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**Use of Cosmetic Products in Pregnant and Breastfeeding Women and Young Children:  
Guidelines for Interventions during the Perinatal Period from the French National  
College of Midwives (5)**

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## **Use of Cosmetic Products in Pregnant and Breastfeeding Women and Young Children: Guidelines for Interventions during the Perinatal Period from the French National College of Midwives (5)**

**Précis:** Cosmetic use among childbearing women and young children should be reduced when possible. When needed, perinatal professionals should help families select safer and trusted products.

### **ABSTRACT**

We conducted a literature review focusing on the use and health effects of cosmetics, especially among pregnant and lactating women and young children. Based on these data, we propose clinical practice guidelines for health care professionals to use for informing and advising their patients. These include the recommendations that families: (1) reduce the number and the frequency of use (**grade B**) and the amount applied (**expert consensus**) of all cosmetic products during the perinatal period and among children; (2) prefer simple, fragrance-free, and rinsable products, with short ingredient lists (**expert consensus**); and (3) for children, avoid industrial wipes and prefer water, with suitable soap when necessary.

**Keywords:** cosmetic products, guidelines for clinical practice, pregnant women, young children, maternal exposures

### **Quick points**

- The average number of cosmetic products used daily in France is 18 for pregnant women and 6 for children younger than 3 years.
- The use of cosmetic products was associated with higher levels of phenols, parabens, plasticizers, and phenoxyethanol in urine than among non-users.
- Some existing prevention strategies might be set up by perinatal professionals to reduce the exposure of women and children.
- In some situations, labels and smartphone applications might be used to support families in the choice of cosmetics products.

## INTRODUCTION

A cosmetic product is defined by the European Union (EU) as

*any substance or mixture intended to be placed in contact with the external parts of the human body (epidermis, hair systems, nails, lips and external genital organs) or with the teeth and the mucosa membranes of the oral cavity with a view, exclusively or mainly, to cleaning them, perfuming them, changing their appearance, protecting them, keeping them in good condition or correcting body odours.*<sup>1</sup>

The term *cosmetics* groups together a broad range of types of products: for hygiene and toiletry (shampoos, shower gels, soaps, deodorants, toothpaste, etc.), hair care (conditioners, styling products, colorants, etc.), face and body care (moisturizing, firming, anti-aging, massage products, etc.), makeup (foundation, mascaras, lipsticks, etc.), fragrance (perfumes, eau de toilette, etc.), shaving and depilation products, sun care, and baby products (diapers, wipes, etc.). A *cosmetic product* is considered to be the result of a combination of several ingredients; it is therefore a mixture. A *cosmetic ingredient* is defined as any substance, natural or synthetic, used in the formulation of a cosmetic product.

The cosmetic products available on the European market are subject to European (EC) regulation 1223/2009, commonly known as the *cosmetics regulation*.<sup>1</sup> It mandates that cosmetic products available for sale must be safe for human health in normal or reasonably predictable conditions of use. In other words, no known risk for the health of consumers is tolerated. For this purpose, the manufacturer must evaluate the safety of all of the ingredients contained in the product and must conduct an evaluation of the safety of the finished product before it is marketed.<sup>1,2</sup>

A specific evaluation of the safety of products intended for children younger than 3 years is also required. Thus, some compounds authorized in cosmetic products intended for the general population can be banned or limited in terms of their concentrations and/or type of product.<sup>1</sup> For example, in France, as part of an expert assessment, the *Agence Nationale de Sécurité du Médicament* (national agency for drug and health safety, ANSM) issued guidelines in 2018 that limit the use of phenoxyethanol in cosmetic products intended for the buttocks of small children.<sup>3</sup>

Since 1999, it has been mandatory to list the complete composition of all cosmetic products on their packaging [INCI (International Classification of Cosmetic Ingredients) list]: the ingredients present at concentrations exceeding 1% must be classified in decreasing order of concentration; those present at concentrations less than 1% can be mentioned in any order. Nonetheless, for perfumes, regardless of their composition, only the generic term *perfume* or *fragrance* must be mentioned; some components used in perfumes and scented products (shower gels, body creams, etc.) can thus not be included on the ingredient list.<sup>1</sup>

Cosmetics are habitually used more often by women than men. Pregnancy is a period when women are likely to use cosmetic products because changes in their skin (dryness, stretch marks, etc.) can induce them to increase their use of, for example, moisturizing products. Cosmetics can then be perceived as beneficial products providing bodily well-being. Nonetheless, this use is not risk-free for the health of either the pregnant women or the unborn child. Cosmetic products contain various compounds, some of which have possibly toxic effects. For example, some substances present in cosmetics can potentially cause endocrine disruption. The presumed effects of endocrine disruptors are varied, including metabolic disorders (obesity and diabetes), some fertility disorders, and an increased risk of some cancers (breast, prostate, and testes). For pregnant women, there also exists an increased risk of unfavorable pregnancy outcomes (eg, small-for-gestational-age neonate, preterm birth, and congenital malformations) or impairments in children's neurodevelopment (such as cognition, behavior, and autism spectrum disorder).<sup>4</sup>

Mechanisms other than endocrine disruption are nonetheless possible for some chemical substances, including direct toxicity or epigenetic mechanisms that can induce long-lasting effects throughout life and even be transmitted to the generations to come.<sup>5</sup> Pregnancy is also a period of vulnerability in relation to these substances, since they may affect the development and growth of the embryo and then the fetus because of its immature metabolism.<sup>6</sup> Moreover, cutaneous problems (stretch marks, dryness, etc.) can increase skin permeability and thus internal exposure. The skin of young children, especially newborns and in often irritated zones, such as the buttocks, is more permeable to substances than that of adults.<sup>7</sup>

The objective of this article is to present a synthesis of the knowledge available about cosmetic use by women either pregnant or breastfeeding and for young children and about the risks associated with it. Based on these elements, we propose here clinical practice guidelines for health care professionals working with pregnant women and parents.

