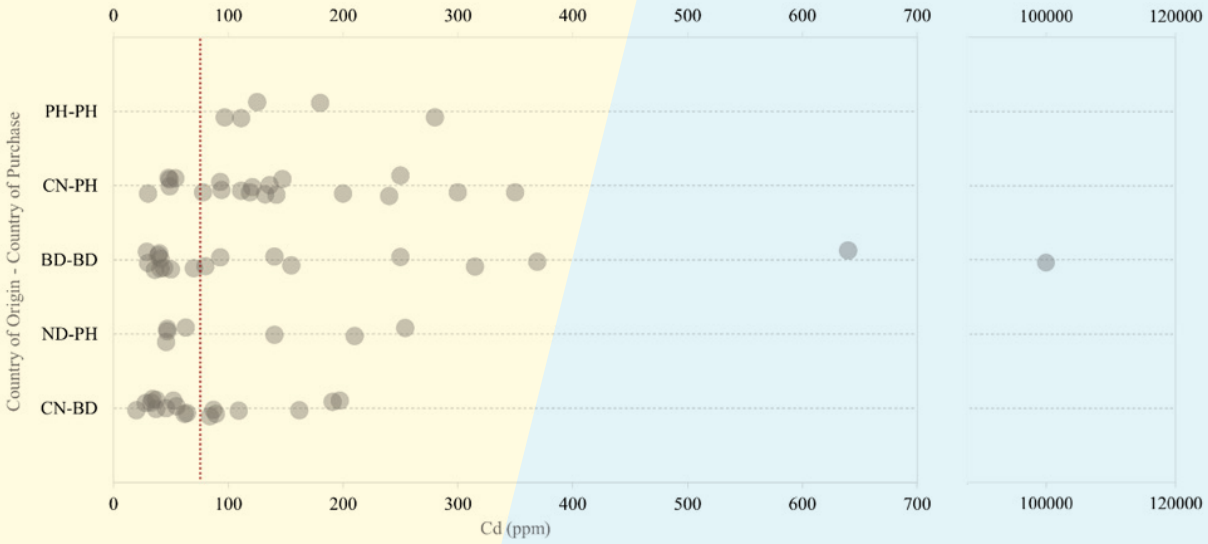

Figure 3. Cadmium levels in children's toy samples distributed by country of origin

LEAD [Pb]

Lead toxicity has been well-documented throughout the years, with its harmful effects on both the environment and public health widely recognized. Exposure to this highly toxic substance can occur through various sources, including contaminated water, food containers, spice ingredients, cosmetics, Ayurvedic medicines, toys, and other commercial-based products[lxvii]. Childhood exposure can result in adverse consequences, such as detrimental issues to the brain and the central nervous system at high levels of exposure. At lower contact thresholds, lead still ushers to various implications across bodily systems. Moreover, childhood survivors of lead poisoning can still be left with impacted intellectual capabilities and behavioral disorders[lxviii].

Toy sample with highest concentration of lead: Avengers Cellphone	
Country of Origin:	China
Country of Purchase:	Philippines
Pb (ppm):	4,600

Results

The ISO standard established for toy materials concerning the heavy metal lead have been established at 90 milligrams per kilogram, however data shown in Figure 4 depicted that a significant amount of samples has not complied in consideration for the safety and health measures set for the maximum amount permissible. Table 8 shows that 78 out of 257 toy samples were detected with the presence of lead, and that 52 of the sample group surpassed the established maximum limit. A toy from the Philippines that had originated from China leads the sample population with a recorded value of 4,600 ppm.

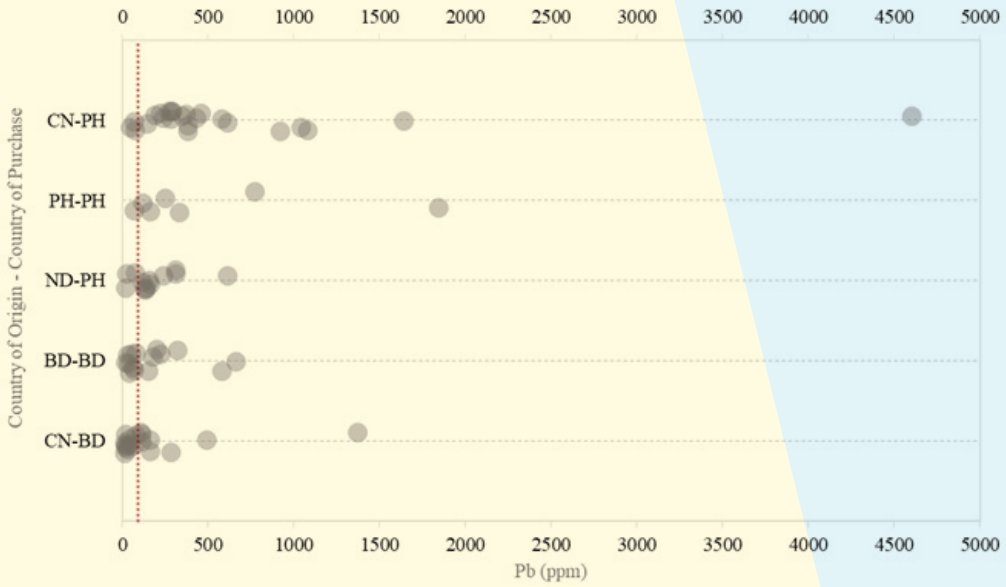

Figure 4. Lead levels in children's toy samples distributed by country of origin

MERCURY [Hg]

As youth are particularly vulnerable to environmental dangers, their heightened susceptibility to mercury poses a serious threat to their health. To children, encounters with the toxic chemical can occur through their diet, medicinal agents, occupational exposure and consumer products[lxix]. Pervasive and highly dangerous, mercury manifests in different forms (elemental, organic or inorganic), with various exposure pathways that can lead to acute or chronic health issues determined by dosage levels[lxx]. Childhood exposure routes for mercury can occur through ingestion, inhalation, and transdermal and transplacental absorption[lxxi] that can disrupt anatomical, functional, metabolic and physiological bodily processes that impact areas within the digestive, immune, respiratory, urinary and the central nervous system[lxxii].

