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Potential Health Risks Associated with Cosmetics and Personal Care Products: An Overview

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Abstract

Cosmetics are substances used on the face or body to enhance look. They purify, enhance beauty, encourage attractiveness, and change how the body looks. The history of humanity and civilization parallels the idea of beauty and cosmetics. Women utilize a variety of cosmetic products, notably those related to skincare, hair, fragrances, oral hygiene, and nails, all of it can contain harmful substances that are terrible for our health. This study employs an integrated method for reviewing the literature, as outlined by Whittemore and Knafl, 2005. This study links potential health issues documented in the scientific literature to the primary hazardous chemicals found in cosmetic items. In the composition of cosmetic products, the cosmetic industries are currently using more chemicals with preservative activity, surfactants, perfumes, stains, etc. These compounds improve the quality, characteristics, and durability of cosmetics; however, many of them are poisonous to humans and pose health hazards, it might vary in severity from a mild allergic reaction to a deadly intoxication of dangerous substances, such as talc, parabens, mineral oil, triethanolamine, coal tar dye, phthalates, scent, lead, arsenic, nickel, cadmium, and mercury, are found in most cosmetic goods. Over time, the body's bioaccumulation of these dangerous chemicals and metals has been linked to several health issues such as cancer, developmental and reproductive abnormalities, contact dermatitis, hair loss, lung damage, aging, skin diseases and reactions, allergies, and nail damage. Inhaling perfumes, deodorant, nail polish, scented powder, etc., or absorbing through the penetration of toxic chemicals from body creams, moisturizers, cleansers, eye shadow, etc. are two ways that dangerous chemicals and metals can enter the body. Another way is by oral consumption of metals and compounds found in lip balms, glosses, lipsticks, etc.

Keywords: Metals, chemicals, cosmetics, health implications, and hazards.

Introduction

Cosmetics are items that are used on the body to improve appearance traits and beautify, cleanse, or im-

prove look (Singh, 2010). The US Food and Drug Administration (MoCRA, 2022) claims that, cosmetics 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 cleansing, beautifying, promoting attractiveness, or altering the appearance." They contain a variety of items like deodorant, after-shave lotion, styling gel, shampoos, conditioners, toothpaste, mascara, lotions, creams, powders, perfumes, lipsticks, nail polish, eye and facial makeup, permanent waves, hair colors, hair sprays, and deodorants. Claeyssens (2009) classifies makeup as a subcategory of cosmetics that are used to enhance facial beauty. According to Schneider et al. (2001), skincare products and cosmetics are composed of synthetic or natural chemical compounds that are intended to enhance the body's appearance or odor. These are substances meant to be applied, rubbed, poured, sprayed, or otherwise mixed with the human body or any portion of it to enhance beauty, purify, or change the look without changing the composition or operations of the body. Numerous chemical additions have harmful effects on human health, ranging from minor hypersensitivity to potentially fatal or life-threatening overdose. Consequently, the use of cosmeceuticals has lately grown in importance as a public health concern (Bilal, 2019). According to the United Nations Environmental Program, there are about 70,000 synthetic compounds in use worldwide and 1500 new chemicals are released year (UNEP, 2004). The list of possible health problems that could arise is extensive because of the vast range of pollutants that could be present in a wide range of makeup products. Cancers, including malignant mesothelioma and breast cancer, infertility problems and birth defects, neurological disorders, hormone imbalances, pregnancy difficulties, asthma, thyroid problems, and other conditions are some of the common health issues associated with toxic cosmetics (Harley KG, et al., 2019; Leslie B. Hart, 2020; NIEHS, 2021; Mandy Goldberg, 2022; Rosen EM, et al., 2024).

Cosmetics have been used since approximately 10,000 BC (Price, 2015). Ancient Egyptian culture is the source of many modern beauty practices, including hair coloring, waxing, and exfoliation (Patkar, 2008). The ancient Greeks, Romans, and Egyptians utilized a variety of cosmetics that included mercury and white lead (Claeyssens, 2009). While dyes and natural paints were applied to the face, primarily for religious and ceremonial purposes., scented to clean, soften, and mask body odor, ointments and oils were applied (Price, 2015). It is a widely held historical notion, according to Claeyssens (2009), that wearing eye makeup can both enhance vision and ward off evil spirits.