## METHODS

For this systematic review of the scientific literature published in English and in French between 2009 and 2020, ASF and CM searched the MEDLINE database looking for the following themes: use of cosmetic products by women either pregnant or breastfeeding and for young children; exposure to compounds present in cosmetic products and its health effects; and perception of risks by women and health care professionals. The gray literature (publications of guidelines and reports by national bodies, dissertations, and websites) was also analyzed.

## RESULTS

### **Use of Cosmetic Products by Women Either Pregnant or Breastfeeding or for Young Children**

Only limited data are available about the use of cosmetic products by pregnant or breastfeeding women and for children younger than 3 years — both in France and throughout the world. The results described for product use below are limited to France.

#### *Pregnant Women*

In France, the largest national consumer survey, performed via Internet in 2013 among 251 pregnant women sampled by the quota method, collected data about the use and the frequency of use of 141 types of cosmetics.<sup>8</sup> The mean daily number of cosmetic products used was higher for pregnant (n=18 products) than nonpregnant (n=16) women (n=2713). The proportion of users was similar for pregnant and nonpregnant women for most cosmetic products. Hair coloring was nonetheless more frequent among nonpregnant women (46% vs 38% among pregnant women). Inversely, products against stretch marks (6% vs 50%) and for personal hygiene (48% vs 63%) were used more frequently by pregnant women. The frequency of use of these various products remained unchanged during pregnancy, except for a few; during pregnancy, frequency of use increased for shampoos and stretch mark products and diminished for hairspray, face cleansers and makeup removers (micellar cleansing water and cleansing milk), and some makeup products (eyeliner and lip liner) (Table 1). Pregnant women also used

products intended for children more often (shampoos, toothpaste, shower gel, and eau de toilette; 20% vs 10% in nonpregnant women).

A cross-sectional study conducted in 2015 among 128 women (68 pregnant and 60 not) in the Loire and the Haute-Loire districts (France)<sup>9</sup> collected information about their habits for the use of 28 types of cosmetic products during and outside of pregnancy (regular use when not pregnant, change of use during pregnancy, and criteria for choice to use them). Outside of pregnancy, the products most often used regularly were shampoo, shower gel, deodorant, and perfume (more than 90% of nonpregnant women used them regularly); the products used least often were self-tanning products (1%), lip liner (9%), dermatologic soap (17.5%), and night cream for the face (19%). Globally, the results showed that few women intended to or did modify their cosmetic use during pregnancy; nonetheless more women reported the use of nail polish, nail polish remover ( $P < .05$ ), and hair dye ( $P < 0.1$ ) before than during pregnancy. Use of nail polish was stopped during pregnancy by 10% of pregnant women and use of hair coloring by 7%. Moreover, 10% of the pregnant women reported reducing (without totally stopping) their use of perfume. Inversely, moisturizing body cream was the only product whose use rose because of pregnancy (both the proportion of users and frequency of use).<sup>9</sup> In another cross-sectional study of 300 women (153 pregnant and 147 during the postpartum period) in the district of Vienne (France) in 2015–2016, 13% of women reported limiting their use of cosmetics during pregnancy (generally without distinguishing between types of cosmetics).<sup>10</sup> A 2017 study at the Bordeaux University Hospital Center (France) found a higher proportion of women who had reduced their cosmetic use during pregnancy: hair coloring (73% of women), nail polish (60%), perfume and/or deodorant (40%).<sup>11</sup> Despite the differences in percentages, the types of products frequently stopped or reduced during pregnancy (hair coloring, nail polish, perfume, deodorant) are consistent with the results in the study by Marie et al. (2016).<sup>9</sup> Moreover, the differences in results can be explained by differences in methodology (number of women included, periods of inclusion, etc.) or by different analytic criteria. Including postpartum women (after normal birth) involves risks of memory and reporting bias. Finally, the impact of local prevention policies cannot be ruled out, especially in the study by Teyssiere et al. (2019), in which nearly half the women reported receiving information about environmental risks from their physicians.<sup>11</sup>

A recent French study considered the use of essential oils; among the 128 included women either pregnant or postpartum, 18% reported using essential oils during pregnancy.<sup>12</sup>

### *Children Younger than 3 Years*

A national consumer survey via Internet in 2013 focused on the types of cosmetics used and their frequency of use for 395 children younger than 3 years.<sup>13</sup> Parents used an average of 6 cosmetic products daily for their child. The products most widely used were shampoo (87% of users), shower gel (77%), wipes (77%), toothpaste (62%), eau de toilette (47%), and products intended for the buttocks, such as oleo-limestone liniment (33%) or cleansing water (29%). Wipes, very widely used by parents despite controversies related to their composition, were used to clean different parts of babies' bodies, especially the buttocks (64% of users), face (48%), and hands (25%). Based on the data about product quantities used in this study, the authors estimated that exposure to cosmetic products and therefore to their ingredients was much greater among children younger than 3 years than adults (especially for toothpaste, moisturizing products, and shower gel).<sup>14</sup>