Toy sample with highest concentration of mercury: Xylophone	
Country of Origin:	China
Country of Purchase:	Philippines
Hg (ppm):	2,700

Results

High concentrations of Mercury have been found in the samples, with an observable trend of toys collected from the Philippines leaning towards higher levels in comparison to the items collected from Bangladesh (Figure 5). It must be noted as presented in Table 8 that Mercury in toys have been detected in lesser quantities, in contrast to other elements discussed tested for concentration values present in toys. Table 9 presents the differences between the elements, in which 52 out of 257 samples have been detected with notable presence of Mercury, to which 41 toys exceeded the maximum acceptable value established by the ISO standards. The toy sample with the highest value originated in the Republic of China and was acquired in the Philippines, to which has been recorded at 2700 ppm.

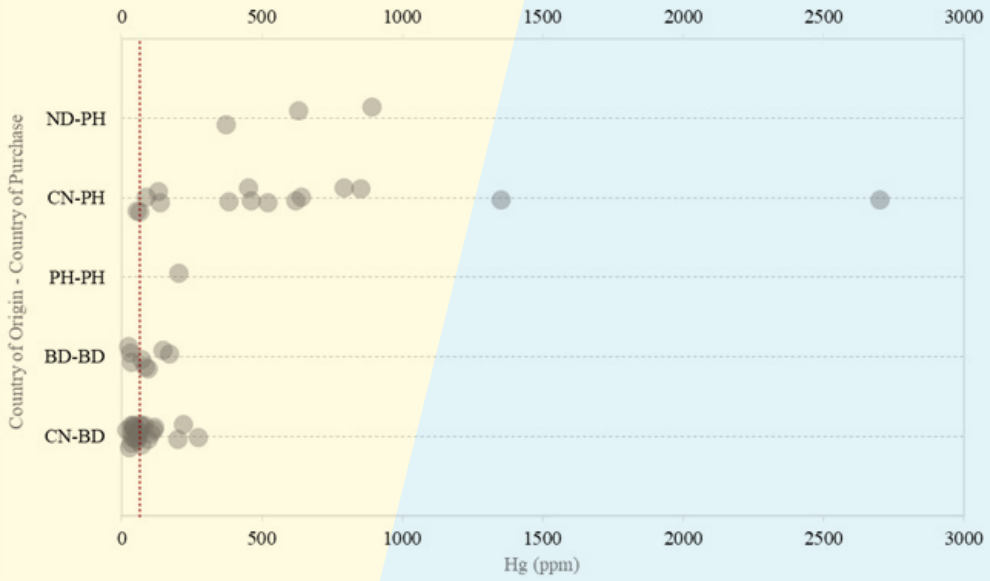

Figure 5. Mercury levels in children's toy samples distributed by country of origin

VII. CONCLUSIONS AND RECOMMENDATIONS

The following section discusses the key findings and recommendations from the project team. In summary, a significant portion of the sampled toys do not adhere to various safety standards at the national and/or global levels, potentially placing children who play with them at risk.

The high levels of toxic chemicals in toys found in both the Philippines and Bangladesh point towards the difficulty in regulating these products even when comprehensive policies are in place. The research team recommends the establishment of stricter policies focusing on regulating the chemicals used in toys.

A. Potential Health Impacts

The study reveals that children in Bangladesh and the Philippines are highly susceptible to toxic health hazards due to the concerning levels of chemicals observed in children's toys, to which a significant portion of the items do not adhere to the safety standards recognized by regulatory bodies of both countries. Furthermore, toys readily accessible and affordable in public stores and markets have toxic heavy metals present such as Arsenic, Cadmium, Lead and Mercury, with traces of potentially hazardous chemicals such as Bromine and Chlorine.

As discussed throughout the paper, the chemicals found in the sampled toys are linked with various health and environmental impacts[lxxiii]. Arsenic is known to cause cancer (lung, bladder, skin), diabetes and hypertension, and other neurodevelopmental impacts. Cadmium is also known to cause lung cancer, obstructive pulmonary disease, neurodevelopmental impacts, and diminished bone mineral density. Lead is also linked with occupational cancers, intellectual disability and neurological issues, high blood pressure and heart disease, kidney disease, and reduced fertility. Finally, Mercury is known to cause neurocognitive and behavioral disturbances, renal tubular necrosis, and peripheral neurotoxicity, and can also impact the central nervous system and lead to cardiovascular issues.

The findings also provide insights on how the toy market can disproportionately impact communities. Most of the toys tested for the study target low-income communities (with prices ranging from USD 1 to USD 3.5). As cheap toys are more likely to bypass industry standards,[lxxiv] children from poorer communities – already burdened with the lack of capacity to access social and health services – may be more exposed to toxic chemicals.

B. Regulatory Issues

A significant percentage of the toys tested failed chemical safety standards, and several also failed to adhere to common regulatory requirements listed in Table 6 (Chapter 3). The toys tested either did not include proper ingredient labelling, or included labels that failed to mention the presence of hazardous chemicals like Lead, Arsenic, Mercury, and Cadmium. Warning labels as well as information on age grading were also often absent from the toys tested. Finally, some toys did not have any information regarding the country of origin or manufacture.

In the Philippines, 27 out of the 107 toys sampled did not include any labelling information. In contrast, all of the toys tested in Bangladesh included labelling information (Table 7).

Still, the data is consistent with the literature reviewed, with the majority of toys tested being manufactured and/or imported from China (164 out of a total of 257 samples, or 63.81%, as shown in Table 7, Chapter 6).

C. The Transboundary Nature of Hazardous Toy Trade

With most of the toys purchased in both countries coming from China, children from the Philippines and Bangladesh are likely sold the same toy products. Photos below of the market monitoring and testing activities for the study, highlight the similarity of toys available in both countries such as rubber ducks, action figures, dolls, and toy vehicles.

Purchasing of toy samples in Dhaka (far left & center left) and Metro Manila (center right & far right)

Among the toys tested, the Shrilling Chicken squeaky toy *(pictured on the side)*, available in both the Bangladesh and Philippines markets, has been flagged by the EU Rapid Alert System for Dangerous Non-Food Products, published on February 15, 2024.[lxxv] The alert indicates that the product originates from China and its plastic material contains an excessive concentration of DEHP, with a measured value of up to 23.62% by weight. Withdrawal of the product from the market has been ordered by the European Commission. The Philippines also issued an advisory in October 2024 against the sale and purchase of the same product as it does not have a valid Certificate of Product Notification.[lxxvi]

It is recommended that an in-depth study on the similarities in kind and origin of toys be conducted. This can shed light on the transboundary nature of the hazardous toy trade, and may provide insights on potential policy recommendations to control the trade of toys at a sub-regional or regional level.

