Global Academic Journal of Medical Sciences

Available online at www.gajrc.com
DOI: 10.36348/gajms.2023.v05i03.001

OPEN ACCESS

ISSN: 2706-9036 (P)
ISSN: 2707-2533 (O)

Review Article

Reviewing the Side-Effects of Cosmetics on Skin and Overall Health

Styliani Bertaki[1], Koralia Papakitsou[2], Dr. Evangelos Papakitsos[3*]

[1]International Hellenic University, Thessaloniki, Greece
[2]Agricultural University of Athens, Athens, Greece
[3]University of West Attica, Thivon 250, 12241 Egaleo, Athens, Greece

***Corresponding Author**
Dr. Evangelos Papakitsos
University of West Attica, Thivon 250, 12241 Egaleo, Athens, Greece

Article History
Received: 05.04.2023
Accepted: 11.05.2023
Published: 13.05.2023

Abstract: This study considers the health complications that can be caused by the use of cosmetic products, depending on the substances present in them. For a more complete understanding of the problems that can be caused on human skin, and health in general, the substances that may be found in a number of cosmetic products precedes. Finally, some concerns of the international community regarding the safe use of cosmetic products by consumers are listed, as well as some corresponding measures taken by national and supranational authorities.

Keywords: Cosmetics, complications, side-effects, skin, health problems.

INTRODUCTION

Most cosmetics used daily contain chemicals that are dangerous to health. A large increase in complaints about side effects caused by cosmetics was recorded by an American study for the two years 2015-2016 in the USA [1]. Reports of adverse side effects were 706 in 2015 (up by 78% from the previous year) and 1,591 in 2016 (a 300% annual increase). This increase is due in part to hair care products. These complaints (e.g., hair loss) were made by doctors and consumers, according to data published in the journal JAMA Internal Medicine by researchers at Northwestern University School of Medicine in Chicago. The scientists examined the complaints made to the US Food and Drug Administration (FDA) and found that 35% of them related to hair care products (shampoo, conditioners etc.), followed by those related to care products of the skin and for tattoos (22%). For the most serious health problems, the most frequent complaints (around 50%) concerned baby products, while the damage involved even injury or disability, and even death. It is pointed out that consumers are exposed to risks because cosmetic companies undergo rudimentary testing and their products are not required to be approved by the FDA before they go on the market. This is because these products are not regarded medicines. In 2014, the FDA began investigating the issue after directly receiving 127 consumer reports of hair loss and bruising, swelling, itching and rash. Later, the FDA learned that the manufacturer had already received 21,000 complaints of alopecia and scalp irritation. The products remain on the market as the FDA seeks additional consumer complaints.

The study lead researcher, dermatologist Shuai Xu at Northwestern University Feinberg School of Medicine, said that "The FDA has much less authority to withdraw cosmetics from the market than it does drugs or medical devices. But unlike drugs and medical devices, cosmetics permeate our daily lives. We are exposed to hundreds of chemicals a day from these products" [1]. From 2004 to 2016 there were a total of 5,144 complaints to the FDA about cosmetics but, according to Xu, these are only the tip of the iceberg, as many incidents are never

reported by consumers or doctors. Xu also stated that "Our study is a wake-up call, as it is necessary for everyone to step up and report any side effects of cosmetics. It's a $430 billion a year global industry with millions of products on the market, yet we only receive an average of 400 complaints a year. If we want more safety and keep dangerous products off the market, the first step is to make sure we have reliable evidence, but the key finding of our study is that we don't have it yet" [2]. It should be noted that many companies claim that their products are a combination of cosmetic and drug because they contain some active substance, but they are not controlled accordingly by the FDA, because they are typically cosmetic and not pharmaceutical companies. Xu pointed out that such products are used by newborns to pregnant women on a daily basis, having ingredients that can cause damage [1]. One approach that could help better inform the public is to make it mandatory for companies to report the complaints they receive from consumers to the FDA, or even increase funding to the FDA from companies, covering the costs of investigating these problems [1].

