

# Assessment of Heavy Metal Contamination in Commercial Cosmetic Products

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## Introduction

Cosmetic products have become an integral part of daily life for millions of individuals across the globe. From lipsticks and eyeliners to creams, powders, and hair dyes, these products are used for beautification, self-expression, and cultural practices. The global cosmetics industry, valued at over \$500 billion, is continuously expanding, driven by innovation, social trends, and consumer demand. However, behind the allure of flawless beauty lies an under-addressed concern—heavy metal contamination in cosmetic products. Heavy metals such as lead (Pb), arsenic (As), cadmium (Cd), mercury (Hg), chromium (Cr), and nickel (Ni) are frequently detected in various cosmetics. These metals may enter products as intentional ingredients, color additives, or as impurities during manufacturing, packaging, or due to contamination of raw materials. Prolonged exposure to heavy metals, even at low concentrations, can cause adverse health effects, including neurotoxicity, carcinogenicity, endocrine disruption, and skin hypersensitivity. Given the dermal route of exposure in cosmetic use—often with prolonged contact or repetitive application—assessing heavy metal contamination in cosmetics is critical for public health safety. Regulatory agencies such as the US Food and Drug Administration (FDA), European Commission (EC), and Bureau of Indian Standards (BIS) have established guidelines and permissible limits for heavy metals in cosmetic products. Yet, enforcement and monitoring vary significantly across countries [1-3].

The majority of heavy metals in cosmetics originate from natural mineral-based ingredients, such as mica, kaolin, talc, and iron oxides, which are mined from the earth and often contaminated with metals. For instance, iron oxides used as colorants in lipsticks and foundations may contain residual lead or arsenic. Heavy metals may be introduced during industrial processing, mixing, and packaging. The use of contaminated water, outdated machinery, or poor-quality additives can increase metal load in the final product. Although banned or restricted in many countries, some manufacturers continue their use—especially in unregulated markets or counterfeit products. Metal containers or colored plastics used for packaging may leach metals into the product over time, especially under heat or prolonged storage.

## Description

Lead is a well-known neurotoxin with no safe exposure level. Chronic exposure, even at trace levels, can result in cognitive deficits, behavioral problems, anemia, renal dysfunction, and reproductive toxicity. In cosmetics, lead accumulates with daily use, especially in lipsticks where ingestion is possible. Used historically in skin-lightening creams, mercury can cause skin rashes, nephrotoxicity, neurotoxicity, and immunosuppression. Organic forms such

as methylmercury are particularly dangerous and can cross the blood-brain barrier. Cadmium is a carcinogen linked to kidney damage, bone demineralization, and endocrine disruption. It is often found in colored cosmetics, especially reds and pinks derived from cadmium-based pigments. Arsenic exposure has been associated with skin lesions, pigmentation changes, peripheral neuropathy, and cancer. It can enter the body dermally or via inhalation of powder products. Hexavalent chromium (Cr VI) is highly toxic and can cause skin allergies, eczema, and respiratory issues. It is sometimes found in eye cosmetics or green pigments. Nickel is a common allergen responsible for contact dermatitis. Although not intentionally added, it can contaminate a variety of cosmetics, especially metallic hues.

Children are particularly vulnerable to heavy metal exposure. Several scandals have emerged globally involving children's play makeup kits containing dangerous levels of lead, arsenic, and cadmium. The skin of children is more permeable, and their developing systems are more sensitive to toxicants. In 2016, the Canadian government recalled a children's makeup set after finding 8.2 ppm of cadmium and 15 ppm of lead—well above safe limits. Regulation of cosmetic products for minors remains a grey area in many jurisdictions. Washed-off products containing metals enter wastewater systems, eventually accumulating in sludge or being discharged into rivers and seas. Aquatic toxicity studies show that metals like mercury and cadmium impair fish reproduction, behavior, and survival. The use of metal-based pigments in nail polishes and hair dyes contributes to household hazardous waste. The lack of regulation for end-of-life disposal of cosmetic waste and poor consumer awareness about metal content exacerbate environmental contamination [4,5].

The widespread presence of heavy metal contaminants in commercial cosmetic products represents a multifaceted public health, regulatory, and ethical issue. While cosmetic products are often perceived as safe due to their topical application, scientific evidence confirms that cumulative, long-term exposure to heavy metals can have serious health consequences, including neurotoxicity, organ failure, developmental issues, and cancer. Despite efforts by some governments and watchdog organizations, regulation and enforcement remain fragmented and insufficient, especially in low-income countries and within the expanding e-commerce and counterfeit markets. The lack of pre-market approval requirements in several jurisdictions allows potentially hazardous products to reach consumers unchecked. The responsibility for safety lies not only with the regulators and manufacturers but also with consumers, researchers, and global institutions. Only through a coordinated and science-driven approach can we ensure that the pursuit of beauty does not come at the cost of human and environmental health.

## Conclusion

The assessment of heavy metal contamination in commercial cosmetics is a pressing global health concern. While cosmetic products offer aesthetic and psychological benefits, they can also serve as unintended vehicles for chronic heavy metal exposure. Scientific evidence clearly indicates the widespread presence of lead, arsenic, mercury, cadmium, and other metals in lipsticks, eyeliners, foundations, and skin creams—often exceeding recommended safety thresholds. Despite the existence of regulations and permissible limits, weak enforcement, lack of consumer education, and the availability of counterfeit and unregulated products pose ongoing risks. Addressing these challenges

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Received: 01 February, 2025, Manuscript No. jctt-25-168479; Editor assigned: 03 February, 2025, PreQC No. P-168479; Reviewed: 15 February, 2025, QC No. Q-168479; Revised: 21 February, 2025, Manuscript No. R-168479; Published: 28 February, 2025, DOI: 10.37421/2471-9323.2025.11.306

requires a multi-pronged approach-including stricter regulatory oversight, enhanced manufacturer accountability, international harmonization of standards, and increased public awareness. Ultimately, ensuring the safety of cosmetic products is not only a matter of regulatory compliance but also a public health imperative. As cosmetic use continues to rise globally, protecting consumers from heavy metal exposure must become a priority for manufacturers, governments, scientists, and society at large.

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## Acknowledgment

None.

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## Conflict of Interest

None.

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**How to cite this article:** Torstveit, Kellar. "Assessment of Heavy Metal Contamination in Commercial Cosmetic Products." *J Cosmo Tricho* 11 (2025): 306.