

Adverse effects of Cosmetics on the Women Health

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Abstract. The Cosmetics used for beautification or enhancement of appearance are in high demand especially among the women but these products have deep dark side. Many additive chemicals in cosmetics like parabens, phthalates, polyethylene glycol, hydroquinone, resorcinol, 1,4 dioxane, trace heavy metals etc. are hazardous and pose a variety of health risks ranging from neurotoxicity, nephrotoxicity, carcinogenicity, endocrine disruption, reproductive disorders etc. Hence the safety of the cosmetics is an issue of prime concern. It is necessary to make people aware of cosmetic chemicals and their deleterious effects. The present study analyses the current scenario of cosmetic use in India, the behaviour of women consumers in Indian Cosmetic market in terms of age group using cosmetics, reasons for using cosmetics and expenditure on beauty products etc. The harmful chemical ingredients in cosmetics are discussed along with their adverse effects on health. The study is carried out with objective of making women aware of large number of toxic chemicals used in cosmetics and their negative health impacts. It will also draw attention of researchers and clinicians to investigate the likely causes of their negative consequences. A relatively new concept of green cosmetics is also mentioned, which are associated with less toxicity to human health and is suggested to be promoted and adopted by women.

1 Introduction

Cosmetics (commonly known as makeup) are used for protection, care and beatification of hair, nails, skin, and teeth. Cosmetics hide the flaws, highlight the features and improve body image in people concerned with appearance schemas [1]. Lipstick, mascara, foundation, hair colour, nail polish are commonly used by women every day. Fig 1 depicts illustrative representation of classification of cosmetics proposed by Food and Drug administration. The Global cosmetic industry is very rapidly growing and is likely to touch \$463.5 billion by 2027, registering a CAGR of 4.3% [2]. Among the list of more than 12000 synthetic chemicals of cosmetics, less than 20% are considered safe [3]. According to some research, our body can absorb up to 5 kg of hazardous substances annually from cosmetics. A host of chemical ingredients in cosmetics are linked to reproductive disorders, developmental disorders, cancers etc [4,5]. dermal exposures to chemicals occurs on applying them directly on skin. Heavy metal containing cosmetics used from hands to mouth and around the lips can cause oral exposure. Heavy metals tend to form complexes with carboxylic acid (-COOH), thinly (-SH) and amine (-NH₂), group of proteins causing cell death that results in various diseases [6].

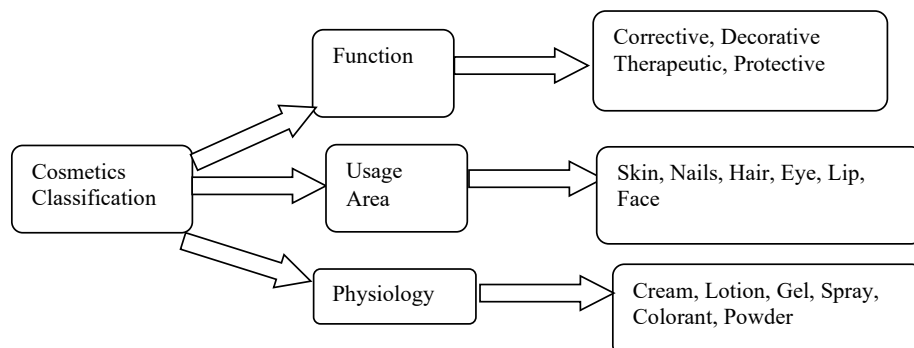


Fig. 1 Classification of cosmetics as categorized by Food and Drug administration (FDA)

Women are more vulnerable to the pressure from society to use cosmetics to look beautiful and also as a ploy to attract mates [7]. It is very important for women to understand the probable harms of chemical ingredients of cosmetics on women’s reproductive aging, reproductive health and overall health. The objective of this paper is to inspect the consumer behaviour of Women cosmetic market in India and is analysed in terms of factors like reasons for cosmetic use, the age group, money spent on cosmetics, make up brand preferred, working /non-working women and also attempt is made to make women aware of large number of lethal substances used in cosmetics and their adverse health effects. At last relatively new concept of green cosmetics is described to raise awareness of women towards relatively less toxic and health safe green cosmetics. The study will also garner the attention of researchers and clinicians to find out probable reasons behind their adverse effects.

