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SERVICES FOR SCIENCE AND EDUCATION

Additives and Endocrine Disruptors in Cosmetic Products for Use by Children Under 2 Years Old: A Danger Not Mentioned in Advertisements

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ABSTRACT

Endocrine disruptors are exogenous substances that alter the functions of the endocrine system and therefore induce harmful effects on the health of an intact organism, its descendants, or populations. They are at the heart of current health concerns, associated with other additives such as dyes and perfumes that constitute a source of allergy in predisposed individuals. The objective of this study is to identify and give the danger of endocrine disruptors, allergens and dyes in common cosmetic products for infants. Our study is described as descriptive, cross-sectional with prospective collection, and included all childcare cosmetic products with a label providing information on the chemical composition and present on the Kolwezi market. In a total of 48 ranges of cosmetic products analyzed, we found 10 types of endocrine disruptors, 13 types of allergens and 6 classes of dyes. Parabens are the most present endocrine disruptors in baby cosmetic products, followed by fragrance; and powder, followed by soap, are the products that contain more endocrine disruptors. Limonene is the most present allergen followed by geraniol; And powder, soap followed by lotion are the products that contain the most. Tartrazine is the most present dye and especially in soaps and lotions. These exogenous substances cause harmful effects on human health, which are accentuated in the most fragile, such as infants.

INTRODUCTION

Endocrine disruptors are found in everyday objects and can leak into our environment, sometimes remaining for long periods of time. Research has linked these chemicals to their health implications, particularly for vulnerable populations such as children and women [1].

Endocrine disruptors are a growing global concern. Following a global assessment in 2002, WHO and the United Nations Environment Programme collaborated to publish the State of the Science on Endocrine Disruptors in 2012. This report presents the latest scientific findings, conclusions and major concerns for human health. WHO is currently working on an update of this report [2].

WHO works on endocrine disruptors in collaboration with experts around the world to: raise awareness and update knowledge, facilitate research on health effects in children, develop

materials to prevent and reduce exposures during pregnancy and childhood, and develop and update key information and capacity training materials for health workers. [3]

Endocrine disruptors pose a particular risk to children today [4]. Children are exposed to low doses and mixtures of endocrine disruptors, which can have different effects depending on the dose and other chemicals present [5]. Exposure during pregnancy and early childhood can impact a child's health and development for the rest of their life. Preventing exposure is essential. [6,7]

Cosmetic products must be safe for all users, regardless of age. Toxic ingredients, strong allergens or substances with endocrine disrupting activity are therefore prohibited or their content is restricted and it is recommended to use preservatives only at their lowest effective concentrations [8].

However, young children are particularly sensitive to the toxic effects of certain chemicals, meaning that any known health risks associated with children's cosmetics must be taken into account [9]. When the characteristics and packaging of cosmetics – their fragrance, appearance, shape, colour or size, etc. – are designed to be attractive, the problem can be compounded, as young children may not be able to distinguish between cosmetics and food products, for example. This results in a real risk of poisoning or choking for young children who ingest cosmetics or even parts of their packaging [10].

And yet, every year, the consumption of cosmetic products increases worldwide. However, consumers may not fully understand the health risks associated with the use of these products [11]. Concerns about product formulation have increased and this control has put pressure on the cosmetic industry [12, 13]. Some metallic-based pigments used as colorants in face paints may contain toxic elements, such as heavy metals, raising doubts about their safety [14, 15]. The use of these products can be associated with different levels of exposure, including through the dermal route and accidental ingestion.

