

Possible Health Implications Associated with Cosmetics: A Review

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Abstract: Cosmetics are products applied to the body or face to improve appearance. They cleanse, beautify, promote attractiveness and alter appearance of the body. The concept of beauty and cosmetics is as old as mankind and civilization. Assorted beauty products such as skincare products, hair products, fragrances, oral hygiene, and nail products, which may contain toxic chemicals that can be harmful to health are used especially by women. Most cosmetic products contain hazardous chemicals like Sodium Laureth Sulphate, Talcum, Parabens, Coal tar dye, Phthalates, Fragrance, Mineral oil, Triethanolamine and some heavy metals eg, Lead, Arsenic, Nickel, Cadmium, and Mercury. The bioaccumulation of these harmful chemicals and metals in the body over time has been associated with cancer, reproductive and developmental disorders, contact dermatitis, hair loss, lung damage, ageing, skin disease and reaction, allergies, and damage of nails. The deleterious chemicals and metals can enter into the body by inhalation of perfumes, deodorant, nail polish, scented powder, etc; by absorption through penetration of harmful chemicals from body creams, moisturizers, cleanser, eye shadow, etc. It can also be by ingestion of chemicals and metals in lip sticks, lip balm, lip gloss, etc. through the mouth.

Keywords: Health, Implications, Hazards, Cosmetics, Chemicals, Metals

1. Introduction

Cosmetics are products applied to the body for the purpose of beautifying, cleansing or improving appearance and enhancing attractive features [1]. They include a range of products such as tooth paste, shampoo, conditioners, mascara, after shave lotion, styling gel, creams, lotions, powders, perfumes, lipsticks, fingernail and toenail polish, eye and facial make-ups, permanent waves, hair colours, hair sprays and deodorants. According to [2] 'make up' is classified as subset of cosmetics that has to do with beautifying of the face. Schneider *et al.*, [3] defined skincare products or cosmetics as mixtures of synthetic or natural chemical compounds used to improve the appearance or smell of the body. They are articles intended to be rubbed, poured, sprinkled or sprayed on, introduced into, or otherwise applied to the human body or any part thereof for promoting attractiveness, cleansing, beautifying or altering the appearance without affecting the body structure or functions.

The use of cosmetics dates back to around 10000BC [4]. Many of the present-day beauty rituals such as hair colouration, depilation and exfoliation find their roots in ancient Egyptian culture [5]. In the olden days, the Romans, Greeks and Egyptians used various cosmetics which contain white Lead and Mercury [2]. Scented oils and ointments were used to clean and soften the skin and mask body odour while dyes and natural paints were used to colour the face, mainly for ceremonial and religious occasions [4]. According to [2], there is a common ancient belief that eye makeup could ward off evil spirits and improve sight.

The use of cosmetics today cuts across people of all spheres of life. Facial cosmetics are a necessity in the entertainment industry where hundreds of new recruits are daily added to the huge number of cosmetics users with little or no knowledge of their side effects. Some of the cosmetics used contain different compounds like zincite, cuprite goethite, amorphous carbon, elemental silicon or talc hematite, minimum organic compounds, and even heavy metals such as Lead [6, 7]. Black Antimony which was used

as eyeliner in ancient Egypt [8] is still being used by people in Northern Nigeria [9]. It is locally known as “Tiro, Otanjel, and Buje,” in the three major languages in Nigeria [10]. Antimony (Sb), is white in colour and more shining than Silver; containing 81% Lead, and mostly harvested from Abakaliki, Ebonyi State, Nigeria [11]. Black Antimony, applied to the eyes as ground, fine crystalline powder with the aid of thin stick, is used to draw a straight line on the eyes. The application of these mineral locally to the eyes is believed to serve as treatment of ophthalmologic infections and as an eye cleanser [9]. The use of the local eye liner has been reported as a suspected source of Lead exposure to the ocular system in children and adults [12].

Calabash chalk also known as Calabar stone is an ancient cosmetic used by Nigerian women. This natural cosmetic is made up of fossilized seashells, mixed with clay mud and other ingredients such as sand, wood ash, and sometimes salt [13]. The calabash chalk is ground into a fine powder and rubbed on the face as facial powder and antiperspirant which makes the face to remain dry [14].

The use of cosmetics by Nigerian women is an ancient tradition. Women, young and old, apply and beautify themselves with cosmetics of different texture and colours, especially during festive periods. Cosmetics are believed to improve the best features and cover the blemishes on the person wearing them.

Some factors such as advertisement, peer pressure and social acceptance, influence the choice of skincare products applied by most women. A study conducted by Robertson *et al.*, [15] revealed that women who apply make-up are insecure, anxious and not confident about themselves.