## **3.2. Consequences Associated with the Use of Cosmetic Products**

### *Exposure to Chemical Substances*

#### Composition of a Cosmetic Product

Cosmetic formulas are most often composed of an aqueous phase and a fatty phase homogenized by substances with emulsifying properties. A cosmetic product thus has a variable number of ingredients, each with a specific function. The ingredients that create the product's texture (thickeners and gelling agents) and serve as a support for the active ingredients often account for most of its composition (water is generally the major component at 40 to 85% of the product). The ingredients that make the product effective (hydration, cell regeneration, soothing, photo-protection, anti-aging, etc.), on the other hand, generally account for less than 3% of the product. Other ingredients (preservatives, fixatives, colorants, etc.) may also be present to improve the product's effectiveness and duration of effect. Cosmetic products thus contain numerous chemical substances: phthalates, phenols, parabens, antibacterials, organic solvents, formaldehyde, heavy metals, and more.<sup>15-19</sup>

#### Exposure Routes

The ingredients can penetrate the organism through different exposure routes. Most cosmetic products are directly applied to the skin, and their components can cross the cutaneous barrier to reach the systemic circulation. Exposure can also take place by inhalation (for cosmetics in

the form of aerosols or sprays, such as hairspray, perfumes, some deodorants, or during the application of nail polish, for example), and, more rarely, by ingestion (for toothpaste or lipstick).<sup>13,20</sup>

During application to the skin, it is necessary to distinguish *rinsable* products (soap, shampoo, shower gel, etc.) and those that are not immediately rinsed off (perfume, deodorant, moisturizing cream, wipes for baby, etc.). The ingredients in the *nonrinsable* products remain in contact with the organism and thus expose their users still more.<sup>7</sup>

### Data about Exposure to the Chemical Substances Contained in Cosmetics

Numerous studies, in particular in the United States, have shown that among adults the use of cosmetic products is associated with a higher level of exposure to some substances:

- To phenols, such as the parabens,<sup>21–23</sup> and to some ketones, such as benzophenone-3<sup>24</sup>
- To phthalates, in particular, diethyl phthalate (DEP) and dibutyl phthalate (DiBP)<sup>17,21,22,25–28</sup> and bis(2-ethylhexyl) phthalate (DEHP),<sup>21,22,25–28,30,31</sup>
- To triphenyl phosphate (TPHP).<sup>32</sup>

Studies in France are rarer. An analysis by *Santé publique France* (the French public health agency) among 4145 women from the ELFE cohort (continental France mother-child cohort) found a total urinary concentration of DEHP metabolites 27% (95% CI, 1.8%–58.0%) higher among women using more than 5 cosmetic products a day compared to women using 2 to 3 a day.<sup>29</sup> Nisse et al. (2017) found a urinary concentration of phenoxyacetic acid (a metabolite of phenoxyethanol used as a preservative in cosmetics) higher among women than men.<sup>33</sup> In this study of 120 adults in the general population of Nord-Pas-de-Calais, the use of cosmetics (in particular, body and face care, hand or foot creams) was the only identifiable factor associated with higher levels. Finally, Garlantézec et al. (2012), in a random sample of 451 women in the French PELAGIE cohort (Bretagne) found a higher urinary concentration of phenoxyacetic acid among hairdressers and beauticians than for the other occupations considered (geometric means [GM]: 1.17 mg/L urine for the group of hairdressers and beauticians vs 0.41 for the others,  $P=0.03$ ).<sup>34</sup> More recently, the ESTEBAN study (*Etude de Santé sur l'Environnement, la Biosurveillance, l'Activité physique et la Nutrition*, that is, of health related to the environment, biomonitoring, physical activity, and nutrition) examined the urinary concentrations of different pollutants in up to 500 children and 900 adults in 2014–2016

(the number of participants varied for the different chemical families). In adults, the study reported quantifiable levels in 99.8% of subjects for phenoxyacetic acid (GM: 0.254 mg/L urine), with a higher concentration in participants who reported using deodorants (+55.7%) or cosmetics (+147 %).<sup>35</sup> For parabens, the level of urinary detection ranged from 0% (pentyl- and heptyl-parabens) to 93.3% (methyl-parabens; GM: 8.15 µg/L), with a 97% augmentation in the level of methyl-parabens in participants reporting using creams and other products for the body and a 207% increase in those reporting use of cosmetic products.<sup>36</sup> For short-chain phthalate metabolites, principally related to cosmetic product use, the urinary detection rate ranged from 93.8% (mono-methyl phthalate [MMP], GM: 2.4 µg/L urine) to 100% (monoisobutyl phthalate [MiBP] and monoethyl phthalate [MEP], GM: 28.5 and 52.0 µg/L urine, respectively).<sup>37</sup> We note that in the ESTEBAN study the term *cosmetics* included makeup products and nail polish and its remover, but not hygiene products, deodorant, hair coloring, or creams and lotions for the body.

Although some surveys have tried to estimate the impact of cosmetic use on exposure levels in children with probabilistic approaches,<sup>14</sup> we currently lack studies based on real measurements. In a study of a sample of children aged 6 years in the PELAGIE cohort, the presence of phenoxyacetic acid was found in all of the (median concentration: 0.141 mg/L).<sup>38</sup> In the ESTEBAN study, the detection frequencies were similar in children and adults for phthalates, glycol ethers, and parabens. Urinary concentrations of short-chain phthalate metabolites and DEHP were higher in children for whom cosmetic product use was reported (+32.8% and +32.9%, respectively).<sup>37</sup>

Cosmetics also contain numerous nanoparticles likely to cause exposure in users, including to some possibly toxic metallic particles.<sup>39</sup> Nonetheless, the real impact of exposure to such levels of contamination remains unknown.