These days, people from all walks of life utilize cosmetics. In the entertainment sector, where thousands of new people join the vast user base of cosmetics every day and many are unaware of their potential negative consequences, facial cosmetics are a must. Hematite, amorphous carbon, and elemental silicon or talc, zincite, cuprite, goethite, minimal organic compounds, and even heavy metals like lead are present in some of the cosmetics that are utilized (Hardy, 1998; 2004). People in Northern Nigeria continue to utilize black antimony, which was once used as eyeshadow in the historical Egyptian (Chukwuma, 1997; Badeeb, 2008). In the three main languages of Nigeria, it is referred to locally as "Tiro, Otanjele, and Buje" (George, 2006). The majority of antimony (Sb), which is extracted from Abakaliki in Nigeria's Ebonyi State, is white and more brilliant than silver. It contains

81% lead (Biringuccio, 1990). Using a thin stick to outline the eyes in a straight line, black antimony is applied as finely ground crystalline powder. It is thought that using this mineral topically to the eyes will help heal ophthalmologic infections and clean the eyes (Chukwuma, 1997). Lead exposure in both adult and pediatric ocular systems has been linked to the use of local eyeliner (Gibbs, 2015).

Calabarstone, another name for calabash chalk, is a traditional cosmetic used by women in Nigeria. Fossilized seashells are combined with clay mud, sand, wood ash, and occasionally salt to create this natural cosmetic (Dean, 2011). After being ground into a fine powder, calabash chalk is used on the face as an antiperspirant and facial powder to keep the skin dry (Ekosse, 2010). Women of many ages use makeup with varying textures and colors to enhance their appearance, particularly during festive seasons. Cosmetics are thought to accentuate a person's greatest qualities and conceal their flaws.

The majority of women choose their skincare products based on a variety of reasons, including social approval, peer pressure, and ads. According to a study by Robertson et al. (2008), women who wear makeup feel self-conscious, nervous, and insecure. Cosmetic items include a wide range of hazardous or poisonous substances that can damage skin. In addition to synthetic components, producers of skincare products also use inexpensive, sustainable, and less hazardous natural resources including cane sugar, shea butter, and rose extract (Rinaldi, 2008).

Side Effects of Cosmetics and public health

Cosmetics, toiletries, and skin care products—including sunscreens—are the most prevalent sources of hospital referrals for allergic contact dermatitis (De Groot, 1990) and quite often result in unpleasant responses (Foley, 1993; Jonathan, 2024). According to estimates, 1-3% of people are allergic to a cosmetic or an ingredient in a cosmetic (De Groot, 1998). During a year, 700 responses were received in an American poll with 30,000 participants (Grief, 1977). Perfumes, makeup, nail polish, and other skincare items can irritate skin and trigger allergic reactions. These products can stay on the body for extended periods and have a major negative impact (Nigam, 2009; Shalom et al., 2013). Reproductive and developmental issues have become more common in recent years. For instance, male reproductive issues, such as hypospadias and undescended testicles, doubled in frequency in men between 1970 and 1993, according to data from the Centers for Disease Control and Prevention (CDC,). Chemicals found in the environment are highly likely to be contributing factors. Several recent studies draw attention to the low-level quantities of possible toxicants that could harm reproduction or development, especially phthalates, found in cosmetics and personal hygiene items (Barrett, 2005).

The largest human organ is the skin. It serves as the body's physical barrier of defense and carries out numerous vital tasks that are essential to life. For millennia, body adornment has been a practice shared by men and women, and it has been linked to many forms of skin and body care (Materna, 2020). The hygroscopic qualities of the skin are enhanced by moisturizers, especially when the body has significant concentrations of these chemicals. It may irritate skin and exfoliate it. These include skin-lightening treatments like hydroquinone (HQ) and other potentially harmful compounds. Nonetheless, ochronosis and possible mutagenicity have been reported. Ochronosis is a rare side effect of HQ that is characterized by a long-lasting, in-

creasing darkening of the area where the cream with high HQ concentration is administered (Nigam, 1998).