In recent decades, the rapid increase in the variety of cosmetic products – cleaning, perfumery and care products – intended for children has brought specific risks, with young children being particularly sensitive to the toxic effects of certain chemicals. [16]

The speed with which new 'children's cosmetics' are arriving on the market has put increasing pressure on market surveillance authorities, whose responsibility it is to flag dangerous products, via the EU's rapid alert system, Safety Gate [17]

Endocrine disrupting chemicals (EDCs) are exogenous agents that interfere with normal endocrine physiology by influencing hormone synthesis, metabolism, and/or cellular actions [18]. The main source of EDCs comes from industrial processes, but they can be naturally present in soy, legumes, and other plant-based products; they can be easily found in air, water, soil, a wide variety of household products and medical devices (clothing, drugs, medical devices, disinfectants, food and containers, furniture, cosmetics, personal care tools, toys, building materials, etc.), thus becoming ubiquitous in our environment [19]. Like other environmental contaminants, these substances can cross the placental barrier and their role

in the developmental origin of diseases such as obesity and diabetes has been proven. Epidemiological data suggest that the increase in diabetes, cancer, and infertility over the past two to three decades may be attributable, at least in part, to in utero exposure to endocrine disruptors. Models based on exposure to endocrine disruptors, both in utero and throughout life, may have effects on human health [20].

Endocrine disruptors can affect the body by direct interaction with hormone receptors or by influencing enzymatic steps in steroidogenesis and neurotransmitter synthesis; they could also affect the epigenetic regulation of endocrine and neural pathways [21].

We are all exposed to endocrine disruptors from embryonic life. The fetus and the child establish crucial developmental processes allowing adaptation to the environment throughout life: they are extremely sensitive to very low doses of hormones and endocrine disruptors because they are developing organisms [22]. Given the developmental origin of well-being and diseases, each adult organism expresses the consequences of the environment in which it has developed. [23] The molecular mechanisms by which the main endocrine disruptors manifest their effects and their potential association with endocrine disorders, such as diabetes, obesity, thyroid diseases and alteration of adrenal hormones[24]

Since there is ample evidence that exposure to endocrine disruptors can negatively impact the health of adults and children due to impaired endocrine function; suggesting their link with endocrinopathies; it is essential in this context to keep in mind what is already known about endocrine disruptors and to deepen our knowledge to establish rules of conduct aimed at limiting exposure to the negative effects of endocrine disruptors. This is the motivation for this work.

Our research question is: What are the endocrine disruptors present in commonly used childcare products and present on the Kolwezi market?

The general objective of this study is to identify endocrine disruptors present in common childcare products: shampoo, shower gel, cleansing water, make-up remover milk, moisturizing cream, base cream and wipes. And specifically, this study aims to quantify the numbers of PEs in childcare products, evaluate their synergistic effect and finally predict the dangers to which consumers are exposed.

METHODS

This is a prospective cross-sectional descriptive study.

Research Strategy

A systematic documentary search was carried out on childcare cosmetic products based on the information provided on their labels.

Integration Criteria

For this study, any childcare cosmetic product with a label providing information on the chemical composition and present on the Kolwezi market during the period of our study was included.

Exclusion Criteria

All products included in childcare cosmetics without a label or with a label but without the information sought, all other cosmetic products not used in childcare were excluded from this study.

Data Extraction

We used a standard data extraction format prepared in Microsoft Excel (Microsoft Corp., Redmond, WA, USA).

Quality Assessment

To assess the quality of all included studies, two reviewers independently assessed the quality of the included data by checking the completeness of the inclusion criteria. Disagreement between the two reviewers was resolved by discussion.

Data Analysis

For data analysis were done using Epi Info 7.2.5 software and Excel, a point estimate of prevalence from each study with a 95% confidence interval was used to estimate the pooled prevalence.

RESULTS AND COMMENTS

Table 1: Distribution of endocrine disruptors in cosmetic products

Endocrine Disruptors	Lotion	Ointment	Powder	Wipes	Soap	Oils	Total
Benzyl salicylate			4	2			6
BHA		2					2
BHT	1	2			2		5
Parabens	10	4	6		5	3	28
Butylphenyl methylpropional			3				3
Salicylic acid			3		2		5
Triclosan			2		3		5
Fragrance	4	2	4	3	6	2	21
Total	17	10	22	5	20	5	

Parabens are the most common endocrine disruptors in baby cosmetics, followed by fragrance. And powder, followed by soap, lotion and ointment are the products that contain the most endocrine disruptors.