In Europe things are not better. According to Rapex (Rapid alert system for non-food dangerous products), the European Commission's (EC) control system that identifies and informs the states about non-edible products that pose a health risk, the percentage of samples deemed "abnormal" is constantly increasing. This phenomenon was recently confirmed by the Italian Society of Toxicology, which found many types of cosmetics out of regulation [3]: bubble baths (35%), care creams (31%), children's products (14%), lipstick (12%), hair dyes (9%), eyeliner (9%), shampoo (6%), nail polishes (6%), talc (3%), sunscreens (3%). The percentages seem small, but if we consider their combined and repeated use, then the risk percentage increases dramatically, since all these are accumulated. Experts claim that a man uses an average of 7 cosmetic products, while a woman uses 20 [3]. The list is long: toothpaste, lipstick, lip gloss, shadows, powder, deodorant, hair lotion, talc, anti-wrinkle and anti-aging cream, sunscreen lotion. More than 10,000 chemicals are used in common cosmetics. Most of these substances are certainly not illegal, but according to many scientific studies they are toxic to the human body. The list of dangerous toxic substances found in them is equally long: aluminum (causes allergic reactions and is blamed for Alzheimer's disease), ammonia compositions, arsenic, acetone, benzophenones (irritant to the respiratory system), benzyl alcohol, diethanolamine and nitrosodiethanolamine (carcinogenic), dibutyl phthalate (a substance that can reduce fertility and cause damage to the fetus), as well as various preservatives and hormones, lead (toxic to the nervous system), nickel, parabens (being a large group of chemicals: methylparaben, ethyl- paraben, propylparaben, butylparaben, isobutyl-paraben, isopropyl-paraben), petrolatum/paraffin wax (our well-known petroleum jelly), mercury, hydroquinone (used for skin whitening), preservatives and hormones. It is generally known that the above are dangerous. According to this research, the risk is mainly presented by the presence of chemical substances in 88.5% of the samples analyzed, while in a smaller percentage (9.2%) a microbiological risk was observed, due to the presence of pathogenic bacteria for the skin and mucous membranes [3].

Regarding the origin of the offending products, the countries/continents of their production are: Europe (44%), China (26%), the United States (9%) and Africa (8%). All these chemical cosmetics end up through the skin in the blood and create problems for the body [3]. Allergy, for example, is a common phenomenon. Many products containing parabens are used on various parts of the body, both occasionally and on a daily basis.

It is a fact that many chemicals contained in cosmetics are harmful to the human body. The companies' arguments focus on the fact that these substances are either in small quantities or not present at all. However, what must be done every time is for the consumer to carefully read the instructions for use, as well as the possible side effects, before using a product. In addition, the European specifications and guidelines for these products must be closely followed [4]. The basic ingredients of cosmetics are divided into two categories:

- The active ingredients, having the effect of the cosmetic and a positive effect on the skin,
- The inactive ingredients, being the auxiliary substances with absolutely no effect on the skin that are intended to help the stability and texture of the products, such as preservatives, emulsifiers etc.

Some of these inactive ingredients not only do not benefit the skin but seriously damage it. In addition, the skin develops defense mechanisms to eliminate these substances, as a result of which the penetration of the active ingredients of the cosmetic is prevented and it becomes ineffective in practice.

Cosmetics and Complications

According to regulation no. 1223/2009 of the European Parliament (EC) and Council of

November 30th 2009 on cosmetic products [5]: "cosmetic product" means any substance or mixture intended to come into contact with external parts of the human body (skin, hairy parts of the body and head, nails, lips and external genitalia) or with the teeth and mucous membranes of the oral cavity, with the sole or main purpose of cleaning them, perfuming them, changing their appearance, protecting them, keeping them in good condition or correcting body odors.

Cosmetic products are mixtures of chemical compounds that come either from natural sources or are synthetically created and have the purpose of personal care, cleaning or protection, and skin care. They are also designed to improve appearance (makeup) and can be used to hide blemishes, add color to a person's face, enhance physical features and even completely change their appearance, but in no case, according to the regulation, cosmetics do not cure. In some Western countries, cosmetics are usually considered only makeup products. However, in the United States, FDA, which regulates the circulation of cosmetics, defines them as products "intended to be applied to the human body for cleansing, beautifying, promoting attractiveness, or changing the appearance without affecting the appearance of the body or its functions", excluding pure soap from this category [6].

Cosmetic ingredients come from a variety of sources, but this is often not a concern for most consumers, unlike food ingredients. Cosmetics typically use vibrant colors, derived from a wide variety of sources, ranging from crushed insects to rust. Over the years, the ingredients have changed dramatically, after the discovery of the manufacture of perfumes and cosmetic compositions. Awareness of the dangers of many common ingredients also greatly influenced the growing industry [7]. A variety of organic and inorganic compounds are included in typical cosmetics. Typical organic compounds are modified natural oils and fats, as well as a variety of petrochemical-derived agents. Inorganic compounds are processed minerals, such as iron oxide and zinc oxide, which are classified as pigments, i.e., substances that do not have solubility in solvents [8]. The mixtures contained in cosmetics range from 15 to 50 ingredients. The amount and type of each substance used will depend on the type of cosmetics, the part of the body on which it will be used and its shelf life (3 months to 3 years) [9].