### *Effect on the Health of Pregnant Women and their Unborn Children*

#### Irritations and Allergies

Numerous substances (preservatives, surfactants, UV filters, fragrances, etc.) contained in cosmetic products are identified as allergens and irritants. Some natural nut oils (such as almond oil, sesame oil, etc.) and essential oils also present allergic risks.<sup>40,41</sup> In 2012, the European Scientific Committee for Consumer Safety (CSCS) listed 82 substances associated with

fragrances as able to induce allergies.<sup>42</sup> Nonetheless, European regulations currently recognize only 26 substances (*Citronellol*, *Geraniol*, *Coumarin*, *Limonene*, etc.) as allergens that must be indicated on product packaging.<sup>1</sup>

### *Effects on Reproduction and Development*

While cosmetic exposure is very frequent in household settings, it is also frequent for women in some occupational settings, and probably at higher levels. Several studies have examined the association between occupational exposure to these products and reproductive and developmental abnormalities. A meta-analysis reported an increase in the risk of stillbirths, of births with a time to conception greater than 12 months, and of fetal growth restriction among women working as hairdressers or beauticians.<sup>43</sup> However, the studies included covered a half-century period (1960-2010): the chemical composition of cosmetic products undoubtedly varied not only over time but also by country. Moreover, most of the studies considered did not take into account postural (such as prolonged standing positions) or psychosocial constraints potentially important for the study of some reproductive and developmental abnormalities (for example, miscarriages and preterm births).

The literature rarely directly associates the use of cosmetic products during pregnancy or in young children with developmental disorders of the fetus and/or child. On the other hand, some studies and reviews in the international literature show an association between exposure to different substances present in cosmetics (including phthalates, parabens, phenoxyethanol, triclosan, and benzophenone) and the risks of preterm birth, fetal growth restriction, congenital malformations, and neurodevelopmental impairment.<sup>6,44-48</sup>

Some questionnaire-based studies have suggested an association with the risk of congenital malformation in children. In a case-control study in Picardie (France) between 2011 and 2014 (219 newborns, including 57 cases born with hypospadias), the use of hairspray and hair colorants during pregnancy was associated with a higher risk of hypospadias (odds ratio [OR], 1.8; 95% CI, 1.0-3.6), after adjustment for potential confounding factors.<sup>49</sup> A similar work in the south of France (95 newborns with cryptorchidism and 188 controls born between 2002 and 2005) showed a higher risk of having a child with cryptorchidism among mothers who reported using products containing phthalates in the workplace, before and during pregnancy.<sup>50</sup> These results nonetheless concern retrospective studies that must be confirmed by prospective studies. A Chinese cohort study of 9710 pregnant women also found a higher risk of small-for-gestational-age children among women using cosmetics for the face (eg, makeup,

lotion, and creams) after adjustment for confounding factors (OR, 1.23; 95% CI, 1.04–1.44). The risk increased with frequency of use, reaching an OR of 1.83 (95% CI, 1.25–2.69) among women who reported use exceeding 5 times a week.<sup>51</sup>

Several meta-analyses have reviewed studies of phthalate exposure (in particular, DEHP and BPD) during pregnancy. These substances were associated with an excess risk of preterm birth, reproductive impairment (reduced anogenital distance, hypospadias, and cryptorchidism), low birth weight,<sup>46,52</sup> and psychomotor developmental disorders.<sup>44</sup> According to a recent literature review, these 2 phthalates, as well as several others with either short or long chains, may be capable of impairing thyroid function (decrease in FT3, FT4, T3, and T4 hormones, depending on the substance).<sup>53</sup> The authors note that impairment of maternal thyroid function has been associated with an increased risk of preterm birth, low birth weight, and neurodevelopmental impairment in children.

A recent meta-analysis showed an association between prenatal exposure to some phenols/ketones (parabens, triclosan, benzophenone-3, bisphenol A, and dichlorophenols) and low birth weight.<sup>48</sup> Several works have also examined phenoxyethanol in the PELAGIE cohort study, which included 3421 women in early pregnancy between 2002 and 2006. They were followed up through the end of their pregnancy, and their children's health status was assessed at birth, 2, 4, and 6 years. The results showed that a higher urinary concentration of phenoxyacetic acid in early pregnancy was associated with a prolonged time to conception, a probability of conception during the cycle reduced by 30% (OR, 0.70; 95% CI, 0.52–0.95).<sup>54</sup> modifications of the concentrations of several steroid hormones in the cord blood,<sup>55</sup> and reduced performance on the verbal scale of the WISC-IV (neurocognitive test) in children at the age of 6 years.<sup>56</sup> Finally, a case-control study from the PELAGIE and EDEN cohorts showed that children's birth weight was inversely correlated with their mothers' early pregnancy urinary concentration of dichlorophenols and positively correlated with that of benzophenone-3.<sup>57</sup> The impact of triclosan, a potentially endocrine-disrupting preservative, on fetal growth and the risk of preterm birth remains uncertain according to a systematic review,<sup>58</sup> while a nearly contemporaneous US study found lower school performance (reading and mathematics) in the most strongly exposed 8-year-old children (measured by maternal urinary concentration at birth and the child's urinary concentration at one year of life).<sup>59</sup>

Combining the epidemiologic data with experimental findings from rodents, Leppert et al. (2020) showed an increased risk of overweight in little girls in their first 9 years of life after

maternal exposures to butyl-paraben during pregnancy,<sup>60</sup> via its action on the neurons that regulate appetite.