According to Dogra, Minocha, and Kaur (2003), 3.3% of patients who used different cosmetics experienced contact allergic dermatitis. Just 35 percent of people had photoallergic dermatitis from hair dyes and lipsticks. The other less frequent symptoms were nail and hair breaking, contact irritant dermatitis, hyper- and hypopigmentation, contact urticaria, and acneiform eruptions. A few cases involved multiple allergies to different cosmetics and their constituents. PPD is reported to be a common contact allergen in hair dyes and a very potent sensitizer in 35–42% of cases (Pasricha, 1988; Dogra, 2003). It has been demonstrated that certain products, like shaving cream containing isopropyl myristate and musk mix (Calnon, 1976), soaps containing chloroxylenol (dc Groot, 1988), lipsticks containing propyl gallate (Bajaj, 1996), bindis containing tertiary butyl hydroquinone (Mehta, 2003), and face cream containing bronopol, butyl hydroxy anisole, cetyl alcohol, isopropyl myristate, sorbitan mono-oleate, sorbitan sesquiplane, triclosan, triethanolamine, and different perfumes, etc (Yueh MF, 2016; Weber AA, et al., 2022).

Certain chemicals found in personal care products can disrupt the hormone system and provide hazards at extremely low concentrations (Veldhoen, 2007; Laura, 2012; Stevens DR, et al., 2023). According to research, the period of prenatal and early postnatal development, when organ and neurological systems are established, may be the most vulnerable to the effects of "endocrine disrupting" chemicals such as phthalates and parabens (NIEHS, 2019; Welch BM, et al., 2022). Endocrine disorders and certain forms of cancer have been related to exposure to these substances (Harley, 2020). Endocrine disruptors, for instance, have been connected to breast cancer because of their known effects on how women's bodies use estrogen. Additionally, studies have demonstrated that endocrine disruptors might impair immunity, which increases our susceptibility to illness and viruses (Goldberg, 2019; Chang CJ, et al., 2023).

Due to p-phenylenediamine (PPD), which is present in commercial hair dye mixed with henna paste, black henna tattoos are chemically stained. PPD side effects include erythematous rash, blisters and surface leaking, and swelling. Studies and reports on the instantaneous allergic reactions associated with henna dye use have been published. Rather than a skin reaction, the majority of instances involve sneezing, runny nose, coughing, and shortness of breath (Nigam, 1998; Chan M, et al., 2023; Wise LA, et al., 2023).

Sunscreen chemicals may elicit allergic, irritating, phototoxic, or photoallergic reactions. The most prevalent sensitizers are benzophenones; photoallergic dermatitis can be brought on by debenzoylmethanes, para-aminobenzoic acid (PABA), and cinnamates (Johansen, 1996; Bhattacharjee et al., 2021).

The scent or other compounds in deodorants and antiperspirants are largely to blame for allergic reactions related to them. Fragrances can produce headaches, weariness, dizziness, irritation of the eyes, nose, and throat, amnesia, and other symptoms. They can also enter the body through the skin (adsorption), lungs, airways, ingestion, and pathways from the nose directly to the brain. Airborne contact dermatitis can be brought on by fragrances sprayed or detected in the atmosphere. Fra-

grances contain compounds including coumarin and phethleugenol, which are potential carcinogens, and phthalates, which are suspected hormone disruptors (Bridges, 2002).

Shampoos and conditioners simply apply to the hair and have less contact with the skin, thus they have fewer side effects. They could, however, become an issue if they go into the eyes while shampooing your hair. Matting of the scalp hair, also known as tangling of the hair, is the most frequent side effect of shampoo use (Wilson, 1990). Types I and IV allergic contact responses can be brought on by active components in hair bleaching products such as ammonium persulfate and hydrogen peroxide solutions.

Health and Environmental Hazards of Some Chemicals in Cosmetics:

Components used in cosmetics are also becoming contaminants. They are only beginning to monitor the environment. Nonetheless, it is well recognized that they enter the environment through a variety of routes, frequently via water, endangering human health as well as the health of freshwater and marine ecosystems. (Nicolopoulou-Stamati, 2015). Closely related synthetic compounds called butylated hydroxyanisole (BHA) and butylated hydroxytoluene (BHT) are employed as preservatives in lipsticks and moisturizers, among other cosmetics. The skin may respond allergicly to BHA and BHT. BHA has been identified by the International Agency for Research on Cancer as a potential human carcinogen. BHA has also been classified as a Category-I priority substance by the European Commission on Endocrine Disruption due to evidence that it interferes with hormone function (Schrader, 2008). In some circumstances, BHT may stimulate the growth of tumors. There is insufficient data to support the theory that high levels of BHT could have negative reproductive effects by imitating the main female sex hormone, estrogen, and inhibiting the development of male sex hormones (Schrader, 2008). Some examples of these chemical additives are Diazolidinyl Urea, Dioxane, Formaldehyde and Paraformaldehyde, Imidazolidinyl urea, heavy metals, Methylchloroiso – thiazolinone - methylisothiazolinone (MCI-MI), Methyld - ibromoglutaronitrile - phenoxyethanol (MDBGN-PE), Parabens, Phthalate, Quaternium-15, Thimerosal and others. Thus, in public health science, the term “cosmetovigilance” began to represent a kind of health surveillance where the aim is the safety of the cosmetic product for commercial purposes. This surveillance is very important to control potentially hazardous ingredients and can thus set our minds at ease on the products placed on the market (Vigan, 2014; NTP, 2021).

