Cosmetics use and age at menopause: is there a connection?

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Cosmetics contain a vast number of chemicals, most of which are not under the regulatory purview of the Food and Drug Administration. Only a few of these chemicals have been evaluated for potential deleterious health impact: parabens, phthalates, polycyclic aromatic hydrocarbons, and siloxanes. A review of the ingredients in the best-selling and top-rated products of the top beauty brands in the world, as well as a review of highlighted chemicals by nonprofit environmental organizations, reveals 11 chemicals and chemical families of concern: butylated hydroxyanisole/butylated hydroxytoluene, coal tar dyes, diethanolamine, formaldehyde-releasing preservatives, parabens, phthalates, 1,4-dioxane, polycyclic aromatic hydrocarbons, siloxanes, talc/asbestos, and triclosan. Age at menopause can be affected by a variety of mechanisms, including endocrine disruption, failure of DNA repair, oxidative stress, shortened telomere length, and ovarian toxicity. There is a lack of available studies to make a conclusion regarding cosmetics use and age at menopause. What little data there are suggest that future studies are warranted. Women with chronic and consistent use of cosmetics across their lifespan may be a population of concern. More research is required to better elucidate the relationship and time windows of vulnerability and the effects of mixtures and combinations of products on ovarian health. (Fertil Steril® 2016;106:978–90. ©2016 by American Society for Reproductive Medicine.)

Key Words: Menopause, cosmetics, personal care products, ovarian aging, reproductive senescence

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Women are susceptible to the societal pressures of using cosmetics to beautify themselves (1–3). One theory behind the origins of the ♀ symbol used to denote "woman" is that it represents the hand mirror used by the Roman goddess Venus or the Greek goddess Aphrodite (4). In their efforts to look beautiful, both men and women apply cosmetics to hide their flaws and accentuate their features. Cosmetics have been a part of human history as far back as the ancient Egyptians (5). The ancient Egyptians, Romans, and Greeks used various ingredients to soften, improve, exfoliate, and detoxify skin (5). The ancient Romans and Greeks used walnut extracts as hair dye, antimony (a known toxic heavy metal) as eye shadow, white lead carbonate as a skin lightener, charcoal crocodile excrement as a skin darkener, and cinnabar as rouge (5).

The present article broadly addresses the question, "Cosmetics use and menopause—is there a connection?" The Oxford English Dictionary defines "cosmetics" as "A preparation intended to beautify the hair, skin, or complexion" (6). The word comes from the Greek word *kosmetikos* ("relating to adornment"), which is taken from the Greek word *kosmein* ("to arrange, adorn"), which itself is taken from the Greek word *kosmos* ("order, adornment") (6). For the purposes of this review, we define cosmetics as any product applied to the skin to enhance and beautify, i.e., products often labeled as "makeup." In 2014, the revenue of the cosmetics industry in the United States alone was 56.63 billion dollars (7), compared with the global oral contraceptive pills market which was valued at 5.236 billion that same year (8). Companies sell a broad spectrum of cosmetic items, each item containing a huge variety of chemicals that all contribute to the color, texture, patina (sheen vs. matte), odor, preservation, suspension, lubrication, thermal stability, and finishing texture of the cosmetic. Given the widespread and frequent personal use of cosmetics containing classes of compounds that are endocrine disrupters, it is of great importance for women and health care providers to understand the potential harm that ingredients in cosmetics can have on women's reproductive health and reproductive aging. In a survey administered to pregnancy planners and pregnant women regarding risk perception of cosmetic use, out of 128 respondents (68 of whom were pregnant), 39.5% thought

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that cosmetics outside of pregnancy were "fairly safe" and 37.7% thought that cosmetics were "not really safe" (9). Despite this fairly high level of concern, most women did not intend to/had not changed their cosmetics use during pregnancy (9).