D. Policy Recommendations

Given the results of the study, the direction toward the national standardization of requirements and toy safety policies following international standards should align with the establishment of stricter safety requirements addressing toxicity as well as enhancing enforcement and compliance to ensure the protection of children from chemical-related risks of toys.

Review existing national regulations and enact new ones to adopt recent additions in the international standards.

Regulatory frameworks must broaden to include chemical restriction on known, presumed or suspected products to have carcinogenic, mutagenic, or reprotoxic effects in toys. Regulatory bodies should also consider additional groups of chemicals beyond the commonly cited eight migratable elements and six ortho-phthalates (DEHP, DBP, BBP, DINP, DIDP, DnOP), specifying requirements for these substances and chemicals.

Policy makers can refer to good scientific practices and international toolkits, such as the International Chemicals Management Toolkit for the Toy Supply Chain developed by the United Nations Environment Programme (UNEP).[lxxvii] This toolkit focuses on chemicals of concern in toy materials, particularly plastics.

Transparency and traceability requirements must be established with an emphasis on the use of harmonized labelling requirements that clearly indicate the chemicals and materials used in the manufacture of toys. This can contribute towards improving the capacity of countries to monitor and limit the kinds of toys entering their territories. A key recommendation of the study is the conduct of in-depth investigations on the transboundary nature of the hazardous toy trade, which may call for the formulation of policies that address the trade of toys beyond the national levels. A stricter enforcement of transparency and traceability requirements can greatly enhance the capacities of countries to coordinate and work together in regulating these products.

In the Philippines, stricter enforcement of legal requirements — especially for imported toys —calls for a review and strengthening of regulatory bodies. Additional requirements and measures must be imposed on manufacturers, importers, and distributors to limit the entry of hazardous toys and to take immediate steps to mitigate risks once products are on the market. Regulatory bodies must have the capacity to closely monitor trade, identify hazards, and remove toys from the market when known risks are identified. Moreover, the current draft Order revising Rules and Regulations Governing the Issuance of Authorization for Toys and Childcare Articles presents an opportunity for the country to comprehensively update its policies and regulations.

In Bangladesh, the same factors mentioned above must be considered as the country embarks on the formulation of toy safety policy.

VIII. ANNEXES

Annex 1

Chemicals of Concern Detected in Children's Plastic Toy Samples Purchased in the Philippines

Sample #	Area	Item Type	Country Origin	Pb	Hg	Cd	As	Br	Cl
PH-BI-002	Pasay	Gun	China			147		450	>10%
PH-BI-003	Pasay	Mini Cooking Set	China				32	270	>10%
PH-BI-004	Pasay	Billiard	China	220				420	>10%
PH-BI-005	Pasay	Bubble Toy	Philippines			97		133	>10%
PH-BI-006	Pasay	Guitar	Philippines	330				290	>10%
PH-BI-007	Pasay	Sword	Philippines	1840				230	>10%
PH-BI-008	Pasay	Hulla hoop	310					23	>10%
PH-BI-009	Pasay	Gun and Grenade	China				23	280	>10%
PH-BI-010	Pasay	Robot	Philippines	250				180	>10%
PH-BI-011	Pasay	Crab Shape	131				39		>10%
PH-BI-014	Pasay	Mini Cars	China	350				610	>10%
PH-BI-015	Pasay	Toys	China	380	620				>10%
PH-BI-017	Pasay	Tambourine	China			48			>10%
PH-BI-019	Pasay	Backhoe Truck	Philippines			125		90	>10%
PH-BI-020	Pasay	Squeaky Toy	137						>10%
PH-BI-021	Pasay	Squeaky		16		46		16	>8.3%
PH-BI-023	Pasay	Doll	China					190	>10%
PH-BI-024	Pasay	Doll	China		460	132	40		>10%
PH-BI-025	Pasay	Bubble Toy	China	1080				370	>10%
PH-BI-026	Pasay	Dump Truck	Philippines	770	202			1110	>10%
PH-BI-028	Pasay	Bubble Toy	China		85				>10%
PH-BI-029	Pasay	Bubble Toy	China					1020	>10%
PH-BI-030	Pasay	Lazer Pointer	China	1640				166	>10%
PH-BI-031	Pasay	Lazer Pointer	China		850				>10%
PH-BI-032	Pasay	Lazer Pointer	China		450				>10%
PH-BI-033	Pasay	Lazer Pointer	China						>10%
PH-BI-034	Pasay	Lazer Pointer	China					128	>10%
PH-BI-006	Manila	Sword	China	380		350		190	>10%
PH-BI-007	Manila	Nails	China						>10%
PH-BI-008	Manila	Xylophone	China		2700	136		240	>10%
PH-BI-009	Manila	Crown	China			240			>10%
PH-BI-010	Manila	Toys (Dinosaur)	China	370	380				>10%
PH-BI-011	Manila	Toys (Batman)	China	920				870	>10%
PH-BI-013	Manila	Rubik's Cube	China			93	35	660	>10%
PH-BI-014	Manila	Toys (Ironman Red)	China	580		142		600	>10%
PH-BI-016	Manila	Toy (Batman)	240		370	47			>10%
PH-BI-017	Manila	Toys	China	460		119		36	>10%
PH-BI-020	Manila	Sword	China	270				15	>10%
PH-BI-022	Manila	Water Game	China	44					>10%