Coal Tar Dyes

Coal tar is a complex mixture of various petroleum -derived compounds. The majority of colors used in cosmetics are produced from coal tar and are often designated with a five-digit Colour Index (CI) number. One type of coal tar dye that is utilized in numerous hair dyes is called p-phenylenediamine. In comparison to lighter colors, darker hair dyes typically include more phenylenediamine (Mansour, 2018; Eberle CE, et al., 2020).

The primary worry regarding specific coal tar colors—whether made synthetically or from coal tar—is that they may be carcinogenic due to the association between coal tar and cancer. Certain colors could contain trace amounts of heavy metal contamination, and some of them are blended with aluminum substrate. The brain is known to be harmed by aluminum compounds and numerous heavy

metals. Despite not being permitted as food additives, several of the colors used to make these dyes are found in lipstick and other cosmetics that are meant to be consumed. According to Rollison (2006), P-phenylenediamine causes cancer. According to Zhang's (2008) research, women who use hair dyes, particularly over an extended period, are more likely to acquire non-Hodgkin's lymphoma, a kind of lymphatic cancer. Because it can have long-term negative (chronic) impacts on aquatic organisms, the European Union classifies p -phenylenediamine as hazardous (whether by contact, inhalation, or ingestion) and very harmful to aquatic organisms (White, 2021; Chang, 2022).

DEA (Cocamide DEA and Lauramide DEA)

Substances related to DEA (diethanolamine) are used as a pH adjuster to lessen the acidity of other substances or to make cosmetics creamy or sudsy. They are present in cleansers, soaps, and shampoos. Cosmetic nitrites and DEA combine to generate nitrosamines. Nitrites can be impurities or are occasionally added to products as anti-corrosive agents (Zhang, 2008). When cosmetics are exposed to air, certain compounds employed as preservatives might break down and emit nitrites. High dosages of DEA-related substances have been demonstrated in lab studies to cause precancerous alterations in the thyroid and skin as well as liver malignancies. Additionally, these substances may irritate the skin and eyes mildly to moderately. Because it can bioaccumulate and is acutely poisonous to aquatic life, cocamide DEA is regarded as environmentally hazardous (Zhang, 2008).

Dibutyl Phthalate (DBP)

DBP is mostly used in nail products as a plasticizer to keep nail polish from getting too hard and breaking easily, as well as a solvent for dyes. It has been demonstrated to result in sperm count reduction, modifications to the prostate and testes, and developmental abnormalities (Barlow et al., 2004; Iizuka, 2022). Because it alters hormone function, may harm the fetus, and exacerbate infertility, it has also been categorized as a possible endocrine disruptor. Additionally, Health Canada reports that prolonged consumption of phthalate-containing goods might result in adverse health effects in young children, including liver and kidney failure (Stahlhut, 2007; Health Canada, Survey Cycle 1, 2010). Among other negative health effects, phthalates have been connected to decreased sperm counts in men and reproductive abnormalities in the developing male foetus when the mother is exposed during pregnancy (Ferguson, 2014; Zhao, 2014; CDC, 2021).

Parabens

The most often used preservative in cosmetics is parabens. Parabens are included in cosmetics in an estimated 75–90% of cases (usually in extremely small amounts). Endocrine disruption is the theory behind parabens' easy skin penetration and potential interference with hormone function. They can mimic the main female sex hormone, estrogen. They may also impede the reproductive processes of men. Furthermore, research suggests that methylparaben administered topically combines with other substances to cause DNA damage and faster skin aging (Darbre, 2004; Serrano, 2014). Although a synthetic preparation made from petrochemicals is used in cosmetics, parabens are found naturally in low concentrations in some foods, including barley, strawberries, carrots, onion, currents, and vanilla (Vince, 2004). When consumed, parabens in food are broken down and lose some of their potent estrogenic effects. Parabens in cosmetics, on the other hand, avoid the metabolic process

and enter the bloodstream and body organs intact when applied topically and absorbed into the body. Women are thought to be exposed to 50 mg of parabens from cosmetics each day (Vince, 2004). Among other harmful health effects, they are linked to neurotoxicity and cancer (Anderson and Anderson, 1998; Yang, 2023).