Cosmetic products contain varieties of different harmful or toxic chemicals capable of attacking the skin. Manufacturers of skincare products do not only use synthetic ingredients but also natural products, such as Shea butter, Rose extract, and cane sugar which are sustainable, cheap and less harmful to the consumer [16].

2. Side Effects of Cosmetics

Skincare products such as perfumes, make up, nail polish, etc, can cause allergic reactions and skin irritation; these products can remain on the body for a long period of time and cause significant adverse reactions [17, 18]. Moisturizers increase the hygroscopic properties of the skin particularly when the concentration of these substances is high in the body. It can cause irritation and exfoliation. Skin lightening agents such as hydroquinone (HQ) is one of the most harmful chemicals. However, there have been reports of ochronosis and potential mutagenicity. Ochronosis is an uncommon adverse effect of HQ, characterised by progressive darkening of the area to which the cream containing high concentrations of HQ is applied for many years [19].

Black henna tattoo is a chemical stain due to p-phenylenediamine (PPD), in the form of commercial hair dye mixed into the henna paste. Negative effect of PPD may include, blisters and surface oozing, swelling, erythematous

rash. Studies have been made and reports given about the immediate allergic reactions on using henna dyes. Most cases involve sneezing, runny nose, cough and shortness of breath instead of skin reaction [19].

Sun-screening agents can cause irritant, allergic, phototoxic or photo-allergic reactions. Benzophenones are the most common sensitizers, while debenzoylmethanes, para-aminobenzoic acid (PABA) and cinnamates may cause photo-allergic dermatitis [20].

The allergic reactions associated with deodorant/anti perspirants and fragrances are mostly caused by the fragrance or other ingredients. Fragrances can enter the body through skin (adsorption), lungs, air ways, ingestion and through pathways from the nose directly to the brain and can cause headaches, dizziness, fatigue, irritation to eyes, nose and throat, forgetfulness and other symptoms. Fragrances sprayed in the air or found in air can cause air-borne contact dermatitis. Chemicals like coumarin, phthaloleugenol found in fragrances are suspected carcinogens, while phthalates are suspected hormones disrupters [21].

Shampoos and conditioners do not have much contact with the skin; they are only applicable to the hair and as such, cause less adverse effect. However, they can be a problem when they come in contact with the eyes during washing of the hair. The most common effect of using shampoo is the matting of the scalp hair (also referred to as tangling of hair) [22]. Active ingredients in hair bleaching product such as Hydrogen peroxide solutions, and Ammonium persulfate, may cause Types I and IV allergic contact reactions.

3. Health and Environmental Hazards of Some Chemicals in Cosmetics

BHA (butylated hydroxyanisole) and BHT (butylated hydroxytoluene) are closely related synthetic chemicals used as preservatives in moisturizers and lipsticks, among other cosmetics. BHA and BHT can cause allergic reactions in the skin. The International Agency for Research on Cancer has classified BHA as a possible human carcinogen. The European Commission on Endocrine Disruption has also listed BHA as a Category I priority substance, based on evidence that it interferes with hormone function [23]. BHT may act as a tumour promoter in certain situations. Limited evidence suggests that high doses of BHT may mimic oestrogen, the primary female sex hormone, and prevent expression of male sex hormones, resulting in adverse reproductive effects [23].

3.1. Coal Tar Dyes

Coal tar is a mixture of many chemicals, from petroleum. Coal tar-derived colours are used mostly in cosmetics, generally identified by a five digit Colour Index (CI) number. The p-phenylenediamine is a particular coal tar dye used in many hair dyes. Darker hair dyes tend to contain more phenylenediamine than lighter colours.

Coal tar is associated with cancer and the main concern with individual coal tar colours (whether produced from coal tar or synthetically) is the possibility of them to cause cancer. These colours may be contaminated with low levels of heavy metals and some are combined with Aluminum substrate. Aluminum compounds and many heavy metals are known to be harmful to the brain. Some of these colours used to produce these dyes are not approved as food additives, yet they are used in cosmetics that may be ingested, like lipstick. P-phenylenediamine has been found to be carcinogenic [24]. Zhang [25] has established that women who use hair dyes especially over a long period have increased risk of developing non-Hodgkin's lymphoma (cancer of the lymph system). The European Union classifies p-phenylenediamine as toxic (whether by contact, inhalation, or by ingestion) and as very toxic to aquatic organisms, as it may cause long-term adverse (chronic) effects in the aquatic environment.