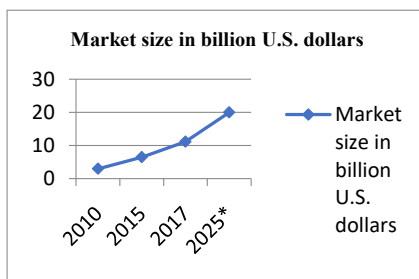
2 Methodology

The study is based exclusively on documentary research in databases of scientific articles; survey reports etc and is interpreted in the light of objectives of the study.

3 Data Analysis and Discussion

1 Indian women consumer behaviour in cosmetic market

According to a report by Avenues, the global market for cosmetics and personal care would grow by \$725 billion by 2025 and at the same time Indian industry is anticipated to touch \$28 billion by then [8]. The Euro monitor International Study reports Indian beauty and personal care (BPC) industry is 8th largest in the world total value of \$15Bn and is growing at ~10% [9]. TechSciResearch reports market size of cosmetic industry of India for year 2020 is 13191.23 million USD and expected to grow in future and reach 28985.33 million USD by the end of year 2026. The global share of cosmetic industry is USD 422.72 billion in 2020 and anticipated to touch USD 558.12 billion by the end of year 2026 [10]. According to TechSciResearch, India owns share of only 1% in cosmetic market, which is also expected to enhance in future. The graph 1 represented below shows market size of cosmetic industry across India (in billion U.S. dollars) from 2010 to 2025 [11].



Graph 1 Market size of Indian cosmetic industry from 2010 to 2025

Indian cosmetic industry has two main sections of population i.e. the Teenagers and Women. The teenagers’ cosmetic use is associated with their desire to establish a sense of individuality, experiment to have fun and to look more sociable and assertive to others [12]. Teenagers contribute to 65% of market share in Indian cosmetic industry. A study on consumers of Indian make up wearers suggests 35% are in age group 21-29 years old and 53% are women. 59% of the makeup wearers are married and 45% are employed. It was found that 41% Indian makeup wearers purchased cosmetic products online [13]. According to a survey conducted in 2014, the working women spend 57% of their saving while non-working women spend 43% on cosmetics (fig 2).

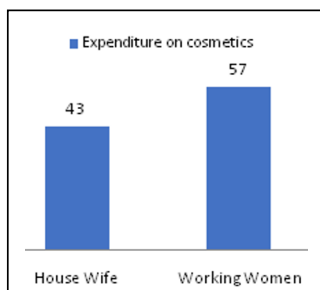


Fig. 2 Expenditure of Indian working and house wife women on cosmetics

Women state that there are eight main reasons of buying cosmetics (figure 3). As shown on pie chart the purpose of 24% women for buying cosmetics for face care, 15% for their job requirement, 13% for enhancing self image, 13% for looking young, 10% for medical reasons, 12% for feeling good and 8% for fashion and the remaining 5% use cosmetics for attracting men towards them [14].

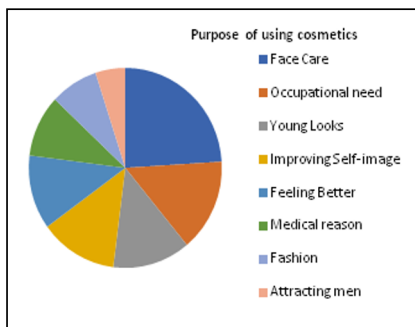


Fig 3 Representation of chief reasons of women for buying cosmetics

The research on 1500 women consumers of European countries (UK, France, Germany, Italy, Spain) concluded 59.1% women stated 'lipstick' to be most important, followed by face mask (57.4%). Survey further reported that European women prioritise skin sensitivity and cruelty-free manufacturing while choosing and purchasing cosmetics [15]. In India, kajal is the most popular make up product of women. The consumption of 'fairness' products have slight decrease in India due to refusal of Bollywood celebrities to advertise them [16].

The survey conducted by ProQuest Dissertations Publishing on the basis of experience of 138 women reports 15-16 years is the average age when most women are under pressure to wear cosmetics [17]. Further according to CEO of MyGlamm, the company's sale increased by 30% during festivals, indicating larger consumption of cosmetics amongst women during festival season [18]. A study on cosmetic product market of Coimbatore revealed 21% female consumers' preferred using Lakme brand, 17% applied Himalaya, 13% respondents used L'Oreal, 10% used Boutique and VLCC, 4% used Elle. Despite the pay gap of men and women, the women consumers account for 80-90% of estimated \$500 billion market for beauty products [19]. As per research conducted in India in February 2019, the below listed table 1 shows how much money women are ready to spend on cosmetics [20].