These results as a whole suggest that some substances present in cosmetics affect reproduction and fetal and child development. They remain to be confirmed in studies that take into account some limitations of the existing studies, such as issues with exposure measurements (for example, the sometimes short half-life of the substances monitored) and the failure to adjust for co-exposures.

### *Household Accidents*

According to a local French study, acute poisoning with cosmetic products (most often, associated with ingestion of or ocular contact by soap/shower gel, shampoos, or perfumes) accounts for 25% of bathroom poisonings. In the vast majority of cases, these accidents concern children younger than 4 years. The symptoms vary according to the type of product and type of contact (Table 2).<sup>61</sup>

### **Perceptions Associated with the Use of Cosmetic Products**

Several studies in France have examined perceptions of cosmetic product use by pregnant women; knowledge of the perceptions linked to the use of these products for children younger than 3 years is more limited.

#### *Perception by Pregnant Women*

Globally, women appear to be worried about the risks linked to exposure to cosmetic products during pregnancy: in the study by Marie et al. (2016), more than half the women (55%) considered cosmetics as a risk during pregnancy<sup>9</sup>; Rouillon et al. (2017) reported that 91% of the women identified cosmetics as a source of endocrine disrupters.<sup>10</sup>

Nonetheless, as reported above, reduction of the use of cosmetic products because of pregnancy appears to be limited.<sup>9,10</sup> Cutting back cosmetic use did not appear to be a priority for reducing exposure to endocrine disrupters. For example, only 13% of women reported that they limited cosmetic use during pregnancy, although more than 30% reported taking other steps to limit their exposure to endocrine disrupters (verifying recycling codes, eating more foods produced by organic agriculture, eating more fresh products, reducing intake of industrial products, etc.).<sup>10</sup> In the study by Marie et al. (2016), fewer than 20% of women reduced their use of cosmetic products during pregnancy, and fewer than 10% replaced some products by others considered "less harmful."<sup>9</sup> On the other hand, use of some types of cosmetic products

was reduced or even stopped during pregnancy: nail polish and polish remover, hair dyes, perfume, and deodorants.<sup>9,11</sup> Moisturizing body cream was the only product used more often in pregnancy — in terms of both the proportion of users and the frequency of use.<sup>9</sup> During pregnancy, the principal criteria for the choice of cosmetic products were their composition and their odor.<sup>9</sup>

These data show that women seem to be aware of a risk associated with cosmetics; nonetheless, most modify their usage habits very little, if at all, during pregnancy. Prevention of exposure to cosmetic products is often not a priority and might be difficult to implement because of the ubiquitous even invisible nature of chemical contaminants and alternatives that are less practical and/or more expensive.<sup>9,10</sup> These obstacles have been observed in 2 qualitative studies in Canada.<sup>62,63</sup> Studies also often mention the lack of information and advice provided to women during pregnancy. That is, more than 65% of women (pregnant or not) wanted advice about the use of these products.<sup>9</sup> More generally, 70% of women did not consider themselves sufficiently informed about sources of environmental exposure<sup>11</sup> and felt that their knowledge of endocrine disrupters was inadequate.<sup>10</sup> Only a minority reported having received advice and information from health care professionals about exposure to endocrine disrupters and/or use of cosmetic products.<sup>9,10</sup> Nonetheless, women often perceived the health authorities and health care professionals (midwives, gynecologists-obstetricians, and general practitioners) as relevant sources of information.<sup>9,11</sup>

#### *Perceptions by Health Care Professionals*

In France, several studies have examined health care professionals' perceptions of the risks associated with cosmetic product exposure to pregnant women and children younger than 3 years. These studies agreed that globally these professionals: (1) are aware of the risks associated with cosmetic product use by pregnant women and very young children, (2) are asked by pregnant women about the use of cosmetic products and their risks, and (3) clearly lack adequate knowledge and tools to respond appropriately to these questions by pregnant women.<sup>64</sup>

There have been 3 cross-sectional investigations on this topic in France. A study conducted in 2015 in the region of Auvergne among 189 perinatal health care professionals (obstetricians, midwives, and general practitioners) showed that 37% of professionals considered the use of cosmetics by pregnant women as a risk for the health of the women and their unborn babies.<sup>64</sup> Midwives and general practitioners perceived this risk more often than

obstetricians ( $P < .01$ ). Among health care professionals, 20% reported that women frequently ask them about cosmetic product use; most did not feel able to answer these questions correctly. A tiny minority of professionals (4%) advised women to reduce their use, and approximately 30% (most often midwives) recommended that they use products "without phthalates," "without parabens," and "without fragrance."<sup>64</sup> In another study conducted in 2017 (Provence-Alpes-Côte d'Azur region) among 962 health care professionals (41% midwives, 26% physicians, and 16% nurses), Sunyach et al. (2018) questioned them about the topics that women most often asked them about.<sup>65</sup> Among the environmental health themes, cosmetic products (including products for infants) was the topic raised most often (20%), along with pollution. Nonetheless, cosmetics are one of the topics least well understood by health care professionals. In a final study conducted in several French public and private hospitals, 57% of the professionals (midwives, obstetricians, general practitioners, and residents) reported that they provide women with no information about endocrine disruptors during pregnancy.<sup>6</sup> Overall, 74% of the respondents considered that the information about the health risks of endocrine disruptors is important, and 93% wanted to be better informed.