THE ROLE OF THE FOOD AND DRUG ADMINISTRATION IN COSMETICS

While the United States Food and Drug Administration (FDA) closely monitors the chemicals that go into foods, drugs, and medical devices, cosmetics are not subjected to similar scrutiny. The FDA does not have to approve any cosmetics that go on the market unless the product claims to treat or prevent disease or alter the body in any way (in which case the product is classified as a drug) (10). There are only 11 chemicals that are outright prohibited or restricted for use in cosmetics: bithionol, chlorofluorocarbon propellants, chloroform, halogenated salicylanilides, hexachlorophene, mercury compounds, methylene chloride, cattle materials, sunscreens, vinyl chloride, and zirconium-containing complexes (11). Of note, color additives must be approved by the FDA before use in any cosmetics (12). The exception to this rule is color additives derived from mineral, plant, or animal sources, or additives derived from coal tar or petroleum (12). However, coal tar dyes, especially para-phenylenediamine, have been linked to DNA damage (13–15). This paper describes the chemicals that cosmetics contain and discusses the few studies that address how these chemicals can potentially affect human physiology, especially in relation to menopause.

METHODS

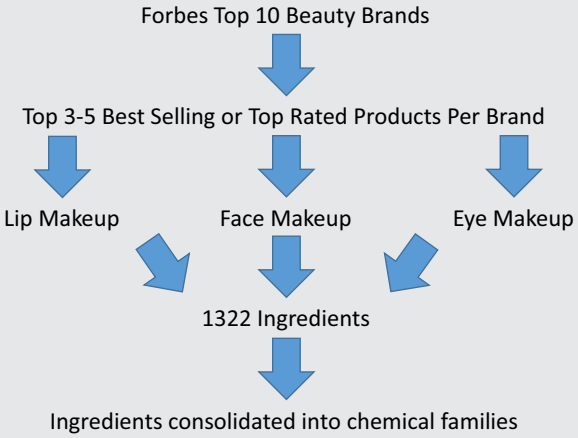
Selection of Cosmetics and Their Ingredients

Owing to the vast number of chemical ingredients in cosmetics, we devised the following methodology to identify chemicals for which to conduct our literature review (Fig. 1). Once these chemicals were identified, we generated a word cloud to visualize the frequency of chemicals and undertook a literature review. To summarize our identification methodology, we began by using the Forbes list of top ten global beauty brands in 2012 (16). We did not use the top-grossing global beauty companies, because many companies own several brands. From the top ten beauty brand list, we went to the websites of the top five. These brands are denoted by symbolic letters X, A, B, C, and D (in order from largest to smallest global brand revenue) (16). On each site, we looked at lip makeup, face makeup, and eye makeup products of each company and extracted the ingredient list of the top three to five best-selling or top-rated products in each category, depending on the company (Table 1 provides a complete list of the products assessed in this paper). Brands X and D carry only skin care products and no makeup, so they were not included in the table.

Definitions

We defined face makeup as any product that is applied to the skin for enhancing purposes. Eye makeup encompassed any makeup that is applied near the eye, including eye liners, mascaras, eye shadows, and brow liners. Lip makeup is any lip color–or shape–enhancing makeup, therefore not including lip balms.

FIGURE 1



Path of determination of ingredients most commonly found in beauty products.

Chow. Cosmetics use and menopause. Fertil Steril 2016.

Chemical Families and Their Ingredients

Because several ingredients are in the same chemical family but have different names, we simplified the list of ingredients by replacing some with their chemical family name (e.g., paraben in place of methylparaben and ethylparaben) to better isolate which chemical families most commonly appear in the ingredients. Table 2 presents the ingredients and their associated chemical family names. Because different companies named some ingredients differently (e.g., "safflower seed oil" vs. "*Carthamus tinctorius* [safflower] seed oil"), we also standardized the names, but we did not include the standardizations in Table 2. The simplified ingredient list was then inserted into a word cloud generator to visualize which chemical families appeared the most (Fig. 2). There are two algorithms used in word cloud generation: One is a direct correlate of the count data and the other is a log function of the count. We used the direct correlation to best represent what cosmetic users may be most concerned about. From the word cloud, it was immediately apparent that coal tar dyes, siloxanes, and parabens were the most frequent chemical exposures from cosmetics application. Iron oxide and titanium dioxide color dyes appeared with high frequency, but because they are inorganic compounds that have little dermal penetration we did not include them in our literature search (17). A total of 1,322 ingredients were compiled for the word cloud. Of the 1,322 ingredients, we consolidated chemicals into nine chemical families. Of the three largest chemical families, 145 ingredients were classified into the family of coal tar