Table 1 Monthly expenditure on cosmetics and personal care products (February 2019)

Expenditure	Share of respondents
Upto Rs 700/-	43.88%
Rs 701-1700	18.92%
Rs. 1701-3500	8.57%
Rs. 3501-7000	3.4%
Rs. 7001-10000	1.24%
> Rs. 10000	0.93%














2 Hazardous chemicals in cosmetics and their health effects

Despite the drugs and cosmetic Act, 1940, undergoing amendments, is aimed at ensuring drugs and cosmetics are safe, effective and conform to state standards, yet the manufacturers continue to use inexpensive low quality raw materials which is aided by little to no regulation of chemicals used in cosmetics. Chemical additives are added to cosmetic products to enhance their effectiveness, viability, qualities performance etc [21]. Women customers have little or no awareness of chemical ingredients and their harms are influenced by advertisements, discounts and free samples. This section deals with some chemical additives added in cosmetics (figure 4) and their harmful effects on health (Table 2).

1,4 Dioxane: A carcinogenic contaminant found in shampoos, liquid soaps etc. and produced during manufacture (ethoxylation) of cosmetics in which ethylene oxide is added to reduce harshness of other chemicals. It is classified by National Toxicology Program as an animal carcinogen and potential human carcinogen by United States Environmental protection agency. 1,4 dioxane penetrates the skin. Its exposure in large amount causes kidney and liver damage. It is irritating to skin, eyes and respiratory tract [22]

BHA and BHT: Butylated hydroxyl anisole (BHA) and butylated hydroxy toluene (BHT) are synthetic antioxidant found in moisturizers, cleansers; cosmetic makeup's and acts as stabilizers in cosmetic products. Both are linked to cancer; interfere with hormonal system, autoimmunity, thyroid issues, hives, rashes etc. They are red flagged as potentially problematic on European commission potential disruptor list [23].

Table 2 Different types of commonly used cosmetics, their chief chemical constituents and ill effects on health.

Cosmetic	Chief Chemical ingredients	Harmful health effects
Shampoo 	Sodium lauryl sulphate, Parabens, polyethylene glycol, phthalates, formaldehyde, triclosan, Dimethicone, 1,4 dioxane, retinyl palmitate, alcohol, fragrances, color, toluene, resorcinol, selenium sulphide, Quaternium-15	Irritation and possible eye damage
Eye Shadow 	Polyethylene terephthalate, formaldehyde, titanium dioxide, heavy metals, mineral oils, parabens, carbon black, ethyloxylated ingredients, paraffin wax, polyacrylamide, talc, polybutene and octyldodecyl stearoyl stearate, teflon	Infertility, hormonal disruptions and damage to body's organs, Cancer,
Lipstick 	Polymethylmethacrylate, methylparaben, polyparaben, retinyl palmitate, dyes, tocopheryl acetate, lead, propylene glycol, methylparaben	Allergies and cancers
Nail paint 	Phthalates, Xylene, triphenylphosphate, nitrocellulose, methylacrylate, camphor, triphenylphosphate, ethyl acetate, butyl acetate, acetone, toluene, formaldehyde, ethyl tosylamide, parabens	Affects reproductive system and poses problems for developing babies
Perfume 	Benzaldehyde, benzyl alcohol, acetone, linalool, ethanol, ethyl acetate, benzaldehyde, camphor, formaldehyde, methylene chloride, limestone, phthalates, stearates, parabens.	Kidney damage, irritation to mouth, throat, eyes.
Hairspray 	Octinoxate, isophthalates, carboxymethylcellulose, denatured alcohol, hydrofluorocarbon, plasticizers including esters of citric acid, adipic acid, polyvinylpyrrolidone, polydimethylsiloxane, gum Arabic, alcohols, polyvinyl alcohol, propylene glycol	Hormone disruption, change the cell structure, Allergies, irritation of eyes, nose, throat
Blusher 	Ethylparaben, propylparaben, formaldehyde, carbon black, talc, phenoxyethanol, Butylated hydroxyl toluene, parabens, ethanolamine compounds	Irritation, rashes and hormonal disruptions
Foundation 	Polymethylmethacrylate, heavy metals	Allergies, cancers, disrupts immune system
Deodorant 	Isopropyl Myristate, Parfum, triclosan	Headaches, dizziness, respiratory problems, irritation of eyes, skin and lungs
Body Lotion 	Methylparaben, propylparaben, polyethylene glycol	Rashes, irritation, hormonal disruptions
Make up remover 	Formaldehyde, quaternium-, DMDM hydantoin, urea, bromopol, glyoxal	Human carcinogen
Sunscreen 	Retinol, retinyl acetate, retinyl palmitate, all-trans retinoic acid, tretinoin, octinoxate	Linked to cancer, developmental and reproductive toxicity
Moisturizer 	Butylparaben and isopropylparaben	Early puberty, certain parabens cause breast cancer.