Perfume (Fragrance)

On an ingredient list for cosmetics, the word "fragrance" (perfume) typically refers to a sophisticated blend of several compounds. As perfumes, over 3,000 compounds are employed. The scent is a noticeable component of colognes, deodorants, and perfumes. Almost all kinds of skincare products contain it. Fragrance elements, in the form of masking chemicals that keep the brain from sensing odor, can be found in even "fragrance-free" or "unscented" items (Health Canada, Survey Cycle 1, 2010). A lot of compounds included in unlisted fragrances are irritating and can trigger symptoms of asthma, allergies, and excruciating migraines. In children, perfume may potentially be a contributing factor in the development of asthma. According to the IARC Monographs (2015), it is the second most frequent cause of allergy in patients.

Polyethylene Glycols (PEGs)

Petroleum-based polyethylene glycols, or PEGs, are frequently employed in creams as thickeners, solvents, softeners, and moisture-transporting agents. Measurable levels of 1,4-dioxane can contaminate PEGs, depending on the production procedures used. It has been suggested that 1,4-dioxane may cause cancer. Even after being washed down the shower drain, it does not break down quickly and might linger in the environment for a long time (Bridges, 2002). PEGs can irritate and be hazardous to the system when applied to injured skin, and there is some evidence of their genotoxicity (Hoang et al., 2021).

Triclosan

Triclosan (TCS) is employed as a preservative; nevertheless, because of its lipophilic qualities, it can be absorbed and enter the systemic circulation through the mucous membrane when exposed to the skin (Lin, 2000; Moss, 2000). TCS acted as a liver tumor promoter by increasing hepatocyte proliferation and the formation of reactive oxygen species (ROS) (Yueh, 2014; Weatherly, 2017). TCS reduced allergic skin reactions when they became irritated. TCS has a variety of negative consequences and is not quickly digested dermally, remaining largely as the parent molecule for at least 24 hours (Barkvoll, 1995; Weatherly, 2017).

Petrolatum

In many moisturizers, petrolatum acts as a barrier to preserve skin hydration. It adds shine to hair and is found in hair care products. Another name for it is mineral oil jelly. Polycyclic aromatic hydrocarbons (PAHs) can contaminate petroleum. Research has demonstrated a link between cancer and PAH exposure, including prolonged skin contact. As a result, petrolatum is categorized as a carcinogen by the European Union and its usage in cosmetics is restricted. Petrolateum's PAHs have been linked to allergy and skin irritation (Ulrich, 2004).

Siloxanes

Softening, smoothing, and moisturizing skincare products are the purposes of these silicone-based chemicals in makeup. They facilitate the faster drying of hair products and the easier application of deodorant creams. Most often, they are utilized in face treatments and moisturizers. Water-dwelling creatures may be exposed to harmful, persistent

cyclotetrasiloxane and cyclopentasiloxane combinations. Being an endocrine disruptor that affects hormone function in humans and potentially a reproductive toxin, cyclotetrasiloxane may reduce fertility (Niel, 2015; Ajayi, 2021).

Diazolidinyl Urea

Since 1982, this additive has been utilized in the production of personal care goods for children, skin care products, makeup for the eyes and face, hair care products, and nail care products. This substance is known to release formaldehyde, a fixative and preservative, which can result in allergic contact dermatitis. It is also considered a mutagenic and carcinogenic agent (Pfuhler, 2002).

Formaldehyde and Paraformaldehyde

Both formaldehyde and paraformaldehyde, which is a polymer generated from formaldehyde, are harmful preservatives. Due to its molecular properties, formaldehyde poses a significant risk of cancer (Pfuhler, 2002; Lv C et al., 2015). Formaldehyde, the second most common cause of contact dermatitis from cosmetic items, was found to be the cause of allergic contact dermatitis in 13% of a sample of 957 participants in clinical research (Warshaw, 2009). In a 1999 study by Agner et al., the formaldehyde exposure of 57 patients was assessed. The participants were requested to bring the primary cosmetics they used on a daily basis for this investigation. Out of the 409 goods that were cataloged, 103 of them included formaldehyde in their ingredients.

Table 1: Dermal products.