Sample #	Area	Item Type	Country Origin	Pb	Hg	Cd	As	Br	Cl
PH-BI-023	Manila	Toy	China	70		78		260	>10%
PH-BI-024	Manila	Trucks	Philippines						>10%
PH-BI-025	Manila	Cooking Set	China	190					>10%
PH-BI-027	Manila	Make-up Set	China					380	>10%
PH-BI-029	Manila	Rope	China					63	>10%
PH-BI-030	Manila	Snake	Philippines				77		>10%
PH-BI-034	Manila	Car and Pin Ball	China			121		16	>10%
PH-BI-036	Manila	Spring Toy	China	240		111			>10%
PH-BI-037	Manila	Gun	Philippines			111	68	92	>10%
PH-BI-041	Manila	Guitar				140			>10%
PH-BI-002	Quezon	Squeaky Toy	China					240	>10%
PH-BI-003	Quezon	Squeaky Toy					121		>10%
PH-BI-004	Quezon	Squeaky Toy	119					45	>10%
PH-BI-005	Quezon	Squeaky Toy	China					154	>10%
PH-BI-006	Quezon	Squeaky Toy	China						>10%
PH-BI-007	Quezon	Squeaky Toy						26	>10%
PH-BI-008	Quezon	Squeaky Toy						250	>10%
PH-BI-009	Quezon	Squeaky Toy			630		55		>10%
PH-BI-010	Quezon	Squeaky Toy					37	209	>10%
PH-BI-011	Quezon	Squeaky Toy					17	128	>10%
PH-BI-012	Quezon	Squeaky Toy	130			47			>10%
PH-BI-013	Quezon	Squeaky Toy	China				34		>10%
PH-BI-014	Quezon	Squeaky Toy	China				32		>10%
PH-BI-015	Quezon	Squeaky Toy	China	1040	640				>10%
PH-BI-016	Quezon	Squeaky Toy	China		1350				>10%
PH-BI-017	Quezon	Squeaky Toy	China				37		>10%
PH-BI-018	Quezon	Squeaky Toy	China		790				>10%
PH-BI-019	Quezon	Squeaky Toy	China	290	520				>10%
PH-BI-020	Quezon	Squeaky Toy	China			49			>10%
PH-BI-021	Quezon	Mickey Mouse	610		890				>10%
PH-BI-023	Quezon	Mickey Mouse					44	170	>10%
PH-BI-025	Quezon	Ultraman Toy					33	19	>10%
PH-BI-026	Quezon	Doll	China			94		270	>10%
PH-BI-028	Quezon	Food Toy	China	430		250			>10%
PH-BI-029	Quezon	Kitchen Toy	China	290				210	>10%

Annex 2
Chemicals of Concern Detected in Children's Plastic Toy Samples Purchased in the Bangladesh

Sample #	Area	Item Type	Country Origin	As	Cl	Pb	Cd	Br	Hg
BD 001	Bashundhara City	Jigsaw Puzzle Toy (Watermelon)	China	5	>10%		33	13	
BD 002	Bashundhara City	Jigsaw Puzzle Toy (Guava)	China		>10%			9	
BD 003	Bashundhara City	Jigsaw Puzzle Toy (Apple)	China		>10%			30	
BD 004	Bashundhara City	Jigsaw Puzzle Toy (Orange)	China	10					57
BD 005	Bashundhara City	Jigsaw Puzzle Toy (Strawberry)	China		>10%	25		22	
BD 006	Bashundhara City	Jigsaw Puzzle Toy (Pineapple)	China	12	>10%			11	
BD 007	Bashundhara City	Jigsaw Puzzle Toy (Papaya)	China		>10%		34	8	
BD 008	Bashundhara City	Jigsaw Puzzle Toy (Grape)	China		>10%		89		
BD 009	Bashundhara City	Jigsaw Puzzle Toy (Banana)	China		7.70%				
BD 010	Bashundhara City	Jigsaw Puzzle Toy (Melon)	China		>10%	111		34	
BD 011	Bashundhara City	Jigsaw Puzzle Toy (Tray)	China				64		103
BD 012	Bashundhara City	Jigsaw Puzzle Toy (Knife)	China		>10%				
BD 013	Bashundhara City	Jigsaw Puzzle Toy (Plate)	China						63
BD 014	Newmarket	Toy Car (Blue)	Bangladesh			320		3360	
BD 015	Newmarket	Toy Car (Orange)	Bangladesh			148		2890	
BD 016	Newmarket	Stationary (Sharpener)	Bangladesh				41		84
BD 017	Newmarket	Stationary (Pikachu Sharpener)	Bangladesh		>10%				170
BD 018	Newmarket	Chicken Hei Hei Toy	Bangladesh	18	>10%			61	
BD 019	Newmarket	Fidget Spiner Toy	Bangladesh			200		880	
BD 020	Newmarket	Children Cup with Pacifier	China	247		1370	37		
BD 021	Chowk-Bazar	Doll Set (Pink)	Bangladesh						
BD 022	Chowk-Bazar	Doll Set (Purple)	Bangladesh			180		11	
BD 023	Chowk-Bazar	Doll Set (Yellow)	Bangladesh				140	61	
BD 024	Chowk-Bazar	Jennifer Doll (Pink)	China	15	>10%				
BD 025	Chowk-Bazar	Jennifer Doll (Blue)	China	82	>10%	160			
BD 026	Chowk-Bazar	Jennifer Doll (Yellow)	China		>10%		197	36	35
BD 027	Newmarket	Stationary Bag (Green)	Bangladesh		>10%	580		88	
BD 028	Newmarket	Stationary Bag (Blue)	Bangladesh	20	>10%		155		
BD 029	Chowk-Bazar	Baby Breads Necklace	China	40				6	115
BD 030	Newmarket	Mug (Yellow)	Bangladesh			220	315	25	
BD 031	Newmarket	Mug (Orange)	Bangladesh			65	640	15	
BD 032	Newmarket	Lipstick	Bangladesh						33
BD 033	Newmarket	Lipstick	Bangladesh						
BD 034	Newmarket	Kids Bracelet	Bangladesh	28	>10%		41	139	
BD 035	Bashundhara City	Duck Toy Set (Rabbit)	China		>10%				
BD 036	Bashundhara City	Duck Toy Set (Jellyfish)	China		9.80%				71
BD 037	Bashundhara City	Duck Toy Set (Chicken)	China			280		27	
BD 038	Bashundhara City	Duck Toy Set (Pink)	China	14					200
BD 039	Bashundhara City	Duck Toy Set (Pink Fish)	China	28	>10%			87	
BD 040	Bashundhara City	Duck Toy Set (Green Fish)	China	24	>10%			22	
BD 041	Bashundhara City	Duck toy set (Penguin)	China	12					
BD 042	Bashundhara City	Duck toy set (Turtle)	China		>10%				
BD 043	Bashundhara City	Duck toy set (Red Fish)	China		>10%	63		40	
BD 044	Bashundhara City	Duck toy set (Pink bunny)	China						114