The most common ingredients found in cosmetics are the following [10]: alcohol to incorporate specific minerals, fragrances to be consumer friendly, oils and fats for creams or lipsticks, water for liquid products, thickeners to improve consistency, preservatives to increase the shelf life of the product and dyes for color. Natural cosmetics are natural substances that include any substance of botanical, animal or mineral origin as well as their mixtures. Handmade and certified organic products (with only natural ingredients) are becoming more mainstream, due to the fact that some chemicals in some skincare products can be harmful if absorbed through the skin. Products claiming to be organic should carry certification [7]. Minerals are substances extracted from the earth and used as raw materials for the synthesis of various products such as cosmetics, fabrics, medicines, etc. Although they are natural materials, it does not mean that they do not contain substances and elements that are dangerous to health (such as arsenic, lead etc.). Therefore, they must undergo various treatments to make them suitable and safe for use [9]. Mineral makeup usually does not contain parabens, synthetic fragrances, preservatives, mineral oils and chemical dyes. For this reason, dermatologists may consider makeup with minerals to be gentler on the skin than makeup containing these ingredients. Porous minerals are a subcategory of mineral makeup ingredients where the porosity of the particles allows for superior absorption compared to non-porous mineral materials. For example, titanium dioxide found in sunscreens and zinc oxide have anti-inflammatory properties [11].

Preservatives ensure the stability and longevity of cosmetic products. In the list of ingredients, preservatives are usually listed at the end and since they are listed in order of concentration, it means they are present in the lowest concentration. In recent years there has been a trend to eliminate preservatives from cosmetics, but this is no longer the case. Most cosmetics are not used until 3-6 months or more after they leave the manufacturing facility. So, some form of maintenance is required. If the product does not contain water, it can be preserved with lower levels of preservatives, since water is necessary for microbial growth. Many products labeled "preservative free" actually contain preservatives, but the ingredient falls into a different category. For example, phenoxyethanol has a lovely rose scent and can be used as a fragrance ingredient, while actually being a preservative. Many spices, such as clove essences, can be used for a combination of flavoring and preservation. Finally, it is also possible to reduce the concentration of the preservative with special packaging. Many of the newer products are dispensed in a jar fitted with a one-way valve top. This valve prevents oxygen and anything foreign from entering the jar [12].

Often the products used cause unwanted allergic reactions on the skin. The most common complications of care products are the following [13]: acne, eye irritation and allergies. It is very important for the consumer to read the labels of cosmetic products so that they can recognize the harmful ingredients they may contain. Listed below are the most common toxic ingredients that can be found in cosmetics and should be avoided [14]:

Sulfates are the well-known SLS (Sodium Lauryl Sulfate) and SLES (Sodium Laureth Sulfate), used as foaming agents in most personal care products (foam showers, shampoos, soaps, toothpastes, facial cleansers etc.). They cause eye irritation, dermatitis, allergies, hair loss. When combined with other chemical components they can form carcinogenic substances.

Phthalates are used as solvents and are basic components of plastics. In cosmetics, these substances are mainly found in nail polishes, hair sprays, perfumes and lotions. The most common are Dibutylphthalate, Diethylphthalate and Dimethylphthalate. They disrupt the endocrine system, in large quantities they can create reproductive problems, while they are suspected of carcinogenesis. They are difficult to locate as they are not always listed in the product ingredients (they are included in the perfume composition and the only mention is “perfume” or “fragrance”).

Petrochemical ingredients are an endless category with highly dangerous substances (Benzene and benzyl products, Butanol and butyl products, diethanolamine, ethanolamine, ethylenediaminetetraacetic acid, parabens, polyethylene glycol, propyl products, paraffin, mineral oil, aluminum compositions, toluene, formaldehyde). They are derived from petroleum and are widely used in cosmetics. They are contained in moisturizing creams, serums, shampoos, shower gels, lipsticks, sunscreens, etc. They are considered toxic and particularly dangerous for health and the environment. They have been associated with many health problems such as dermatitis, eye irritation, allergic reactions, headaches, etc., while many of them are suspected of carcinogenesis. The list of petrochemical ingredients that can be found in cosmetics is endless.