Phthalates: colourless, odourless, oily liquids also called plasticizers function as solvents and stabilizers in perfumes. Dibutylphthalate (DBP), dimethylphthalate (DMP) and diethyl phthalate (DEP) are ingredients used in nail polish, hair spray, and perfumes respectively. These are linked with cancer, developmental and reproductive toxicity, and endocrine disruption. Their higher levels lead to impaired sperm mobility. Di-2-ethylhexylphthalate (DEHP) is reported to be carcinogenic by the National Toxicology Program and U.S. Environmental Protection Agency. DBP proliferates breast tumour. DEHP and DBP have weak estrogenic effects. The National Institute of Occupational Safety and Health claims use of DEHP can result in liver cancers in animals [24,25].

Parabens: Commonly used artificial preservatives in cosmetics to protect them from microbial contamination. Studies suggest parabens to cause allergic reactions, skin irritation, interfere with hormones in body, harm fertility, accelerate growth of breast cancer, ovarian, endometrial, uterine cancers etc, harm reproductive organs, after birth results and increase the hazard of cancer. Parabens penetrate the skin, enter blood stream and mimic the effects of estrogen. Paraben chemicals in personal care products bring earlier puberty in girls. Parabens decrease female fertility, affect the menstrual cycle, increase risk of early birth and alter expression of genes. It is found that use of cosmetics exposes women to 50 mg parabens everyday. Methylparaben increases skin aging and DNA damage [26,27].

Polyethylene Glycols: They are heavy duty sterilizers used in shampoos, deodorants, eye creams, face cleansers etc. Polyethylene glycols contain ethylene oxide and 1,4 dioxane carcinogenic impurities which are also eye, skin, respiratory irritants. Some studies suggest polyethylene glycols to cause genotoxicity and irritation and systemic toxicity when applied on broken skin. PEG can cause skin irritation and severe hypersensitivity reactions. PEG can also be contaminated with propylene oxide which is another mutagen and carcinogen [28].

Siloxanes: Endocrine disruption, fertility problems etc are a few of the risks associated with the use of siloxanes in cosmetics. Cyclopentasiloxane can influence neurotransmitters in the nervous system, possess estrogenic and tumorigenic effects. Cyclomethicone is a mixture of 4D,5D, 6D siloxane used in cosmetics. 4D siloxanes classified as class 1 endocrine disruptor, affect fertility, may cause thyroid disease, can cause autoimmune diseases. 5D siloxanes are linked with infertility, uterine tumours [29].

Formaldehyde: known as formalin or oxymethylene and paraformaldehyde is used as preservative in cosmetics. The colorless gas used in cosmetics can cause skin irritation, scalp burns, hair loss, irritation of eyes, nose, throat, skin. The allergic, mutagenic and carcinogenic nature of formaldehyde is an issue of public health concern. FA concentration of 0.5-1.0 ppm could trigger ophthalmic irritation, conjunctival redness and increased blinking frequency, while beyond 1.0ppm, nose and throat irritation occurs [30].