Sample #	Area	Item Type	Country Origin	As	Cl	Pb	Cd	Br	Hg
BD 045	Bashundhara City	Duck toy set (Peach Pig)	China	26	>10%				
BD 046	Bashundhara City	Duck toy set (Duck)	China		>10%				
BD 047	Bashundhara City	Duck toy set (Octopus)	China		>10%				
BD 048	Bashundhara City	Duck toy set (Frog)	China		>10%	490		181	
BD 049	Bashundhara City	Duck toy set (Big duck)	China	51	>10%				
BD 050	Newmarket	Alphabet Set (Pink)	Bangladesh	9				51	
BD 051	Newmarket	Alphabet Set (Yellow)	Bangladesh			63	80	57	
BD 052	Newmarket	Alphabet Set (Purple)	Bangladesh			49			
BD 053	Newmarket	Alphabet Set (Green)	Bangladesh	23			36	15	
BD 054	Newmarket	Alphabet Set (Orange)	Bangladesh	50	>9%	660			
BD 055	Newmarket	Alphabet Set (Red)	Bangladesh	5			29	27	
BD 056	Newmarket	Xylophone (Red)	Bangladesh						
BD 057	Newmarket	Xylophone (Yellow)	Bangladesh						
BD 058	Newmarket	Xylophone (Blue)	Bangladesh						
BD 059	Newmarket	Xylophone (Green)	Bangladesh						
BD 060	Newmarket	Xylophone (Purple)	Bangladesh						
BD 061	Newmarket	Xylophone (Red Stick)	Bangladesh			20		7	
BD 062	Newmarket	Eraser Set (Green)	China						
BD 063	Newmarket	Eraser Set (Red)	China	37					
BD 064	Newmarket	Wooden Stick (Green)	Bangladesh			37			
BD 065	Newmarket	Wooden Stick (Yellow)	Bangladesh			28			23
BD 066	Newmarket	Wooden Stick (Orange)	Bangladesh					8	
BD 067	Chowk-Bazar	Colorful Rainbow Bracelet (Rainbow)	China		>10%			11	
BD 068	Chowk-Bazar	Butterfly	China	8	>10%			700	
BD 069	Chowk-Bazar	Red Bead	China	19	>10%			5	
BD 070	Chowk-Bazar	Golden Jewelry (Locket)	Bangladesh				>10%		
BD 071	Chowk-Bazar	Red Bead	Bangladesh	12			369		
BD 072	Newmarket	Clay Doh (Brown)	China				52		94
BD 073	Newmarket	Clay Doh (Yellow)	China			38	37	12	
BD 074	Newmarket	Clay Doh (Orange)	China						
BD 075	Newmarket	Clay Doh (Red)	China		>10%				35
BD 076	Newmarket	Clay Doh (Green)	China					19	
BD 077	Newmarket	Clay Doh (Pink Dark)	China	9					
BD 078	Newmarket	Clay Doh (Blue)	China	57					
BD 079	Newmarket	Clay Doh (Purple)	China					39	
BD 080	Newmarket	Clay Doh (Pink)	China	57					
BD 081	Newmarket	Clay Doh (Peach)	China						
BD 082	Newmarket	Clay Doh (Black)	China						
BD 083	Newmarket	Clay Doh (Stick)	China						
BD 084	Miniso	Clay Set (Yellow Mold)	China				87		35
BD 085	Miniso	Clay set (Pink Mold)	China						
BD 086	Miniso	Clay set (Blue Mold)	China	23			109	34	
BD 087	Miniso	Clay set (White Mold)	China	8			46		53
BD 088	Miniso	Clay set (Pink)	China			12		20	
BD 089	Miniso	Clay set (Black)	China		>9.3%				
BD 090	Miniso	Clay set (Green)	China	7					40
BD 091	Miniso	Clay set (Dark Brown)	China		>10%			55	
BD 092	Miniso	Clay set (Light Brown)	China						40
BD 093	Miniso	Clay set (Ocean Blue)	China	15				9	

Sample #	Area	Item Type	Country Origin	As	Cl	Pb	Cd	Br	Hg
BD 094	Miniso	Clay set (Neon Orange)	China	6				29	
BD 095	Miniso	Clay set (Yellow)	China	11					18
BD 096	Miniso	Clay set (Sea green)	China	17					
BD 097	Miniso	Clay set (Chocolate brown)	China			30	28	16	
BD 098	Miniso	Clay set (Bright Orange)	China					19	
BD 099	Miniso	Clay set (Light orange)	China	12					27
BD 100	Miniso	Clay set (Mustard yellow)	China			11	20		
BD 101	Miniso	Clay set (Magenta)	China		>10%	76			69
BD 102	Miniso	Clay set (Teal)	China		>10%				
BD 103	Miniso	Clay set (Red)	China						58
BD 104	Miniso	Clay set (Blue)	China						
BD 105	Miniso	Clay set (Navy Blue)	China						81
BD 106	Miniso	Clay set (Peach)	China						37
BD 107	Miniso	Clay set (Dark Green)	China						
BD 108	Miniso	Clay set (Dark Orange)	China	3					
BD 109	Miniso	Clay set (purple)	China						45
BD 110	Miniso	Clay set (Parrot green)	China			16		19	
BD 111	Miniso	Clay set (Cream)	China		>10%	46			
BD 112	Miniso	Clay set (Box)	China						270
BD 113	Chowk-Bazar	Hairband (Pink)	Bangladesh	8		38			
BD 114	Chowk-Bazar	Hairband (Yellow)	Bangladesh	5					
BD 115	Chowk-Bazar	Hairband (Purple)	Bangladesh		>10%	80	93	9	
BD 116	Chowk-Bazar	Hairband (Magenta)	Bangladesh					11	
BD 117	Chowk-Bazar	Hairband (Sky Blue)	Bangladesh	7				7	
BD 118	Chowk-Bazar	Hairband (Packet)	Bangladesh		>10%		50	7	
BD 119	Newmarket	Twinkle Jewel Seal (pink)	China			111		70	
BD 120	Newmarket	Twinkle Jewel Seal (Purple)	China		>10%	160	162	210	
BD 121	Newmarket	Twinkle Jewel Seal (Magenta)	China			104			
BD 122	Newmarket	Twinkle Jewel Seal (Sky Blue)	China			16			
BD 123	Newmarket	Twinkle Jewel Seal (Green)	China					45	
BD 124	Newmarket	Twinkle Jewel Seal (Red)	China						
BD 125	Newmarket	Twinkle Jewel Seal (Silver)	China	17	>10%				
BD 126	Newmarket	Twinkle Jewel Seal (Yellow)	China	42			191		
BD 127	Newmarket	Glitter (Red)	Bangladesh	20			70		29
BD 128	Newmarket	Glitter (Yellow)	Bangladesh					8	
BD 129	Newmarket	Glitter (Orange)	Bangladesh						
BD 130	Newmarket	Glitter (Magenta)	Bangladesh		>10%				
BD 131	Bashundhara City	Kids Makeup Big Set (Yellow Glitter)	China				62		43
BD 132	Bashundhara City	Red Glitter	China	7					
BD 133	Bashundhara City	Dark Green	China			18	55		
BD 134	Bashundhara City	Light Green	China					9	
BD 135	Bashundhara City	Blue	China						61
BD 136	Bashundhara City	Pink Powder	China						
BD 137	Bashundhara City	Yellow Powder	China	19					
BD 138	Bashundhara City	Pink Nail Polish	China						
BD 139	Bashundhara City	Orange Something	China						
BD 140	Bashundhara City	Lipstick	China		>10%		84		220
BD 141	Newmarket	Makeup Set (Blush-Reddish Pink)	Bangladesh	24					
BD 142	Newmarket	Pink	Bangladesh	18			39		