The principal obstacles to the provision of information and advice to pregnant women shown in these studies were the professionals' lack of knowledge about cosmetic products, lack of training, the lack of scientific evidence in the area of environmental health, fear of women's reactions, and the absence of alternative solutions.<sup>63-67</sup>

### **Studies of Interventions to Reduce Exposure to Some Cosmetic Ingredients Considered Suspect**

The studies described above suggested that increased cosmetic product use was associated with higher exposure levels to some compounds in adults, specifically, phenols, parabens, plasticizers, and phenoxyethanol. Logically, reducing cosmetic use should reduce these exposures (LE2). In the interventional study by Harley et al. (2016), the authors replaced the usual cosmetic products of 100 young women with those certified to contain no phthalates, parabens, triclosan, or 3-benzophenone (LE2).<sup>68</sup> Three days after this intervention, urinary concentrations of 3 phthalate metabolites fell by 27%. Similar results were obtained for the measurements of triclosan (-35.6%) and 3-benzophenone (-36%). The results for parabens were more divergent. Hagobian et al. (2016) set up a pilot interventional study among 24 women, aimed at reducing their exposures to bisphenol A.<sup>69</sup> The women selected (by randomization) for the intervention participated in a weekly face-to-face interview aimed at informing them about sources of chemical exposures; they also received one batch of cosmetics and food

storage boxes without bisphenol A. The authors observed a mean decrease of 45% in this chemical's urinary concentration among women who underwent the intervention (LE2). Finally, in a US cohort study of 656 women, Serrano et al. (2014) reported that urinary concentrations of MEP (monoethyl-phthalate, a metabolite of diethyl-phthalate, used in cosmetics) was 54% (95% CI, 17%–102%) higher among women who reported that they only rarely used "environmentally-friendly" products (LE2).<sup>70</sup> This article suggests an interest in *eco-responsible labels* to reduce user exposure.

## DISCUSSION

### Cumulative Exposure

It is important to remember that cosmetic products on the market have been assessed for their absence of known risk to consumers. Nonetheless, as mentioned in European regulations, safety is evaluated individually for each product. No cumulative exposure has yet been assessed, except for the ingredients used as preservatives.<sup>2</sup> Many of these ingredients can be found not only in numerous distinct cosmetic products but also in other sources of exposure, such as food or cleaning products (presence of phthalates, parabens, etc.).<sup>26,46</sup> Cosmetic products may also be contaminated by substances used in the composition of their container. This is especially true for containers made of polyvinyl chloride, for which authors have shown that components such as phthalates are likely to be released from the container and migrate toward the contents.<sup>71,72</sup> Overall, the average number of cosmetic products used daily is 18 for pregnant women and 6 for children younger than 3 years.<sup>8,13</sup> Cumulative exposure to different products could therefore theoretically result in exposure that exceeds health safety thresholds for some of their shared ingredients. To overcome this problem, the principal recommendations to be made to pregnant women and parents of young children should be to limit the frequency of use and the quantity applied at each use, and to prefer, for identical effects, the products containing the fewest possible ingredients. In addition, risk assessments should be conducted to assess this cumulative exposure, or even the potential synergistic effect of some compounds that act with similar mechanisms of action.<sup>73</sup>

### Certification of Cosmetics

Certification is available for cosmetics. Nonetheless, the number of existing labels (Ecocert, Cosmebio, Ecolabel, Demeter, Natrue, etc.) as well as their criteria (nature and origin of the

ingredients used, environmental impacts, animal well-being, etc.) can complicate the choices for users. Moreover, the labels do not all have the same requirements.

Here, the principal criterion of some of the labels is the nontoxicity of their ingredients (use of animal testing is not considered here). The table presented as an appendix (Appendix 1) is therefore not exhaustive but offers a synthesis of selected labels, including French (Cosmebio, Ecocert), European (Nature & Progress, Cosmos, Ecolabel) and international (Natrue) labels. COSMOS is the label most recently standardized at the European level, in 2017; there are 5 relevant European labels including Ecocert and Cosmebio. These labels are mainly distinguished by the percentage of ingredients of natural or organic origin as well as by the ingredients banned in cosmetic products. Most of the cosmetics called "natural" or "organic" contain a maximum of ingredients of plant origin and limit as much as possible the synthetic agents considered undesirable. As of today, there is no legal definition of *natural* or *organic* cosmetics; we can talk instead of natural and organic sources of these ingredients. An ingredient of natural origin can come from an animal, plant, or mineral and can have been transformed, principally by primary mechanical and chemical processes such as distillation, cooking, mechanical filtering, fermentation, and oxidation. It cannot, however, have undergone extensive chemical or technological manipulations that consume excessive quantities of energy, are polluting, and which abusively or totally modify the original component. Ingredients of organic origin correspond to raw materials cultivated or harvested according to certified organic methods. The official label of the European Union (Ecolabel) is presented in this table, but it must be noted that it sets no requirements about the nature or origin of the ingredients used. It is also important to note that an ingredient's natural origin does not guarantee its lack of toxicity. This label essentially considers the environmental impact of products, emphasizing their nontoxicity for the environment throughout their life cycle (design, production, marketing, and use, and information to consumers).