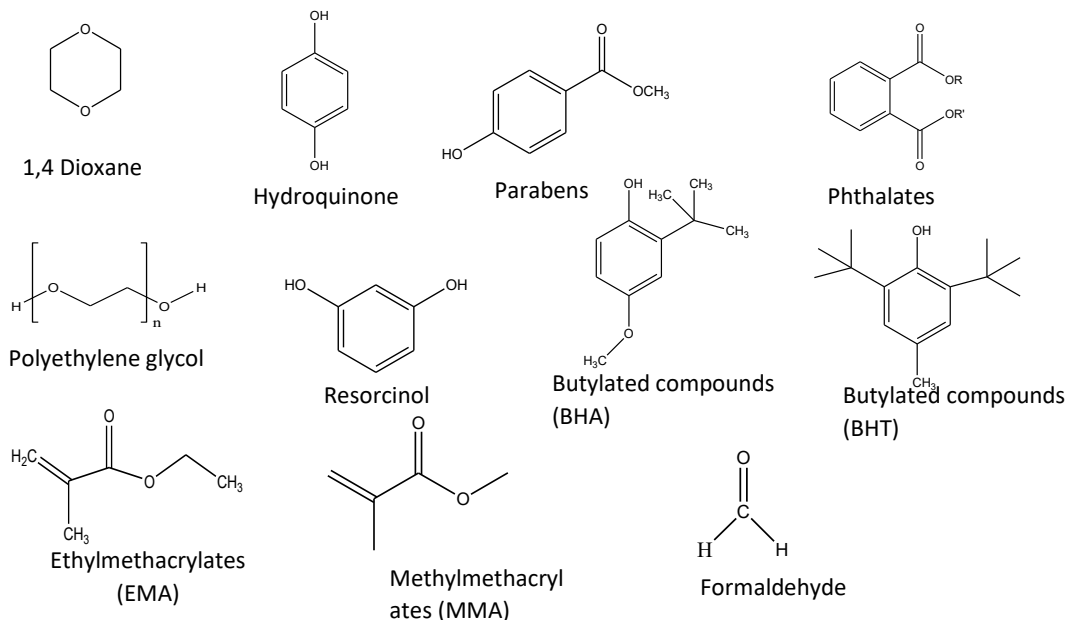


Fig 4 Chemical structures of some harmful constituents of Cosmetics

Acrylates: commonly found in nail cosmetics, the acrylates are derivatives of acrylic acid. Ethyl acrylate is fake eyelashes and nails adhesive. Ethyl methacrylate (EMA) and methyl methacrylate (MMA) enables sculptured artificial nails to shape and adhere to nail plate. The respiratory system is at risk to ethyl acrylate and MMA. The inhalation of MMA causes lung disease, damage to liver, kidneys and nasal passage [31,32].

Titanium dioxide: used in a variety of cosmetics like sunscreen, as UV powder or whitening agent, foundations, lip balm is considered a carcinogen (IARC) when it is inhaled.

Resorcinol: commonly used in hair dyes, is toxic in high concentration, causing sensitivity, irritation, disrupt nervous system and endocrine system functioning. It is a severe eye and skin irritant, toxic to the immune system, leads to developmental and reproductive toxicity. It is harmful for hair follicles. Studies indicate resorcinol exposure may disrupt thyroid function-resulting in goitre [33].

Hydroquinone: most commonly used in skin lightening creams by people having hyperpigmentation skin conditions like melasma, freckles or lentigines. It is linked to cancer and organ system toxicity. When inhaled it causes irritation of respiratory tract. It inhibits melanin synthesis and increase melanin degradation in skin which increases skin’s exposure to UVA and UVB rays, leading to increased risk of skin cancer. It is connected to ochronosis of skin and it causes permanent corneal damage [34].

Trace Metals: A number of trace meals (TMs) including cadmium, arsenic, nickel, copper, lead, manganese, cobalt, antimony, chromium are incorporated in lip cosmetics. Several bad effects of these TMs are shown in figure 5. The entry of these TMs from cosmetics to digestive pathway harms many essential organs, once they enter systemic circulation [35]. Long term exposure of TMs like Ni, Pb, Hg, Cr, Cd, As, Cu are linked to infectious diseases like cardiovascular and neurological disorders [36]. A maximum of 10 ppm of lead as impurity is allowed in cosmetics by FDA. Lead in cosmetics is related to learning, language, behavioural problems, hormonal changes, reduced fertility, menstrual irregularities, and delayed puberty onset in girls [37]. Mercury compounds as preservatives should not be more than 65 ppm in the finished product [38]. It causes immune, respiratory, reproductive and nervous system toxicity. In most countries, the use of lead, mercury, arsenic is legally prohibited in the skin cosmetic products. Ingestion of high levels of cadmium cause stomach irritation, vomiting, diarrhea etc.