Sample #	Area	Item Type	Country Origin	As	Cl	Pb	Cd	Br	Hg
BD 143	Newmarket	White Glitter	Bangladesh	20			250		
BD 144	Newmarket	Golden Glitter	Bangladesh						
BD 145	Newmarket	Brown	Bangladesh		>10%				93
BD 146	Newmarket	Orange	Bangladesh	19					
BD 147	Newmarket	Violet	Bangladesh				40	20	
BD 148	Newmarket	Eye Shadow (Cream Glittery)	Bangladesh				44		70
BD 149	Newmarket	Brown	Bangladesh	22					145
BD 150	Newmarket	Pink	Bangladesh				30		

IX. REFERENCES

i Mithu, A. (2023). Plastic toys in Bangladesh contain alarming levels of toxic metals: study. The Business Standard. Retrieved from: https://www.tbsnews.net/bangladesh/environment/plastic-toys-bangladesh-contain-alarming-levels-toxic-metals-study-725966

ii Dag, N., Turkkan, E., Kacar, A., Dag, H. (2021). Children's only profession: playing with toys. Published by the Northern Clinics of Istanbul. Retrieved from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8430366/

iii The Forgotten Toy Shop (n.d.). History of toys and games. Retrieved from: https://www.theforgottentoyshop.co.uk/pages/history-of-toys-games?srsltid=AfmBOopLrG0eV1IefliqNxOcRp8vVAFe0OlQgk6qRybVnY7tqB7L6WVJ

iv McMahon, F. (n.d.). Toy. Britannica. Retrieved from: https://www.britannica.com/topic/GI-Joe-action-doll

v Lambert, T. (n.d.). A brief history of toys. University of New South Wales. Retrieved from: https://www.arts.unsw.edu.au/sites/default/files/documents/GERRIC_The%20Games%20People%20Play%20Pre-Reading%202020.pdf

vi Roland, A. (n.d.). The history of toys throughout the ages. Giggle Magazine. Retrieved from: https://www.gigglemagazine.com/visit-this-interactive-norad-santa-tracker-site-with-your-kiddos/

vii Ibid. Lambert, T.

viii Circana (2023). The global toy report. Published by the Toy Association. Retrieved from: https://www.toyassociation.org/ta/research/data/global/toys/research-and-data/data/global-sales-data.aspx?hkey=64bda73b-80ee-4f26-bd61-1aca29ff2abf

ix Circana (2024). The Global Toy Report. Published by the Toy Association.

x Children Baby Maternity Expo (2024). Market analysis of China toy industry. Retrieved from: https://en.cbmexpo.com/market-analysis-of-china-toy-industry/

xi Tighe, D. (2024). Leading exporters of toys, games, and sport requisites worldwide in 2023. Statista.

xii The Observatory of Economic Complexity. (2022). Toys, games, and sports. Retrieved from: https://oec.world/en/profile/hs/toys-games-sports

xiii Ibid. The Observatory of Economic Complexity. 2022.

xiv Ibid. Dag, N. 2021.

xv Child Psych (2024). The importance of toys in a child's development. Retrieved from: https://www.childpsych.co.za/the-importance-of-toys-in-a-childs-development/

xvi Kurdi, B. A. (2017). Investigating the factors influencing parent toy purchase decisions: reasoning and consequences. Published by the Canadian Center of Science and Education. Retrieved from: https://www.researchgate.net/publication/315547866_Investigating_the_Factors_Influencing_Parent_Toy_Purchase_Decisions_Reasoning_and_Consequences

xvii Richards, M., Putnick, D., Bornstein, M. (2020). Toy buying today: considerations, information seeking, and thoughts about manufacturer suggested age. National Library of Medicine. Retrieved from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7219796/

xviii Ibid. Dag, N. 2021.

xix Cartland, J. (2020). Addressing environmental toxins that affect children through a children's rights framework: tools to help you succeed. Loyola University Chicago. Retrieved from: https://ecommons.luc.edu/cgi/viewcontent.cgi?article=1022&context=chrc

xx Firelands Health (2023). Holiday safety: small toy choking hazards. Retrieved from: https://www.firelands.com/empower/pediatrics/holiday-safety-small-toy-choking-hazards/

xxi Carroquino, M., Posada, M., Landrigan, P. (2012). Environmental toxicology: children at risk. National Library of Medicine. Retrieved from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7121289/

xxii European Environmental Bureau (n.d.). Toxic chemicals in toys – what you need to know this Christmas. Retrieved from: https://eeb.org/toxictoys/

xxiii Behnisch, P., Petrlik, J., Budin, C., Besselink, H., Felzel, E., Strakova, J., Bell, L., Kuepouo, G., Gharbi, S., Bejarano, F., Jensen, G., Digangi, J., Ismawati, Y., Speranskaya, O., Da, M., Pulkrabova, J., Gramblicka, T., Brabcova, K., Brouwer, A. (2023). Global survey of dioxin- and thyroid hormone-like activities in consumer products and toys. Elsevier. Retrieved from: https://www.sciencedirect.com/science/article/pii/S0160412023003525?via%3Dihub

xxiv PlastChem Project (2024). New report identifies plastic chemicals of concern and highlights approach towards safer plastics. Retrieved from: https://plastchem-project.org/wp-content/uploads/2024/03/PlastChem-Press-Release_English-v1.pdf

xxv Campanale, C., Massarelli, C., Savino, I., Locaputo, V. (2020). A detailed review study on potential effects of microplastics and additives of concern on human health. National Library of Medicine. Retrieved from: https://pmc.ncbi.nlm.nih.gov/articles/PMC7068600/

xxvi US Consumer Product Safety Commission (n.d.). Toy Safety. Retrieved from: https://www.cpsc.gov/FAQ/Toy-Safety

xxvii European Union (n.d.). Directive 2009/48/EC. Retrieved from: https://single-market-economy.ec.europa.eu/single-market/european-standards/harmonised-standards/toy-safety_en

xxviii ISO (n.d.). Safety of toys—Part 1: Safety aspects related to mechanical and physical properties. Retrieved from: https://www.iso.org/obp/ui/es/#iso:std:iso:8124:-1:ed-6:v1:en

xxix International Organization for Standardization (2020). ISO 8124. Part 3: migration of certain elements. Third Edition.