In cosmetic products, such as lipstick, make-up, lip gloss, eye shadows and facial emulsions, metal pigments, consisting mainly of metal salts and oxides, are added [15]. Such cases are [16, 17]: Cadmium sulfide (CdS), lead oxide (PbO), iron oxides (Fe2O3, FeO), oxide and hydroxide of trivalent chromium (CrO3), copper, gold, other heavy metals such as mercury compounds [18], zinc and titanium oxides [17]. The addition of metals to cosmetic products is subject to a concentration limit, according to legislation [17]. However, there are effects of metals on human health, as shown case by case below [19]:

Antimony (Sb)

Exposure to antimony fumes from smelting in the workplace has been reported to cause severe skin damage. By inhalation or ingestion, antimony can cause respiratory disorders (bronchitis, emphysema, changes in lung function, pneumoconiosis, etc.) and gastrointestinal effects (diarrhea, vomiting, ulcers, and abdominal pain). The International Agency for Research on Cancer (IARC) has assessed antimony trioxide as a possible carcinogen. Lipsticks appeared to contain more Sb than other product categories. Regulation (EC) 1223/2009 and Directive 76/768/EEC prohibit antimony and its salts as additional ingredients in cosmetics, but not as a product impurity.

Aluminum (Al)

Aluminum hydroxide is widely used in pharmaceutical and personal care products. It has been used since ancient times, as it forms an insoluble compound on the surface of the skin, making it astringent, resulting in the correction of odors. Aluminum salts present in antiperspirant products dissolve in sweat, forming a thin film on the surface of the sweat glands, restricting the flow of sweat without impeding the skin’s breathability. There is debate about aluminum exposure and the risk of developing neurological diseases, particularly Alzheimer's disease. Chronic disorders that are currently being discussed in relation to aluminum exposure are breast cancer. In vitro, aluminum increases the proliferation of certain breast cancer cells. However, adverse effects on the respiratory tract with asthma-like symptoms, known as Potroom asthma, have been reported in aluminum industry workers. Antiperspirants, lipsticks and toothpastes are the main sources of systemic exposure to aluminum. Aluminum hydrochloride contained in antiperspirants forms aggregates of insoluble polymeric aluminum hydroxide in sweat ducts, thus preventing sweat from reaching the surface of the skin. Aluminum ion (Al3+) can be absorbed in large quantities through the skin. Finally, some aluminum compounds are used as pigments in nail polish, lipstick and lip-gloss.

Arsenic (As)

The toxicity of arsenic, both to humans and to other living things, is of great concern. It is found in inorganic and organic form. The main inorganic forms include As (III) arsenite and As (V) arsenite, with the former being the most toxic form. Various arsenic compounds are used in industry, in insecticides, herbicides, wood preservatives, shipping and fungicides. Arsenite is lipid soluble and readily absorbed from the gut. Long-term inhalation exposure includes skin effects, circulatory and peripheral nervous disorders, increased risk of lung and urinary tract cancer. Arsenic has a strong tendency to be bound by skin, nails and hair. Complications include a variety of skin problems such as alopecia, nail striae and skin cancer. The use of arsenic in cosmetics is strictly prohibited, but it can be present in traces as an impurity in various substances.

Cadmium (Cd)

Cadmium is considered the least essential and toxic heavy metal. It finds various applications, such as batteries, plastics, paints, TV screens, cosmetics, etc. It is usually present as an impurity in lead or zinc deposits and is therefore mainly produced as a by-product of these. The main sources of cadmium exposure for humans are smoking and food. Chronic exposure to low levels of cadmium can cause kidney damage and bone degradation, because it affects calcium metabolism. The International Agency for Research on Cancer (IARC) classified cadmium and its compounds as carcinogenic. Symptoms of acute cadmium poisoning can be shortness of breath, general weakness, fever, pulmonary edema, pneumonia, respiratory failure, which usually appear after 24 hours. Cadmium is involved in the production of free radicals that result in an increase in oxidative stress, which is considered one of the most important mechanisms of genotoxicity, since it can cause damage that destroys the normal function of cellular organelles and produce mutations in DNA that lead to changes in gene expression, ultimately causing apoptosis. In addition, cadmium can affect DNA repair, which leads to the accumulation of lesions, causing genetic mutations resulting in carcinogenesis. Although the presence of cadmium in cosmetic samples may be in trace amounts and absorption through the skin may be negligible, the slow release of cadmium may have harmful effects on the human body, as it accumulates throughout life and is poorly degraded. The use of cadmium in cosmetic products is due to its property as a pigment, as its color is deep yellow to orange. Cadmium sulfide (CdS) is used for the yellow color. When yellow cadmium is mixed with trivalent chromium oxide, a pale green mixture called “cadmium green” results. Cadmium is present in many cosmetic products, but mainly in lipsticks and face powders.