### **Essential Oils and Artisanal Preparations**

In the French study by Cabut et al. (2017), a relatively high proportion of women (18%) reported using essential oils during pregnancy.<sup>12</sup> The ANSM and the ANSES (*Agence nationale de sécurité sanitaire de l'alimentation, de l'environnement et du travail*, national agency of health security for food, the environment, and the workplace) nonetheless point out that any use of essential oils, particularly in pregnant women and children, requires prior medical advice insofar as some of them may present a risk of toxicity.<sup>41,74</sup> Essential oils contain elevated quantities of phenols, ketones, and phenylpropanoids. They can, for example, increase the risk

of miscarriage, especially during the first trimester of pregnancy.<sup>75</sup> The safety during pregnancy of most essential oils has not been evaluated.

It is also important to note that artisanal preparations of cosmetics are not at all certified and must be considered with prudence, in particular during pregnancy and in young children. For example, the manufacture of handcrafted oleo-limestone liniment can induce a risk of burns if done improperly as well as a risk of spoilage because of the absence of preservatives.

### **Baby's Buttocks**

The French study by Ficheux et al. (2016) about caring for the baby's buttocks showed that use of wipes is widespread (64%).<sup>13</sup> Oleo-limestone liniment and cleansing water were used less often (33% and 29%, respectively). The use of wipes has been quite controversial for several years now, since these products are most often unrinsed and contain numerous chemical substances (preservatives, perfumes, etc.).<sup>76</sup> Oleo-limestone liniment is a mixture of extra-virgin olive oil and limewater. Nonetheless, many products are marketed with additional components such as preservatives and emollient or protective substances. Moreover, the liniment must not be considered a detergent because it has no surfactants.<sup>76</sup> Its use must therefore be combined with the use of a mild detergent product (water with appropriate soap).

### **Smartphone Applications**

The recent acceleration of smartphone application development has made it possible to scan or analyze cosmetic products, to list the ingredients present, and identify those that may be toxic. These *apps* make it possible to increase consumers' awareness of the risks associated with cosmetics. Some also offer epidemiologic data (references available about the use of different cosmetics). Nonetheless, these must not be considered a complete source of information and must be used prudently. Most of them were not developed by professionals in cosmetic formulation and thus lack toxicological expertise. Possible errors by the technology used (text detection in a photo, for example) could result in failure to consider potentially harmful ingredients. These databases might be neither complete nor routinely updated when the composition of products is modified. The information provided is often simplified and summarized by a rating (good, poor, limited risk, average risk, etc.). Moreover, these ratings are essentially based on the list of ingredients, without any consideration of quantities. Some apps also offer alternatives labelled *without risk*, but without explaining the selection criteria applied.

## RECOMMENDATIONS

A synthesis of these guideline are presented elsewhere.<sup>77</sup>

### General Recommendations

- Reduce the number (**grade B**), frequency of use (**grade B**), and quantity applied (**expert consensus**) of all cosmetic products used by women in the perinatal period for themselves, but also for their children (**grade B**).
- Prefer simple products, with a short list of ingredients, without perfume, and rinsable (**expert consensus**).
- Avoid the use of essential oils (**expert consensus**).
- Products with trustworthy ecolabels (eg, Cosmebio, Ecocert, Nature & Progress, Cosmos, Natrue) can be preferred (**expert consensus**).
- Smartphone apps can be used by women, once they have been informed of the value of reducing cosmetic use and of the apps' limitations (**expert consensus**).

### Pregnant and Breastfeeding Women

- Avoid the use of perfumes, nail polish/remover, and hair coloring (**expert consensus**).
- Air out rooms after the use of volatile cosmetic products, especially sprays and aerosols (**expert consensus**).

### Children Younger than 3 Years

- For children, avoid industrial wipes (containing a large number of ingredients and not rinsable). Prefer water and an appropriate soap if needed (**expert consensus**).
- When necessary, use cosmetic products intended for children younger than 3 years (**expert consensus**).

As for all possibly toxic products:

- Store cosmetics in a safe place, either high up, or in a locked closet (**expert consensus**)
- Should they be ingested, it is recommended to call the poison center, which can best evaluate the management needed according to the type and quantity of products ingested. In the case of serious events, call emergency medical services (**expert consensus**)

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## Tables and figures

**Table 1. Percentage of Adult Women in France, Nonpregnant and Pregnant, Using Cosmetic Products and Frequency of Daily Use (based on Ficheux et al. 2015)**

		Nonpregnant Women (n= 2713)			Pregnant Women (n= 251)		
		Users (%)	Frequency of use (daily)		Users (%)	Frequency of use (daily)	
			Mean	Standard deviation		Mean	Standard deviation
<b>Hair products</b>	Shampoos	98	0.44	0.33	99	0.53	0.40
	Hairspray	35	0.60	0.55	33	0.45	0.43
	Conditioner	57	0.37	0.30	63	0.37	0.31
	Mask	37	0.12	0.08	43	0.11	0.07
	Coloring	46	0.02	0.01	338	0.02	0.01
<b>Face products</b>	Solid soap	29	1.17	0.62	20	1.21	0.68
	Cleansing milk	37	1.07	0.55	37	0.94	0.51
	Micellar cleansing water	49	1.15	0.59	49	0.94	0.53
	Moisturizing cream	77	1.05	0.39	80	1.06	0.40