Sr. no.	Dermal products	Ingredients	Role	Replacement
1.	Soap	Sodium and ammonium lauryl sulphate	Surfactant	Reetha, chickpeas and shikekai[82,84]
		Paraben and Triclosan	Preservative	Extract of basil, clove, neem androsemary[83,92]
		Dyes and pigments	Provide colour	Barberry(yellow), Annato (orange),Manjishtha (red)[84,85]
2.	Sunscreen	Oxybenzone	Filter UVA and UVB rays	Sacred lotus[85,86]
		Octinoxate	Filter only UVB rays	Aloe vera, raspberry and glycerine[85,86]
		Homosalate	Organic UV filter	Sandalwood, ashwagandha andarjuna[85,86]
		TiO2 and Zinc oxide	Inorganic UV filter	Jojoba oil, argon oil, shea butter[85,86]
3.	Moisturizer	BHT and BHA	Antioxidant	Papaya seeds, coffee leaves andchestnut[86,87]
4.	Powder	Talc	Adhesive, slip material	Fumes silica, corn starch[87,88]
		Zinc oxide and Zinc stearate	Covering agent	Gum tragacanth[88,89]

Health Risk Associated with Heavy Metals in Cosmetics

According to Popoola (2013) and Ramakant et al. (2014), heavy metals have been linked to cosmetics that are often used by women. Once more, risks related to heavy metals in cosmetics have been covered in the literature (Environmental Defence, 2015). A number of health issues, including cancer, disorders pertaining to reproduction and development, neurological issues, cardiovascular, skeletal, blood, immune system, kidney, and renal issues, headaches, vomiting, nausea, and diarrhoea, lung damage, con-

tact dermatitis, brittle hair, and hair loss, have been linked to heavy metal accumulation in the body over time. While many substances are respiratory poisons, others affect hormones. There is, however, no established safe blood level for some, such as lead. They can penetrate the skin and be absorbed through it, particularly through damaged skin (Sainio, 2001; Darroudi et al., 2013).

Cadmium

The environment naturally contains cadmium. The body absorbs cadmium from body and hair creams through skin contact (Ayenimo, 2010); it is subsequently deposited in the liver and kidney, however it is present in nearly all adult tissues. According to the IARC (2010), it is regarded as "carcinogenic to humans," and the US Department of Health and Human Services (CSC, 2007) lists its constituents as recognized human carcinogens. High amounts of cadmium consumption can cause extreme stomach discomfort, vomiting, and diarrhea, while prolonged exposure to low levels can cause kidney damage, bone deformation, and brittleness (CSC, 2007; ATSDR.CDC, 2008).

Lead

According to Sprinkle (1995), lipstick can get contaminated with lead if tainted raw materials or pigments containing lead are used. Everyday lead contact results in some lead being absorbed via the skin (Health Canada, Survey Cycle 1, 2010). Women and children who use leaded eye powders (such as Surma, Kohl, and Alkol) had higher blood lead levels (IARC, 2007). Little children and pregnant women are especially at risk since certain substances can easily pass through the placenta and into the fetus's brain (Sprinkle, 1995). Additionally, it can be kept in bones and passed from mother to child through breastfeeding (Rothenberg, 2000; WHO, 2007). In addition, miscarriages, hormonal abnormalities, decreased fertility in both sexes, irregular menstruation, and delayed puberty initiation in girls have all been related to lead exposure (Sprinkle, 1995). Human carcinogenicity has been identified for lead and inorganic lead compounds (IARC, 2008; Chaudhari, 2018).

Nickel

Because this metal is found in large quantities in the environment, everyone is exposed to it in trace amounts. This exposure occurs mostly through food, air, soil, household dust, and skin contact with goods that contain the metal, such as cosmetics (CSC, 2007; Health Canada, Survey Cycle 1, 2010). Health effects from high levels of exposure can vary depending on the type and route of nickel exposure (Health Canada, Survey Cycle 1, 2010). Although some forms of nickel are deemed "toxic" due to their potential for cancer, metallic nickel and its alloys have been identified as potentially carcinogenic to humans (IARC, 2008). Similar to nickel allergies, nickel dermatitis can be extremely severe (Health Canada, Survey Cycle 1, 2010). There has been one documented incidence of eye shadow-induced nickel allergy; exposure to merely 1 ppm of nickel may intensify pre-existing allergies (Sainio et al., 2001).