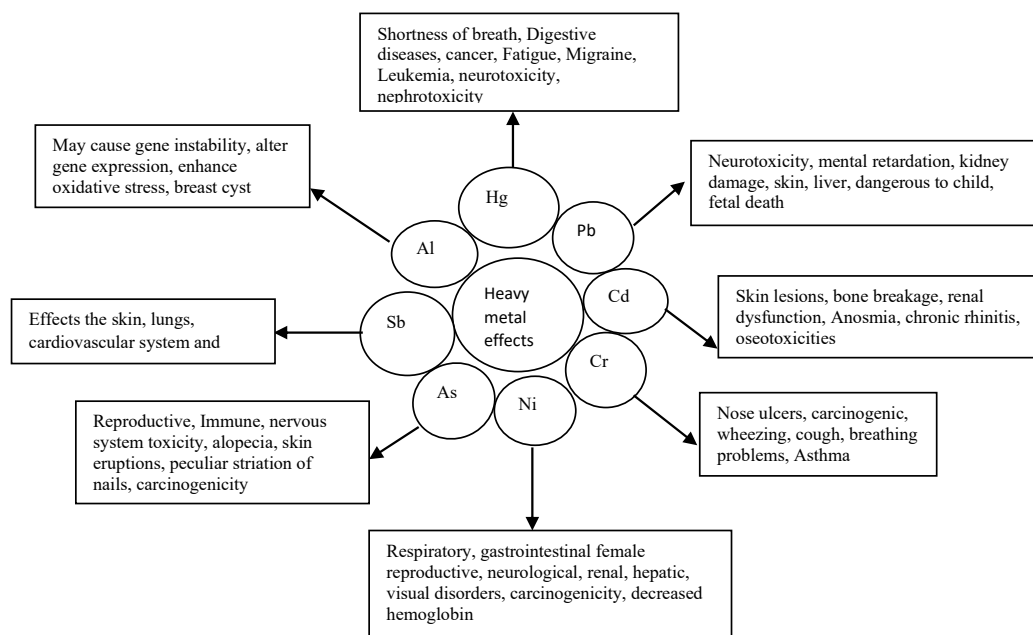


Fig 5: Health risks of some heavy trace metals like mercury, lead, cadmium, chromium, nickel, arsenic, antimony and aluminium

3 Green cosmetics/biocosmetics

Green cosmetics are sustainable ecofriendly cosmetics i.e. environmentally friendly formulations utilizing organic ingredients formed from renewable raw materials. Green cosmetics avoid many toxic elements found in popular brands as the ingredients are all natural materials such as coconut oil, almond oil, aloe vera, argan oil. Green cosmetics don’t harm skin [39]. Natural and oleo chemical ingredients are less likely to cause skin irritation and consumer gets long term health and beauty. By 2025, organic cosmetic industry will earn \$25.211 billion. In case of green cosmetics, it is claimed to ensure that products are developed in accordance with principles of green chemistry. They represent a perspective of reducing risk to human health and environment impacts caused by cosmetics [40]. In a research conducted with purpose to know awareness and attitude of young female consumers towards green cosmetics carried out in district Bhiwani, the women respondents agree that government needs to take necessary measures to promote the production of green cosmetics [10]. The consumers are little aware about green cosmetics so marketers should work on labelling and certification of green cosmetics.

4 Conclusion

Millions of men and women around the world use cosmetics for enhancing their appearance but cosmetics and personal care products contain numerous chemicals like parabens, phthalates, hydroquinones, polyethylene glycols, acrylates, butylated compounds, formaldehyde and trace heavy metals. Some of the harmful effects associated with these are carcinogenicity, nephrotoxicity, neurotoxicity, endocrine and reproductive disorders, skin allergies, hepatic, visual and

cardiovascular disorders etc. Hence it is very important to study their effects on human health and the research on safety of the cosmetics is a matter of great concern. Present study besides listing the harmful ingredients of cosmetics, also covers the harmful effects and the cosmetic consumer behaviour of Indian women with respect to the age group using cosmetics, reasons for using cosmetics and their expenditure on beauty products. The study will familiarise women with detrimental effects of chemicals in cosmetics. The concept of green cosmetics (claimed to be relatively safe) based on principles of green chemistry is also described.

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