3.2. *DEA (Cocamide DEA and Lauramide DEA)*

DEA (diethanolamine) related ingredients are used to make cosmetics creamy or sudsy, or as a pH adjuster to reduce the acidity of other ingredients. They can be found in shampoos, soaps and cleansers. DEA reacts with nitrites in cosmetics to form nitrosamines. Nitrites are sometimes added to products as anti-corrosive agents or can be present as contaminants [25]. The deterioration of some chemicals used as preservatives in cosmetics can release nitrites when the product is exposed to air. In laboratory experiments, exposure to high doses of DEA-related ingredients has been shown to cause liver cancers and precancerous changes in skin and thyroid. These chemicals can also cause mild to moderate skin and eye irritation. Cocamide DEA is known as hazardous to the environment because of its acute toxicity to aquatic organisms and can bioaccumulate [25].

3.3. *Dibutyl Phthalate (DBP)*

DBP is used mainly in nail products as a solvent for dyes and as a plasticizer that prevents nail polishes from becoming hard and easily broken. It has been shown to cause developmental defects, changes in the prostate and testes and reduces sperm counts [26]. It has also been classified as a suspected endocrine disruptor on the fact that it interferes with hormone function, and may cause harm to the unborn child and worsen infertility. Furthermore, Health Canada reveals that exposure to phthalates may pose health effects such as liver and kidney failure in young children when products containing phthalates are ingested for extended periods [27, 28]. Phthalates have been linked to reduced sperm count in men and reproductive defects in the developing male foetus (when the mother is exposed during pregnancy), among other health effects.

3.4. *Parabens*

Parabens are the most commonly used preservative in cosmetics. An estimated 75 to 90 per cent of cosmetics contain parabens (typically at very low levels). Parabens

easily penetrate the skin and are suspected of interfering with hormone function (endocrine disruption). They can mimic oestrogens, the primary female sex hormone. They can as well interfere with male reproductive functions. In addition, studies indicate that methylparaben applied on the skin reacts with other chemicals, leading to increased skin aging and DNA damage [29]. Parabens occur naturally at low levels in certain foods, such as barley, strawberries, carrots, onions, currents, and vanilla, although a synthetic preparation derived from petrochemicals is used in cosmetics [30]. Parabens in foods are broken down when eaten, making them less strongly estrogenic. In contrast, when applied to the skin and absorbed into the body, parabens in cosmetics bypass the metabolic process and enter the blood stream and body organs intact. It has been estimated that women are exposed to 50 mg per day of parabens from cosmetics [30]. They are associated with cancer and neurotoxicity among other adverse health effects [31].

3.5. *Perfume (Fragrance)*

The term perfume (fragrance) on a cosmetic ingredients list usually represents a complex mixture of many chemicals. Some 3,000 chemicals are used as fragrances. Fragrance is an obvious ingredient in perfumes, deodorants and colognes. It is used in nearly every type of skincare product. Even products marketed as "fragrance-free" or "unscented" may contain fragrance ingredients in the form of masking agents that prevent the brain from perceiving odour [27]. Many of unlisted fragrance ingredients are irritants and can cause allergies, severe headache and asthma symptoms. Perfume can worsen asthma and perhaps even contribute to its development in children. It is ranked the second most common cause of allergy in patients [32].

3.6. *Polyethylene Glycols (PEGs)*

Polyethyleneglycols (PEGs) are petroleum-based compounds that are widely used in creams as thickeners, solvents, softeners and moisture-carriers. Depending on the production processes, PEGs can be contaminated with measurable amounts of 1,4-dioxane. According to the, 1,4-dioxane has been suspected to be carcinogenic. It does not easily degrade and can remain in the environment long after it is rinsed down the shower drain [21]. PEGs show some evidence of genotoxicity and if used on broken skin can cause irritation and systemic toxicity.

3.7. *Petrolatum*

Petrolatum serves as a barrier to lock moisture in the skin in a variety of moisturizers. It is used in hair care products to make hair shine. It is also known as mineral oil jelly. Petrolatum can be contaminated with polycyclic aromatic hydrocarbons (PAHs). Studies have shown that exposure to PAHs – including skin contact over a long period of time – is connected with cancer. On this basis, the European Union categorise petrolatum as a carcinogen and

restricts its use in cosmetics. PAHs in petrolatum can also cause allergies and skin irritation [33].

3.8. Siloxanes

These are silicone-based compounds used in cosmetics to soften, smoothen and moisten skincare product. They make hair products dry faster and deodorant creams slide on more easily. They are mostly used in moisturizers and facial treatments. Cyclotetrasiloxane and cyclopentasiloxane known are toxic, persistent and have the potential to bioaccumulate in aquatic organisms. Cyclotetrasiloxane is classified as an endocrine disruptor, as it interferes with human hormone function, and as possible reproductive toxicant, may impair human fertility [34].