xxx ISO (n.d.). Foreword – Supplementary Information. Retrieved from: https://www.iso.org/foreword-supplementary-information.html

xxxi DTI (n.d.). PNS on Safety of Toys. Retrieved from: http://www.opac.dti.gov.ph/DocumentFolder/pages%20from%20pns-bhdt-iso%208124-1-2008.pdf

xxxii Department of Health (2009). Revised Policies and Guidelines on the "Regulations on the Issuances of a License to Operate (LTO), Certificate of Conformity and Clearance for Customs Release Prescribed to Manufacturers, Importers and Distributors of Toys in the Philippines." Retrieved from: https://www.fda.gov.ph/wp-content/uploads/2021/05/Administrative-Order-No.-2009-0005.pdf

xxxiii Food and Drug Administration (2011). Addendum to Administrative Order No. 2009-0005 "revised Policies and Guidelines on the Regulations on the Isuuances of a License to Operate (LTO), Certificate of Conformity and Clearance for Customs Release Prescribed to Manufacturers, Importers and Distributors of Toys in the Philippines.". Retrieved from: https://www.fda.gov.ph/wp-content/uploads/2021/05/Administrative-Order-No.-2009-0005-A.pdf

xxxiv Food and Drug Administration (2011). FDA assures the public that toys and school supplies (crayons and pencils) are being monitored in the market. Retrieved from: https://www.fda.gov.ph/wp-content/uploads/2022/06/DOH-FDA-Advisory-No.-2011-005.pdf

xxxv Food and Drug Administration (2015). Guidelines on the Electronic Notification of Toys and Childcare Articles (TCCAs). Retrieved from: https://www.fda.gov.ph/wp-content/uploads/2021/05/FDA-Circular-No.-2015-002.pdf

xxxvi Supreme Court E-Library (2019). (Republic Act No. 10620, September 03, 2013) An Act Providing for Toy and Game Safety Labeling, Appropriating Funds Therefor. Retrieved from: https://elibrary.judiciary.gov.ph/thebookshelf/showdocs/2/58219

xxxvii EcoWaste Coalition (2019). Toy labels fall far short of RA 10620's requirements. Retrieved from: http://ecowastecoalition.blogspot.com/2019/08/toy-labels-fall-far-short-of-ra-10620s.html

xxxviii BAN Toxics. (2023). Ban Toxics urges FDA and DTO to review the 10-yr old RA 10620 or Toy and Game Safety Labeling Law. Retrieved from: https://journal.com.ph/ban-toxics-urges-fda-and-dti-to-review-the-10-yr-old-ra-10620-or-toy-and-game-safety-labeling-law/

xxxix DENR (n.d.). Republic Act No. 6969: An Act to Control Toxic Substances and Hazardous and Nuclear Wastes, Providing Penalties for Violations Thereof, and for other Purposes. Retrieved from: https://emb.gov.ph/wp-content/uploads/2015/09/RA-6969.pdf

xl DENR (2013). Chemical Control Order (CCO) for Lead and Lead Compounds. Retrieved from: https://chemical.emb.gov.ph/wp-content/uploads/2017/03/DAO-2013-24-CCO-Lead.pdf

xli DENR (2021). Chemical Control Order (CCO) for Cadmium and Cadmium Compounds. Retrieved from: https://chemical.emb.gov.ph/wp-content/uploads/2021/05/DAO-2021-08-CCO-Cadmium.pdf

xlii DENR (2024). Chemical Control Order for Benzene (Draft). Retrieved from: https://chemical.emb.gov.ph/wp-content/uploads/2024/07/Final-Draft-DAO-CCO-Benzene-052024v4.pdf

xliii DENR (2022). Chemical Control Order for Vinyl Chloride (Draft). Retrieved from: https://chemical.emb.gov.ph/?attachment_id=751

xliv Food and Drug Administration. (2023). Rules and Regulations Governing the Issuance of Authorizations for Toys and Childcare Articles. Retrieved from: https://www.fda.gov.ph/wp-content/uploads/2023/12/Draft-for-Comments-Rules-and-Regulations-Governing-the-Issuance-of-Authorizations-for-Toys-and-Childcare-Articles.pdf

xlv Bangladesh Post. (2024). Editorial: Keep our kids safe from toxic toys. Retrieved from: https://bangladeshpost.net/posts/keep-our-kids-safe-from-toxic-toys-147699

xlvi Hossain, S., Sultana, S., et al. (2013). Study Report on Toxic Toys: Heavy Metal Content & Public Perception in Bangladesh. Retrieved from: https://ipen.org/sites/default/files/documents/ESDO%20Study%20Report%20on%20Toxic%20Toys%20in%20Bangladesh.pdf

xlvii Rita, S. (2024). Dangerous toys abound in Dhaka markets, putting children at risk. Retrieved from: https://www.dhakatribune.com/bangladesh/361013/dangerous-toys-abound-in-dhaka-markets-putting

xlviii Ibid.

xlix S. Siddika, personal communication, July 17, 2024

l World Health Organization (2020). 10 chemicals of public health concern. Retrieved from: https://www.who.int/news-room/photo-story/photo-story-detail/10-chemicals-of-public-health-concern

li Metallurgical Engineering Services (n.d.). X-ray fluorescence. Retrieved from: https://www.metengr.com/testing-services/chemical-analysis/x-ray-fluorescence#:~:text=XRF%20analysis%20can%20ensure%20product,chemicals%2C%20cement%2C%20and%20food.