Cobalt (Co)

Cobalt is considered a skin allergen that causes allergic contact dermatitis (ACD). In 1991, the IARC classified cobalt and its compounds in group 2B (probably carcinogenic). In addition, some of its compounds are classified in group 2A by the EU, such as cobalt sulfate and chloride (Regulation EC No. 1272/2008). It participates in redox reactions, like nickel. Iron deficiency and fasting increase cobalt absorption. Transdermal absorption depends on whether the skin is intact or not. If the skin is intact, absorption is less. Cobalt accumulates primarily in the liver and secondarily in the kidneys and lungs when inhaled. It is mainly excreted through the urine. Cobalt salts are widely used as pigments in make-up and brown hair dyes. Significant levels of cobalt were also found in eye shadows and henna dyes.

Lead (Pb)

Lead is a common pollutant with traces found in soil, water and food. Its compounds have been classified as possible carcinogens. They are absorbed through the respiratory and digestive systems, but also through the skin and then enter the brain, creating a toxin in the central nervous system, which accumulates in soft and hard tissues, in bones and in various but vital organs such as kidneys, pancreas, liver and lungs. In adults, lead primarily affects blood pressure and the kidneys, resulting in chronic kidney disease. It also prevents the normal biosynthesis of heme and affects the life time of erythrocytes, resulting in the appearance of anemia. Children are particularly sensitive to lead, due to high intake from the gastrointestinal system. In pregnant women, lead can easily cross the placenta and enter the fetal brain, even causing miscarriage. Prenatal lead exposure is associated with a greater risk of preterm birth, reduced postnatal growth, lower mental development in childhood, schizophrenia and dementia in adulthood. In men, chronic exposure to lead mainly from hair dyes has been found to reduce fertility. After direct exposure, humans can get rid of 50% of lead within 2-6 weeks, but it takes 25-30 years to get rid of the remaining 50% that has accumulated in the body over time. It is mainly excreted through the urinary and digestive systems. In cosmetics, lead is present in pigments such as lipsticks and powders, skin whitening creams and eye makeup products.

Nickel (Ni)

Nickel is a natural element that functions as a trace element in the human body. Its dispersion in the environment is large. Human exposure is mainly

through inhalation or ingestion. Nickel is a carcinogen that can lead to gastrointestinal distress, kidney problems, pulmonary fibrosis and dermatitis. Common complications are insomnia, vomiting, vertigo, nausea and headache. In relation to cosmetics, nickel represents the main cause of contact dermatitis. Nickel dermatitis produces erythema, eczema and lichenification of the hands and other skin areas that come into contact with it. Nickel sulfide, nickel oxide and its soluble compounds are carcinogenic. Nickel compounds are absorbed through the gastrointestinal tract. It is carried in the blood mainly by the protein albumin and is thought to be present in high concentrations in the brain, adrenal glands, kidneys, liver and lungs. It is excreted through urine and faeces and has also been observed in sweat and saliva. Nickel allergy is often associated with the simultaneous action of other metals, such as chromium and cobalt, although this version is not yet scientifically confirmed. It is mainly used in pigments and other raw materials used in the cosmetics industry. A study of 2011 reported that 36% of lipsticks had nickel above the safe limit, while a high concentration has been found in certain eye shadows. The highest content was measured in gray, brown, yellow and purple colors.

Mercury (Hg)

Mercury is a common pollutant found in the environment, both in inorganic and organic forms. In cosmetics it exists in both forms. Mercury compounds are transported by blood and lymph and diffuse to almost all tissues, but it accumulates mainly in the brain, liver, lymph nodes, muscles, kidneys and spleen. It has strong toxic effects on the central nervous and digestive system. On the skin, complications reported include contact dermatitis, erythroderma and allergic purpura. Endocrine, mutagenic, neurotoxic and teratogenic complications have been reported in patients with chronic poisoning. Mercury-induced toxicity is due to inhibition of antioxidant defense systems, resulting in increased production of free radicals (ROS). It is metabolized and excreted mainly through the digestive system and is completely eliminated in at least 90 days after exposure. In cosmetic products, inorganic mercury (e.g. ammoniacal mercury) is used in creams and soaps for skin whitening, as its inorganic forms inhibit the formation of melanin. Organic mercury (e.g. phenylmercury salts) is used as a preservative in cleaning products and make-up.