Parabens are accepted worldwide as preservatives by the cosmetic, food and pharmaceutical industries [25]. They are recognized for their ability to modulate or alter the endocrine system and, therefore, can have negative effects on health due to their cumulative nature in tissues [26] including obesogenic effects [27] acting through the modification of the number or volume of adipocytes by interfering with transcriptional regulators, controller of lipid flux and adipocyte proliferation and differentiation, but, in particular through the peroxisome proliferator enzyme (PPAR) [28]. Also, parabens promote adipocyte differentiation into 3T3-L1 cells, whose action increases in conjunction with the linear length of the alkyl chain associated with the activation of PPAR γ [29].

The dose-response relationship between paraben exposure and increased risk of adverse events is not defined, as toxicological information on the acceptable human exposure dose to parabens is uncertain and inaccurate [30]. Since paraben exposure is ubiquitous in these vulnerable infants, there is a need to identify sources, quantify them in terms of dose and duration, and mitigate exposure [31]. Infants in intensive care units are in intimate and constant contact with medical devices containing parabens and other endocrine disruptors [32]. These infants are also at risk of drug and drug excipient accumulation, due to their renal immaturity [33]. Perinatal exposure to BP has been shown to alter the spermatogenesis process [34]. For all these reasons, many countries have banned the use of certain parabens in personal care products intended for newborns and children [35].

Fragrance ingredients are commonly added to many personal care products to provide a pleasant scent, including those intended for babies. [36] Fragrances are added to baby products to provide a positive psychological impact and identify the product. Infants and children have higher metabolic rates and activity levels, resulting in higher inhalation rates relative to body weight and higher inhalation exposure [37,38] A fragrance is a mixture of added substances whose role is to provide a pleasant aroma or mask an unpleasant odor to a formula, and identified in a list of cosmetic ingredients simply as "Fragrance" because it includes ingredients that are not mandatory to be listed on the label and whose effects can be neurotoxic.[39] The fragrance was either natural at its origin, or derived from organic materials, such as essential oils or natural extracts; or synthesized from a mixture of chemicals[40]; with adverse effects on health or the environment, including contact dermatitis (irritant and/or allergic), non-eczematous contact reactions, photosensitivity, photoallergy and immediate contact reactions, which can have a negative impact on quality of life[41-43]

Triclosan is an antimicrobial additive considered potentially harmful to health as an endocrine disruptor, following prolonged use. Continuous exposure to very low or minimal concentrations of triclosan can lead living organisms to absorb this compound [44,45]. This is how triclosan was banned in 2013 by the FDA [46]. As for BHA and BHT, the Cosmetics Ingredient Review (CIR) has established concentration limits for these substances (0.5% max) due to their uncertain toxicological profile and their potential irritating power on the skin and mucous membranes [47,48]. The Food and Drug Administration (FDA) has advised against the use of products containing chlorphenesin for children and breastfeeding women because of its collateral side effects on children, particularly on the respiratory tract and the central nervous system [49]

Table 2: Distribution of colorants present in cosmetic products

DYE	LOTION	OINTMENT	POWDER	SOAP	OIL	TOTAL
Tartrazine	1	1	1	1		4
Titanium dioxide			1	1		2
Green dye				1		1
chromium oxide green				1	1	2
red dye	1			1		2
Anonymous dye	1	1		1		3
Total	3	2	2	6	1	14

As for dyes, they are contained in descending order, more in soaps, followed by lotions and ointments and less in powder and oils. Tartrazine (TZ) under the code CI 19140, was more present, then anonymous dyes, then red dye under the code CI 17200 and chromium oxide green under the code CI 77288, and finally titanium dioxide under the code CI 77891 and green dye under the code CI 59040.