lii M.J dos Anjos; R.T Lopes; E.F.O de Jesus; J.T Assis; R Cesareo; C.A.A Barradas (2000). Quantitative analysis of metals in soil using X-ray fluorescence. , 55(7), 1189–1194. doi:10.1016/s0584-8547(00)00165-8

liii Kodom, K.; Preko, K.; Boamah, D. (2012). X-ray Fluorescence (XRF) Analysis of Soil Heavy Metal Pollution from an Industrial Area in Kumasi, Ghana. Soil and Sediment Contamination: An International Journal, 21(8), 1006–1021. doi:10.1080/15320383.2012.712073

liv Olympus (n.d.) XRF technology for analysis of arsenic and lead in soil. Retrieved from: https://www.olympus-ims.com/en/applications/xrf-technology-analysis-arsenic-lead-soil/

lv Greenpeace. (2003, August 18). PVC: The Poison Plastic.

lvi Straková, J., Grechko, V., Brosché, S., Karlsson, T., & Buonsante, V. (2022). Brominated flame retardants in plastic products from China, Indonesia and Russia. International Pollutants Elimination Network. https://ipen.org/sites/default/files/documents/ipen-bfr-2021-v1_6aq-en.pdf

lvii Jitka, S., Valeriya, G., Sara, B., Therese, K., Vito, B. (2022). Brominated flame retardants in plastic products from China, Indonesia, and Russia. IPEN. Retrieved from: https://ipen.org/sites/default/files/documents/ipen-bfr-2021-v1_6aq-en.pdf

lviii Brown, E., MacDonald, A., Allen, S., Allen, D. (2023). The potential for a plastic recycling facility to release microplastic pollution and possible filstration remediation effectiveness. Elsevier. Retrieved from: https://www.sciencedirect.com/science/article/pii/S2772416623000803

lix Balali-Mood, M., Naseri K, Tahergorabi Z., Khazdair M. R., & Sadeghi M. (2021). Toxic Mechanisms of Five Heavy Metals: Mercury, Lead, Chromium, Cadmium, and Arsenic. Frontiers in Pharmacology, 12. doi.org/10.3389/fphar.2021.643972

lx American Academy of Pediatrics Council on Environmental Health. (2019) In: R.A. Etzel & S. J. Balk (Eds.).

Pediatric Environmental Health (4th ed.). American Academy of Pediatrics.

lxi Skröder Löveborn, H., Kippler, M., Lu, Y., Ahmed, S., Kuehnelt, D., Raqib R., & Vahter, M. (2016). Arsenic Metabolism in Children Differs from That in Adults. Toxicol Sci., 152(1), 29-39. https://doi.org/10.1093/toxsci/kfw060

lxii Rodríguez-Barranco, M., Lacasaña, M., Aguilar-Garduño, C., Alguacil, J., Gil, F., González-Alzaga, B., & Rojas-García, A. (2013). Association of arsenic, cadmium and manganese exposure with neurodevelopment and behavioural disorders in children: A systematic review and meta-analysis. Science of The Total Environment, 454-455, 562–577. https://doi.org/10.1016/j.scitotenv.2013.03.047

lxiii New York State Department of Health. (2011, February). Cadmium in Children's Jewelry. Retrieved November 16, 2024. https://www.health.ny.gov/environmental/chemicals/cadmium/cadmium_jewelry.htm

lxiv Straif, K., Benbrahim-Tallaa, L., Baan, R., Grosse, Y., Secretan, B., El Ghissassi, F., Bouvard, V., Guha, N., Freeman, C., Galichet, L., Cogliano, V., & WHO International Agency for Research on Cancer Monograph Working Group. (2009). A review of human carcinogens--Part C: metals, arsenic, dusts, and fibres. The Lancet. Oncology, 10(5), 453–454. https://doi.org/10.1016/s1470-2045(09)70134-2

lxv World Health Organization. (2021). Children and digital dumpsites: e-waste exposure and child health. https://iris.who.int/bitstream/handle/10665/341718/9789240023901-eng.pdf

lxvi American Academy of Pediatrics Council on Environmental Health. (2019) In: R.A. Etzel & S. J. Balk (Eds.). Pediatric Environmental Health (4th ed.). American Academy of Pediatrics. Skröder Löveborn, H., Kippler, M., Lu, Y., Ahmed, S., Kuehnelt, D., Raqib R., & Vahter

lxvii Rees, N. & Fuller, R. (2020). The Toxic Truth: Children's Exposure to Lead Pollution Undermines a Generation of Future Potential. UNICEF and Pure Earth. https://www.unicef.org/media/73246/file/The-toxic-truth-children%E2%80%99s-exposure-to-lead-pollution-2020.pdf

lxviii World Health Organization. (2024 September 27). Lead Poisoning. https://www.who.int/news-room/fact-sheets/detail/lead-poisoning-and-health

lxix World Health Organization. (2010). Children's exposure to mercury compounds. https://iris.who.int/bitstream/handle/10665/44445/9789241500456_eng.pdf

lxx Subba Rao, G. (2023). Current environmental mercury poisoning of children: A literature review of its impact on global pediatric health. Current Pediatric Research, 27(10), 2024-2057. https://www.alliedacademies.org/articles/current-environmental-mercury-poisoning-of-children-a-literature-review-of--its-impact-on-global-pediatric-health.pdf

lxxi Bose-O›Reilly, S., McCarty, K. M., Steckling, N., & Lettmeier, B. (2010). Mercury exposure and children›s health. Current problems in pediatric and adolescent health care, 40(8), 186–215. https://doi.org/10.1016/j.cppeds.2010.07.002

lxxii Subba Rao, G. (2023). Current environmental mercury poisoning of children: A literature review of its impact on global pediatric health. Current Pediatric Research, 27(10), 2024-2057. https://www.alliedacademies.org/articles/current-environmental-mercury-poisoning-of-children-a-literature-review-of--its-impact-on-global-pediatric-health.pdf

lxxiii Ibid. World Health Organization. 2020.

lxxiv Child Accident Prevention Trust (n.d.). Warning: dangerous levels of chemicals found in cheap toys on the high street. Retrieved from: https://capt.org.uk/dangerous-levels-of-chemicals-found-in-cheap-toys/

lxxv European Commission (2024). Safety Gate: the EU rapid alert system for dangerous non-food products (Alert number: A12/00315/24. Retrieved from: https://ec.europa.eu/safety-gate-alerts/screen/webReport/alertDetail/10011644?lang=en

lxxvi FDA (2024). FDA Advisory No. 20241384. Retrieved from: https://www.fda.gov.ph/wp-content/uploads/2024/10/FDA-Advisory-No.2024-1384.pdf

lxxvii UNEP (n.d.). International Chemicals Management Toolkit for the Toy Supply Chain. Retrieved from: https://saicmknowledge.org/chemicals-management-toolkit-toy-sector