Mercury

Often included in skin-lightening soaps and lotions is mercury. It can also be found in various cosmetics including mascara, cleaning products, and eye makeup. Most countries in Asia and Africa employ skin-lightening soaps and lotions. Additionally, dark-skinned groups in North America and Europe use them (Biebl, 2006).

Table 2: Beauty products.

Sr. no.	Beauty products	Ingredients	Role	Replacement
1.	Eyeliner	Propylene glycol	Humectant	-
		Pigments	Coloring agent	-
		BHA and BHT	Preservatives and antioxidant	**Papaya seeds, coffee leaves andchestnut**[86,87]
2.	Mascara	Alcohol denaturated	Antimicrobial, solvent	-
		Cyclopentasiloxane (CD5)	Carcinogenic compound,Persistence and bioaccumulation	-
		Phenoxyethanol	Preservatives	-
		Shellac	Curling agent	-
3.	Foundation	Formaldehyde	Preservatives	-
		Talc	Absorbs moisture	**Fumes silica, corn starch**[87,88]
4.	Lipstick	Iron oxides and Mica	Coloring agent	**Lycopene (Red), Carotenoids (Orange)**[89,90]

A decrease in the skin's resistance to bacterial and fungal infections, skin rashes, discoloration, and scarring can all be brought on by mercury found in skin-lightening treatments. Peripheral neuropathy and other symptoms include anxiety, depression, or psychosis. Wastewater eventually contains mercury from soaps, lotions, and other cosmetic items. Following its release into the environment, the mercury undergoes methylation and enters fish's food chain as the extremely hazardous methylmercury. When methylmercury-containing fish is consumed during pregnancy, the fetus absorbs the mercury, which may subsequently cause neurodevelopmental abnormalities in the offspring (Biebl, 2006).

Table 3: Hair Products

Sr.no.	Hair Products	Ingredients	Role	Replacement
1.	Shampoo	Ammonium and Sodium lauryl sulfate	Surfactant	**Reetha and Shikekai.**[90, 91]
		Parabens and Formaldehyde	Preservatives	**Extract of basil, clove and neem.**[92]
		Diethyl and dimethyl pthalates	Plasticizer and gelling agent	**DINCH (1,2-cyclohexane dicarboxylic aciddiisononyl ester).**[93]
2.	Conditioner	Citric acid	Acidifier	**Lemon Balm.**[94]
		Benzophenone	Fragrances	**Tea, coffee leaves and hennapowder.**[95]
3.	Serum	Silicone	Polymer	**Jojoba oil and Shea butter.**[96, 97]
4.	Hair dye	Paraphenylenediamine	Coloring agent	**Henna, coffee and beetroot.**[96]
		Resorcinol	Bond permanent color	-
		DMDM hydantoin	Antimicrobial agent	**4-Chloro resorcinol.**[98]
		Toluene	Oxidative agent	-
		Ammonia	Open hair cuticle	-
		Lead acetate	Color additive	-

Health risk associated with other chemicals present in cosmetics and personal care products:

While preservatives account for the majority of the negative effects associated with cosmetics, other substances may cause allergies. One such substance is the chemical contamination used to obtain surfactants (Cocamidopropyl betaine), which are used to make shampoo, liquid soap, skin cleansers, shower gels, and deodorants. Hair dye compositions frequently contain oxidizing agents, such as para-

phenylenediamine. Permanent hair solutions (used to give hair a wave or curl) contain glyceryl monothioglycolate. The resin toluene sulfonamide-formaldehyde is used to make nail lacquers and polishes. Antioxidants such as propyl gallate, octyl gallate, and dodecyl gallate are used to stop unsaturated fatty acids—which are contained in cosmetic creams and lotions and might result in discoloration and odor—from deteriorating (Park, 2014; Yim, 2014).

Results and Discussion:

The usage of substances with preservative activity, surfactants, perfumes, stains, and other ingredients has expanded in the modern era due to innovation, research, and new cosmetic goods. These ingredients improve the consistency, longevity, and quality of cosmetic formulations; nonetheless, frequent, prolonged, and careless exposure to many of these ingredients can be hazardous to human health.

To minimize health hazards, several agencies worldwide oversee cosmetic items' production, quality control, and safety. These agencies also modify rules and guidelines for the public's safe and healthful use of these products. Nevertheless, no one organization oversees the cost-benefit analysis or ensures the safety of using potentially harmful ingredients in cosmetic items.