Dyes are essential ingredients of cosmetic products and have been used for a long time [50]. They influence the senses of consumers, increase the quality of cosmetics and ensure their better functionality; do not improve the condition of skin, hair or nails. Some of them can be harmful to human health. [51]. Dyes, which are another class of additives frequently used in baby cosmetic products, [52]. Apart from these, dyes like quinoline yellow and acid orange are also used in baby cosmetic products. Both are known to cause DNA damage in vitro. [53]

Perinatal exposure to TZ triggered tissue damage evidenced by histological alterations and neuronal lesions in the brain, medulla oblongata, and cerebellum. [54] TZ caused lipid peroxidation and decreased cellular antioxidants in different regions of the newborn brain. [55]

Exposure to TiO2 can begin already during pregnancy as evidenced by the presence of TiO2 NPs in the human placenta and in infant meconium has unequivocally indicated the maternal-fetal transfer capacity of this nanomaterial. [56] Due to their extremely small size, which makes them likely to cross biological barriers and potentially cause adverse health effects[55] including cognitive deficits in offspring associated with neurotoxicity[57]

Table 3: Distribution of other additives present in cosmetic products

Allergens	Lotion	Ointment	Powder	Wipes	Soap	Oils	Total
Alpha-isomethyl ionone	2	1	2	1	1		7
Amyl cinnamal					2		2
Benzyl alcohol				1	1		2
Cinnamon			2				2
Cinnamyl alcohol			3		1		4
Citral	2	1	4		3	1	11
Citronellol			1	1			2
Coumarin	1	1	2	1	1	1	7
Geraniol	2	1	4	2	3	1	13
Hydroxycitronellal	2	1	1		1	1	6
Limonene	4	2	4		4	2	16
Linalool	2	1	3	2	3	1	12
Methylchloroisothia zolinone (MCI or MTI)	4	2	2		2	2	12
Total	19	10	28	8	22	9	96

Cosmetic products used by children contain, according to this table and in decreasing order, limonene, linalool, geraniol, methylchloroisothiazoline, citral, alpha-isomethyl ionone and finally cinnamal derivatives and benzyl alcohol.

For these additives, cosmetic labeling regulations vary from country to country, it is recommended that specific lists of additives should be disclosed separately on the label including, cinnamal derivatives, coumarin, eugenol, geraniol, benzyl benzoate, citronellol, farnesol, d-limonene, linalool and others are disclosed only under the name "Parfum". [59]

Linalool and limonene auto-oxidize upon exposure to air and become potent contact allergens most common in children.[60] Geraniol is a monoterpene constituent of many essential oils of fruits, vegetables, and herbs, including rose oil, citronella, lemongrass, lavender, and other aromatic plants.[61] It has pharmacological activities, including anti-inflammatory, anticancer, antimicrobial, antioxidant, and neuroprotective activities.[62] Methylchloroisothiazolinone (MCI) is an isothiazolinone, a preservative with antibacterial and antifungal properties, found in many commercially available cosmetics, lotions, and makeup removers.[62] It is a known dermatological sensitizer and allergen; side effects include scaly or flaky skin, rash, redness or itching, and moderate to severe swelling of the eyes . [63]

Citral is a key compound of essential oils extracted from several aromatic plants with lemon scent, used as a food additive and as a perfume in cosmetics [64] due to its interesting properties including antifungal, antibacterial and antioxidant activity [65] and anti-inflammatory [66]. It also possesses carminative, diuretic, deodorant and central nervous system stimulant effects [67]. To which are added numerous anticancer activities of human breast by inhibition of cancer cell growth, results of an induction of apoptosis of the leukemic cell line correlated with the activation of caspase-3, the downregulation of Bcl-2 and NF-kB expressions and the upregulation of Bax expression [64].

CONCLUSION

Baby cosmetic products are marketed as being of the highest quality, advertised to boast of their quality and benefits, and are luring consumers to purchase them at much higher prices. Despite the many benefits, many baby products contain traces of harmful chemicals that are likely introduced during the manufacturing, sterilization or packaging stages. Many additives such as preservatives, flavoring agents, coloring agents and aromatic agents, etc., which are added to these products to increase their shelf life and to improve their taste and appearance, are harmful and are known to cause serious health problems in babies.

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