	Night cream	43	0.97	0.36	41	0.89	0.48
	Eyeliner	59	0.80	0.49	64	0.73	0.52
	Mascara	71	0.79	0.46	83	0.80	0.48
	Foundation (fluid)	35	0.74	0.46	42	0.71	0.49
	Lipstick	63	0.88	0.67	63	0.81	0.66
	Makeup remover lotion	59	1.01	0.54	61	0.88	0.46
<b>Oral hygiene</b>	Toothpaste	99	2.00	0.84	98	2.00	0.95
	Mouthwash	44	0.84	0.70	43	0.77	0.70
<b>Products for the body</b>	Shower gel	91	1.04	0.48	92	1.03	0.44
	Solid soap	43	1.18	0.66	31	1.15	0.71
	Products for personal hygiene	48	0.99	0.54	63	0.96	0.52
	Moisturizing cream	43	0.70	0.52	57	0.75	0.50
	Massage oil	34	0.11	0.09	52	0.10	0.09
	Anti-stretch mark products	6	0.55	0.51	50	0.96	0.61

**Table 2. Examples of Symptoms Linked to Toxicity from Cosmetic Products**

<b>Cosmetic products</b>	<b>Symptoms</b>
<b>Foaming products:</b> <i>soap, shower gel, shampoo, bubble bath</i>	- Ingestion: gastrointestinal symptoms, gastrointestinal tract irritation, respiratory difficulties, sometimes severe to the point of asphyxia, respiratory infections (symptoms due to the large quantities of foam that can be produced)  - Ocular projections: local irritation
<b>Products containing alcohol:</b> <i>perfumes, mouth wash, lotions, eau de toilette, deodorant</i>	Ingestion: alcohol poisoning, hypoglycemia
<b>Products containing acetone, glycol ethers, or ammonia:</b> <i>beauty masks, nail polish, polish remover, hair products</i>	- Ingestion: metabolic and neurological toxicity  - Inhalation: headaches

*From: UHC Lille (2019).*

## **Appendix**

**Appendix 1.** Principal labels used for cosmetic products and the characteristics associated with them.

Labels		Percentage of natural ingredients	Percentage of ingredients from organic agriculture	Prohibited ingredients (limited)
<b>COSMEBIO</b> (private label, created in 2002) – France 	<b>Cosmetics bio</b>	≥ 95%	– ≥ 95% of plant-based ingredients – ≥ 10% of all ingredients – ≥ 20% of ingredients meet the criteria for the Organic Agriculture label	- Ingredients from petrochemicals (limited) - Ingredients from dead animals (including animal fat) - GMO - Packaging: PVC forbidden (obligation to use recyclable materials)
	<b>Cosmetics éco</b>		– ≥ 50% of plant-based ingredients – ≥ 5% of all ingredients – ≥ 20% of ingredients meet the criteria for the Organic Agriculture label	
<b>ECOCERT</b> (private label, created in 1991) – France 	<b>Ecocert bio</b>	≥ 95 %	– ≥ 95% of plant-based ingredients – ≥ 10% of all ingredients	- Ingredients from petrochemicals (limited: silicone, parabens, synthetic perfume) - Ingredients from dead animals (including animal fat) - GMO - Nanoparticles
	<b>Ecocert éco</b>		– organic ingredients: ≥ 50% of plant-based ingredients and ≥ 5% of all ingredients	

<p><b>COSMOS – European (2017:</b> group of 5 private European labels including Ecocert and Cosmebio)</p> 	<p><b>ORGANIC</b></p> <hr/> <p><b>NATURAL</b></p>	<p>95%--100% (&lt; 5% of approved ingredients, from a restrictive list including preservatives)</p>	<p>– ≥ 95% of plant-based ingredients</p> <p>- ≥ 20% of all ingredients (10% for the products to be rinsed)</p> <hr/> <p>No minimum threshold</p>	<p>- Ingredients from petrochemicals (limited): parabens, phenoxyethanol, synthetic perfumes and colorants prohibited (list of ingredients including preservatives authorized, with assay levels)</p> <p>- GMO</p>
<p><b>NATURE &amp; PROGRES</b> (created by Nature &amp; Progress in 1972) – European</p> 	<p>No minimum demanded in terms of plant-based ingredient levels</p>	<p>100% of plant ingredients must be organic: plant-based ingredients must meet the criteria for the Organic Agriculture label.</p> <p>Non-organic ingredients: defined by strict specifications</p>	<p>- Ingredients from petrochemicals (limited: colorants, perfumes, silicone, paraffin, and some preservatives (including parabens))</p> <p>- Ingredients from dead animals (including animal fat...)</p> <p>- Titanium dioxide and zinc oxide nanoparticles.</p> <p>- Palm oil</p>	
<p><b>ECOLABEL – European</b> (created in 1992 by the European Commission)</p> 		<p>No obligation for the level of organic plant ingredients.</p>	<p>- Fragrances (in the composition of shower gels/soap for children)</p> <p>- Limitation even ban on use of some ingredients (including parabens, petroleum-derived products...)</p> <p>All ingredients must be biodegradable</p>	

<p><b>NATRUE</b> (NGO) (international nongovernmental organization created in 2008)</p> 	<b>Organic cosmetics</b>	The label defines groups of products for which a minimum proportion of unmodified natural ingredients is specified: oils (90%), perfumes (60%), body milks (30%), deodorants and makeup products (15%)	≥ 95% of plant-based ingredients	<ul style="list-style-type: none"> <li>- Ingredients from petrochemicals (limited: paraffins, PEG, -propyl, -alkyl, silicone and its derivatives, synthetic fragrances and colorants)</li> <li>- GMO</li> </ul>
	<b>Natural cosmetics, partly organic</b>		≥ 70% of plant-based ingredients	
	<b>Natural cosmetics</b>		The natural raw materials are preferably organic, but there is no minimum threshold	

Abbreviations: GMO, Genetically modified organisms