Chromium (Cr)

Chromium exists in two main oxidation states, trivalent Cr (III) and hexavalent chromium Cr(VI). Trivalent chromium is an essential nutrient found in trace amounts in humans and plays an important role in glucose and cholesterol metabolism. Hexavalent chromium is very toxic to human health and its compounds are considered carcinogenic to humans. Cr(III) can undergo oxidation reactions caused by hydrogen peroxide (H_2O_2) in blood and can be oxidized to carcinogenic Cr(VI) and Cr(V) in living cells. Exposure to chromium is mainly through inhalation, water and food. Inhalation of a large amount of chromium causes problems in the liver, kidneys and stomach, while it is possible to cause respiratory problems, nosebleeds and lung cancer. Regarding transdermal absorption, Cr(VI) penetrates the skin to a greater extent than Cr(III), due to higher solubility, and causes skin rashes. Trivalent chromium can be added to cosmetics as a colorant, while the addition of hexavalent chromium is prohibited.

Zinc (Zn)

Zinc is a valuable trace element for humans. It is found naturally in the body, being one of the most important biologically active components, necessary for life, as it participates in a wide variety of cellular processes. However, when its amount increases significantly, it can have harmful effects on the body. Excessive zinc intake causes potential toxic effects on hematopoietic function, endocrine biochemistry, and the pancreas. Zinc has been reported to cause the same symptoms as lead and can easily be misdiagnosed as lead poisoning. Zinc oxide (ZnO) which appears as a white powder is often used as an ingredient in sunscreens. It is ideal for use as a broad-spectrum inorganic ultraviolet (UV) filter in personal care products. The high refractive index of zinc can make skin appear unnaturally white when incorporated into skin care creams. Since the demand for skin whitening creams is very high, especially in developing countries, this often prompts cosmetic manufacturers to add zinc intentionally to boost their purchases.

Chronic Complications

Some minerals are essential to life and are considered essential elements required for a variety of biochemical and physiological functions. They are found in the body in trace amounts and are therefore called “trace elements”. However, their significant increase in the body can have serious toxic effects on vital organs. The skin is an excellent barrier to the passage of polar chemical compounds, such as water, however many harmful chemicals are non-polar (lipophilic) and their penetration is not completely prevented. Heavy metal ions in the human body form complexes with other groups (e.g., -NH2) of various proteins, such as enzymes and lipoproteins, causing cell dysfunction or death, having resulting in a variety of diseases. Some metals tend to accumulate in the stratum corneum

and cause allergic complications. Skin exposure is the most important route for cosmetic products, as the majority of cosmetics are applied there. Cutaneous absorption is usually considered negligible, but metals are diffused through perspiration and sebum secretion and may penetrate through skin appendages or through intercellular and intracellular pathways and eventually reach the circulatory system. Oral exposure can occur for cosmetics used in the mucosal and perioral region. The result is the entry of metals into the body through the gastrointestinal tract. Hair dyes penetrate through the sebaceous glands, while cosmetic products for the eye area through the mucous membranes. Inhalation exposure is usually considered negligible. Finally, most metals act as endocrine disruptors that interfere with the hormonal system. Therefore, the daily application of many cosmetic products can lead to an increase in their exposure to the body. When heavy metals accumulate in the body, they are used as substitutes for other essential elements, which can lead to an imbalance of functions in the body. Examples of heavy metals that replace essential body elements include calcium replaced by lead, zinc replaced by cadmium, and most trace elements by aluminum. The use of certain heavy metals in cosmetics has been controversial due to their bioaccumulation and toxicity. In most countries, the use of lead, arsenic and mercury in cosmetic skin products is prohibited by law. Since the intentional addition of certain heavy and light metals as ingredients in cosmetics has been legislated, attention is drawn to the presence of these elements and their compounds as impurities with adverse effects on the body. Although several health complications of heavy metals are known, exposure to heavy metals continues and is still increasing in some parts of the world, mainly in less developed countries, whereas exposure has decreased in most developed countries in recent years [19].

RESULTS AND DISCUSSION

The dangerousness of the above substances has led national and supranational organizations (such as the European Union) to take measures and issue safety instructions to the consumer public that include a list of substances that should not be contained in cosmetic products [20]. The British cosmetics association CTPA published in March 2018 [21] a detailed guide aimed at informing citizens about what to do in the event of an adverse event from the use of cosmetic products. In the guide it is pointed out that unwanted complications from cosmetics are rare, due to their strict European production rules, and at the same time it is emphasized that in some cases the complications can be very serious. It advises consumers to carefully read the instructions on the labels and in special leaflets and in case any complication persists, to contact their family doctor and inform the cosmetics company at the same time.

The strict regulatory framework for cosmetic safety in the UK and European market requires that cosmetic products comply with strict European cosmetics laws, which protect consumers from misleading claims. Thus, there are three levels in the procedure for the safety of cosmetics [21]:

- European legislation requires cosmetics to be safe.
- The professional safety assessor personally signs that the cosmetic product is safe.
- Marketed products are monitored for possible unwanted complications, which are dealt with by the companies, and may have to be reported to the Authorities.