4. Health Risk Associated with Heavy Metals in Cosmetics

Heavy metals have been implicated in cosmetics commonly used among women [35, 36]. Again, hazards associated with heavy metal in facial make-ups have been discussed in literatures [37]. Heavy metals which can build up in the body over time are known to cause various health problems, such as; cancer, reproductive and developmental disorders, neurological problems; cardiovascular, skeletal, blood, immune system, kidney and renal problems; headaches; vomiting, nausea and diarrhoea; lung damage; contact dermatitis; and brittle hair and hair loss. Some are hormone disruptors while others are respiratory toxins. However, for some like Lead, there is no known safe blood level. They can be ingested or absorbed through the skin, especially broken skin [38].

4.1. Cadmium

Cadmium occurs naturally in the environment. Cadmium found in body and hair creams are absorbed into the body through dermal contact [39]; stored in the kidney and the liver, although it can be found in almost all adult tissues. It is considered to be "carcinogenic to humans" by the IARC [40] and its compounds, categorized as known human carcinogens by the United States Department of Health and Human Services [41]. Ingestion of high levels of cadmium can lead to severe stomach irritation, vomiting and diarrhoea, while exposure to lower levels for a long time can lead to kidney damage, bone deformity, and the ability of bones to break easily [41].

4.2. Lead

Lipstick can become contaminated with Lead via the use of contaminated raw materials or through the use of pigments that contain it [42]. Skin contact with Lead occurs daily, and some have been found to be absorbed through the skin [27]. The use of leaded eye powders (e.g., Surma, Kohl, Alkol) has been associated with increased blood-lead levels in children and women [43]. Pregnant women and young

children are particularly vulnerable because it can cross the placenta with ease and enter the foetal brain [42]. It can also be transferred to infants through breastfeeding [44] and stored in bones [45]. Lead exposure has also been linked to miscarriage, hormonal changes, reduced fertility in men and women, menstrual irregularities, delays in puberty onset in girls [42]. Lead and inorganic lead compounds have been classified as a suspected carcinogenic to humans [40].

4.3. Nickel

Due to the abundance of this metal in nature, everyone is exposed to small amounts, mostly through food, air, portable water, soil, household dust, and skin contact with products containing it, including cosmetics [27, 41]. High levels of exposure can lead to health effects depending on route and the kind of nickel exposed to [27]. While certain types of Nickel are considered to be "toxic" because of their carcinogenicity, metallic Nickel and alloys have been classified as possibly carcinogenic to humans [40]. Allergy to Nickel is also common and it can cause severe contact dermatitis [27]. The first case of Nickel allergy caused by eye shadow has been reported; even as 1 ppm of it may trigger a pre-existing allergy [38].

4.4. Mercury

Mercury is a common ingredient found in skin-lightening soaps and creams. It is also found in other cosmetics, such as eye make-up, cleansing products and mascara. Skin-lightening soaps and creams are mostly used in certain African and Asian countries. They are also used among dark-skinned populations in Europe and North America [46].

Mercury salts inhibit the formation of melanin, resulting in a lighter skin tone. Mercury in cosmetics exists in two forms: inorganic and organic. Inorganic mercury (e.g. ammoniated mercury) is used in skin-lightening soaps and creams. Organic mercury compounds (ethyl mercury and phenyl mercuric salts) are used as cosmetic preservatives in eye make-ups, cleansing products and mascara. The main adverse effect of the inorganic mercury contained in skin-lightening soaps and creams is kidney damage [46].

Mercury in skin-lightening products can also cause skin rashes, skin discoloration and scarring, as well as a reduction in the skin's resistance to bacterial and fungal infections. Other effects include anxiety, depression or psychosis and peripheral neuropathy. Mercury in soaps, creams and other cosmetic products is eventually discharged into wastewater. The mercury then enters the environment, where it becomes methylated and enters the food-chain as the highly toxic methylmercury in fish. Pregnant women who consume fish containing methylmercury transfer the mercury to their foetus, which can later result in neuro-developmental deficits in the children [46].

5. Conclusion

Although, cosmetic products are not often associated with serious health hazards, this does not mean that they are

always safe to use, especially with regard to possible long-term effects as the products may be used extensively over a long period of time. Cosmetics and skincare products may contain ingredients whose safety is not certain or which are known to cause health risks. Many of the cosmetics, particularly hair dyes and shampoos may contain ingredients classified as known or probable human carcinogens. Again, many of these products may contain penetration enhancers, increasing penetration through the skin.

In Nigeria, the agencies that control the safety of cosmetic products are working hard to ensure safety of the consumers of these products; the manufacturers of these products on their part have the responsibility to ensure the clinical safety of their products.

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