This study examined several compounds that may be hazardous to human health and are used in the manufacturing of cosmetic items all over the world. We also looked at the potential health issues that the scientific literature has linked to the use of cosmetics and these harmful ingredients. According to scientific research, excessive doses of chemical preservatives, fragrances, and emulsifiers used in the production of cosmetics raise health risks and adverse effects due to chemical and physical principles (Lintner, 1998).

Chemically speaking, preservative chemicals are typically linked to aromatic rings, which have the potential to be poisonous and can bind to metals that encourage the body's bioaccumulation of those elements (Bandowe, 2014). Even if the toxicity mechanism of some compounds has not been fully elucidated in the literature, clinical information gathered from these drugs' adverse effects indicates the possible health risks connected with cosmetic use. Cosmetic use carries a risk to one's health that might range from a straightforward case of moderate hypersensitivity reaction to anaphylactic shock or even fatal intoxication.

We have covered the function, potential health risks, and substitution of certain substances in the selected cosmetics in this review study. Cosmetics are made up of a variety of hazardous compounds that can have a major negative impact on a person's numerous organ systems. Globally, the use of cosmeceutical-based personal care and cosmetic products has surged in recent years. To improve the performance, quality, value, and longevity of cosmetics, more and more substances are being added to the composition of cosmetic products like surfactants, antioxidants, and preservatives (Kumari PK *et al.*, 2018). The retail sales of cosmetics and other personal care items are expected to increase by 15% to 20% a year on average, making India's domestic demand for these products among the fastest -growing in the world. The overall demand has increased by 60% in the last five years. India's cosmetics business is propelled by the country's high personal disposable income, growing consciousness of body aesthetics, and growing need for herbal cosmetics. Due to the widespread use of herbal

products and growing awareness of the potential negative consequences of continuous use of chemically formulated cosmetics, the market is expected to expand by 15% yearly (Galanakis, 2018).

The bulk of the Indian cosmetics market is divided into the categories of skin care, hair care, oral care, fragrances, and color cosmetics. By 2025, India will have 5% of the world market for cosmetics and be among the top five global markets in terms of revenue growth. Furthermore, the market will keep expanding due to customers' increasing preference for specialized cosmetics such ayurvedic, organic, and herbal products. The primary businesses expected to grow are color cosmetics, perfumes, specialized skin care, hair care, and makeup cosmetics. A growing number of foreign corporations are entering the Indian personal care and cosmetics sector, which is raising competition for native brands (CDC, 2019; NTP, 2020; Subhashunhale, 2020).

The future focus of the Indian cosmetics industry will be on natural and organic cosmetics. It indicates a better knowledge of the harmful effects that chemical-based cosmetics have on the skin (IBEF, 2023). Zhang (2012) has linked the use of cosmetics to the risk of cancer, despite clinical data not being readily available in the literature. Because side effects and imminent complications are common with cosmetic use, it has been determined that quality control procedures in the manufacturing of cosmetic products are not completely effective in preventing health risks associated with cosmetic use (Kapoor, 2020). These factors contribute to the emergence of a public health issue.

Conclusion

Cosmetic items are not always safe to use, even though they are not frequently linked to significant health risks. This is especially true when considering potential long-term impacts, as the products may be used extensively over an extended period. Certain substances in skincare and cosmetics products are recognized to pose health hazards, or their safety is questionable. Numerous cosmetics, especially shampoos and hair colors, may include substances that are categorized as suspected or known human carcinogens. Once more, a lot of these products might have ingredients that improve skin penetration, called penetration enhancers.

The Cosmetic Vigilance Programme is concerned with the laws and regulations about cosmetic ingredients that are necessary to safeguard the public's health in India. While the Cosmetic Vigilance Program is strictly enforced in European countries, it is not implemented in India. Therefore, in the developing world, the Cosmetic Vigilance Programme must be used appropriately and amended to help control the hazardous ingredients in cosmetics and, consequently, enhance public trust in the use of these agents. Talking about specific adverse impact data with merchants, stakeholders, and cosmetic users is also essential. Consumers nowadays are also searching for natural sources of synthetic substances as alternatives. Therefore, more investigation is needed to learn more about the safety of cosmetic items on the market as well as the natural substitutes for components in cosmetics. By disseminating correct information on the safety of cosmetic goods and their contents, this public health strategy aims to prevent the risks associated with cosmetic use from becoming a serious public health concern.

Conflict of Interest

There is no conflict of interest except our society's and the environment's health benefits.

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