However, despite the safety requirements, unfortunately almost every substance, natural or synthetic, has the potential to cause some reaction. In general, unwanted complications are rare and usually mild and readily reversible. In most cases, when a complication occurs, it is a skin reaction, such as itching, redness or a rash and sometimes swelling. Usually reactions of this kind are mild and will stop immediately after stopping the use of the product. However, serious adverse complications can never be ruled out, and especially in the case of an allergic reaction, the most serious ones may require urgent medical intervention.

Regulation (EC) no. 1223/2009 of the European Parliament and of the Council, of November 30, 2009, on cosmetic products, which began to be applied in 2013, provides, among other things, for the establishment of new obligations to notify serious adverse effects in cosmetics [4]. It is pointed out that responsible persons and distributors must report these actions to their national authorities. All relevant information reported to the Authorities remain confidential, in accordance with the European legislation for the protection of personal data. National authorities must then share this information - as well as any other information they have received from other sources (e.g. users, health professionals, etc.) - to their counterparts in other European Union countries, while the packaging must include a range of information such as the name and address of the person responsible, the contents, precautions for use and the list of ingredients. In addition, they must include:

- New rules for the use of nanomaterials,
- Lists of substances subject to prohibition or restriction of use in cosmetic products,

- Distributors must ensure product compliance with labeling and expiry date reporting requirements, as well as language requirements.

In practice, all these are often not implemented, as the conditions are not met, while in front of the profit at any price the consumer mood prevails. In case of complications, the consumer can report the incident to various centers, such as the Consumer Protection Center - KEPKA [22] in Greece. According to recent data from KEPKA, in 2016 alone, from 3,670 questions and complaints, consumer-members benefited a total of 101,656.14 euros [4].

CONCLUSION

Cosmetic products are sold without the need for a special license to purchase them. The subsequent easy use by many people necessitates that cosmetic products are absolutely safe for consumers. In particular, the skin should not be exposed to risks from the careless use of cosmetic products, whether this is due to the use of incorrect products or due to incorrect dosage. The correct use of cosmetics plays an important role in avoiding adverse effects both on the skin and on the rest of the human body. However, there are gaps in informing the consumer public about possible complications, but with the advancement of Cosmetology science, unwanted complications have been significantly reduced, with the ultimate goal of being completely eliminated.

ACKNOWLEDGEMENTS

The authors would like to express their thankfulness to Assoc. Prof. Iordanis Papadopoulos, of the International Hellenic University, for his contribution to the conduct of this study.

REFERENCES

1. American Medical Association (2017). Adverse Events Reported to the US Food and Drug Administration for Cosmetics and Personal Care Products. JAMA Internal Medicine, Letters (June 26, 2017). Retrieved May 3, 2023, from https://www.healthyliving.gr/wp-content/uploads/2017/06/Adverse-Events-Reported-to-the-US-Food-and-Drug-Administration-for-Cosmetics-and-Personal-Care-Products.pdf
2. HealthyLiving.gr (2017). Cosmetics: Complaints of side effects increased in the US. Health, 30/06/2017. Retrieved May 3, 2023, from https://www.healthyliving.gr/2017/06/30/kallynika-parenergeies-7/ (in Greek).
3. proionta-tis-fisis.com (2017). Complaints about side effects from cosmetics. Our food is our medicine, 31/08/2017. Retrieved May 3, 2023, from https://www.proionta-tis-fisis.com/kataggelies-gia-parenergeies-apo-kallyntika/ (in Greek).
4. Ralli, I. (2015). How dangerous are the cosmetics on the market? Bioprolipsi, 18/09/2015. Retrieved May 3, 2023, from http://www.bioprolipsi.gr/index.php/blog-listing/item/8-media-pet-vizard-released-for-all-vets (in Greek).
5. Tsivginidou, A. (2013). Status Cosmeticus - Cosmetic Intolerance: Cosmetic ingredients that cause adverse skin reactions. Bachelor Thesis, Alexandrian Technological Educational Institute of Thessaloniki, School of Health and Welfare Professions, Department of Aesthetics and Cosmetology, Thessaloniki, Greece (in Greek).
6. Tillery French, C. (n.d.). The History of Makeup. Retrieved May 3, 2023, from https://medusasmakeup.com/pages/history-of-makeup
7. Sarkar, R., Arora, P., & Garg, V. (2013). Cosmeceuticals for Hyperpigmentation: What is Available? *Journal of Cutaneous and Aesthetic Surgery, 3*, 4-11.
8. FDA (2021). Importing Cosmetics. Retrieved May 3, 2023, from https://www.fda.gov/industry/regulated-products/cosmetics-overview
9. Giorgou, K. (2022). Clinical studies of safety and efficacy of innovative cosmetic products: A literature review. Master's Thesis, University of West Attica, School of Health and Welfare Sciences, Department of Biomedical Sciences, Master's Program “Advanced Aesthetics and Cosmetology: Development, Quality Control and Safety of New Cosmetic Products”, Athens, Greece (in Greek).
10. Daskalaki, P. (2010). Getting to know our cosmetics better. Bachelor Thesis, Technological Educational Institute of Thessaly, Larissa, Greece (in Greek).
11. FDA (2022). FDA Authority Over Cosmetics: How Cosmetics Are Not FDA-Approved, but Are FDA-Regulated. Retrieved May 3, 2023, from https://www.fda.gov/cosmetics/cosmetics-laws-regulations/fda-authority-over-cosmetics-how-cosmetics-are-not-fda-approved-are-fda-regulated
12. European Commission (2016). International Cooperation on Cosmetics Regulation. Working Group on the Preservation of Cosmetic Products, International Cooperation for Cosmetic Legislation (ICCR), Brussels.
13. Health & Beauty (2021). Cosmetics and Adverse Reactions. Retrieved May 3, 2023, from https://yo.gr/kallyntika-kai-anepithymites-antidraseis-toy-dermatos/ (in Greek).

14. panabeau.com (n.d.). The most toxic ingredients in beauty products – Avoid them! Retrieved May 3, 2023, from https://panabeau.com/articles/show/the-most-toxic-ingredients-in-beauty-products-18
15. Barbaud, A., & Lafforgue, C. (2021). Risks associated with cosmetic ingredients. *Ann Dermatol Venereol., S0151-9638*(21), 00014-4.
16. Godt, J., Scheidig, F., Grosse-Siestrup, C., Esche, V., Brandenburg, P., Reich, A., & Groneberg, D. A. (2006). The toxicity of cadmium and resulting hazards for human health. *Journal of occupational medicine and toxicology*, *1*(1), 1-6.
17. Arshad, H., Mehmood, M. Z., Shah, M. H., & Abbasi, A. M. (2020). Evaluation of heavy metals in cosmetic products and their health risk assessment. *Saudi Pharmaceutical Journal, 28*(7), 779-790.
18. Mohiuddin, A. K. (2019). Heavy Metals in Cosmetics: The Notorious Daredevils and Burning Health Issues. *American Journal of Biomedical Science and Research, 4*(5), 332-337.
19. Bourtouvalou, P. (2021). Quality Control of Heavy Metals in Cosmetic Products. Diploma Thesis, University of West Attica, School of Health Sciences and Welfare, Department of Biomedical Sciences, Department of Aesthetics & Cosmetology, Athens, Greece (in Greek).
20. Twenty-fourth Commission Directive 2000/6/EC of 29 February 2000 on the adaptation to technical progress of Annexes II, III, VI and VII of Council Directive 76/768/EEC on the approximation of the laws of the Member States of the aforementioned in cosmetic products (Text with EEA relevance), Official Journal no. L 056 of 01/03/2000 p. 0042 – 0046.
21. aesthetics.gr (2021). Thematic Libraries - European Framework for Cosmetics. Retrieved May 3, 2023, from https://www.aesthetics.gr/%ce%b5%cf%80%ce%b9%ce%bc%cf%8c%cf%81%cf%86%cf%89%cf%83%ce%b7/%cf%80%ce%bb%ce%b1%cf%84%cf%86%cf%8c%cf%81%ce%bc%ce%b1-%ce%b1%cf%85%cf%84%ce%bf%ce%bc%cf%8c%cf%81%cf%86%cf%89%cf%83%ce%b7%cf%82/%ce%b5%cf%85%cf%81%cf%89%cf%80%ce%b1%cf%8a%ce%ba%cf%8c-%cf%80%ce%bb%ce%b1%ce%af%cf%83%ce%b9%ce%bf-%ce%b3%ce%b9%ce%b1-%cf%84%ce%b1-%ce%ba%ce%b1%ce%bb%ce%bb%cf%85%ce%bd%cf%84%ce%b9%ce%ba%ce%ac/ (in Greek).
22. Consumer Protection Center – KEPKA (2023). Complaints. Retrieved May 3, 2023, from https://kepka.org/mainmenu-28/mainmenu-56 (in Greek).