Chemicals in Cosmetics Used by Washington Residents

Report to the Legislature
Pursuant to ESSB 5693 (2022) Section 302 (56)

Hazardous Waste and Toxics Reduction Program *and* Environmental Assessment Program

Washington State Department of Ecology

Olympia, Washington

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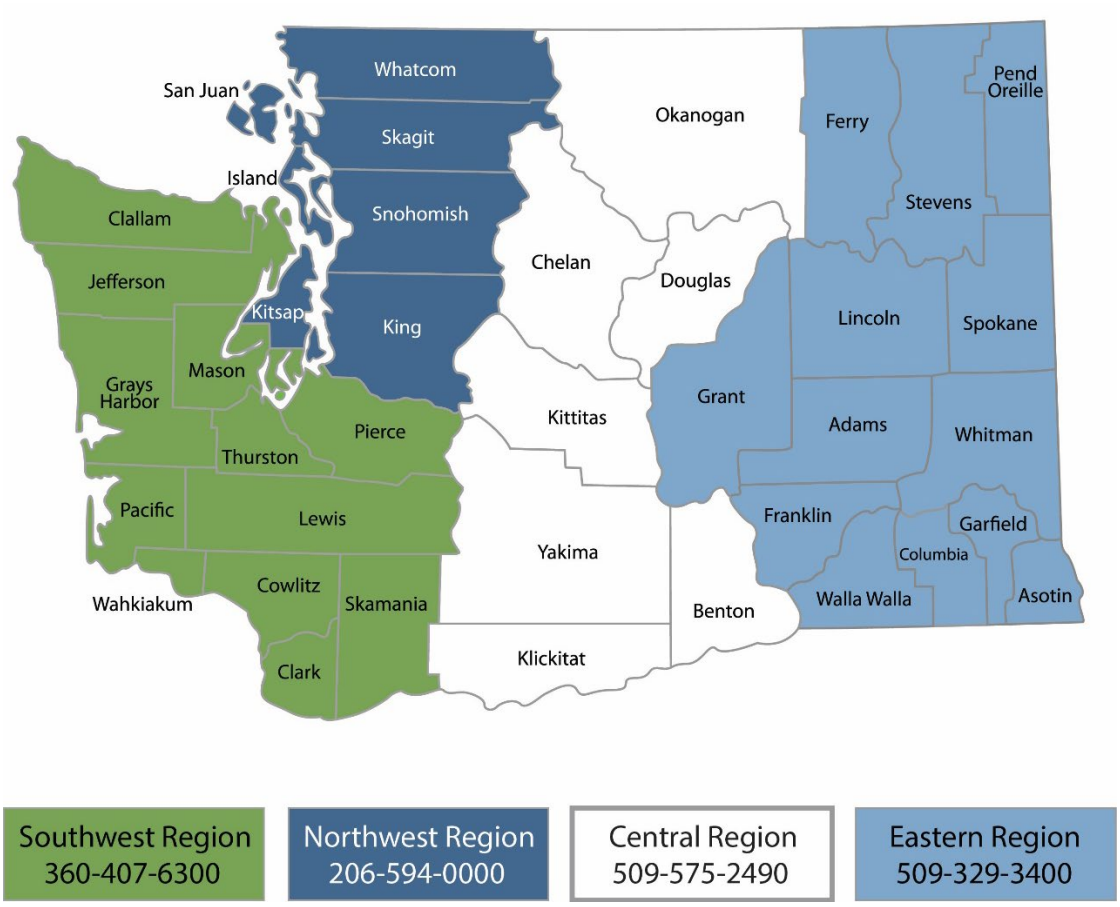

Region	Counties served	Mailing address	Phone
Southwest	Clallam, Clark, Cowlitz, Grays Harbor, Jefferson, Mason, Lewis, Pacific, Pierce, Skamania, Thurston, Wahkiakum	PO Box 47775 Olympia, WA 98504	360-407-6300
Northwest	Island, King, Kitsap, San Juan, Skagit, Snohomish, Whatcom	PO Box 330316 Shoreline, WA 98133	206-594-0000
Central	Benton, Chelan, Douglas, Kittitas, Klickitat, Okanogan, Yakima	1250 W Alder St Union Gap, WA 98903	509-575-2490
Eastern	Adams, Asotin, Columbia, Ferry, Franklin, Garfield, Grant, Lincoln, Pend Oreille, Spokane, Stevens, Walla Walla, Whitman	4601 N Monroe Spokane, WA 99205	509-329-3400
Headquarters	Across Washington	PO Box 46700 Olympia, WA 98504	360-407-6000

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Acronyms

Table 1. Acronyms found in this report.

Acronym	Definition
ASTDR	U.S. Agency for Toxic Substances and Disease Registry
CA Prop 65	California's Proposition 65 list
CDPH	California Department of Public Health
COC	Chain of custody
CSPA	Washington State Children's Safe Products Act
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
EU SVHC	European Union substances of very high concern
EU REACH	European Union's Registration, Evaluation, Authorisation and Restriction of Chemicals
FDA	U.S. Food and Drug Administration
GHS	Globally Harmonized System of Classification and Labeling of Chemicals
Health	Washington State Department of Health
IARC	International Agency for Research on Cancer
IC2	Interstate Chemicals Clearinghouse
LCS	Laboratory control samples
MEL	Manchester Environmental Laboratory
MQO	Measurement quality objectives
NIH	National Institutes of Health
PBT	Persistent, bioaccumulative, and toxic
PCPC	Personal Care Products Council
PFAS	Per- and polyfluoroalkyl substances
ppm	Parts per million
QA/QC	Quality assurance/ quality control
QAPP	Quality Assurance Project Plan
RCW	Revised Code Washington
RPD	Relative percent difference
TRI	Toxics Release Inventory
UNEP	United Nations Environment Programme

Executive Summary

Legislative directive

Section 302 of the 2022 Supplemental Operating Budget, ESSB 5693, provides:

> (56) $266,000 of the model toxics control operating account—state appropriation is provided solely for the department, in consultation with the department of health and community and social justice organizations, to identify cosmetic products marketed to or used by people of color, including adults and children, and test those products for potentially harmful chemicals or chemical classes. The department must provide a technical report on the results of the tests to the appropriate committees of the legislature by December 31, 2022.

Background

Cosmetics are a type of consumer product used to cleanse or alter the appearance of the body. The term "cosmetics" covers not only makeup and perfume, but also items such as shampoo, hair gels, body wash, deodorant, hand lotion, and shaving cream. Cosmetics can contain chemicals that are hazardous to people or the environment. These chemicals may be either intentionally added ingredients or unintentional contaminants. The U.S. Food and Drug Administration does not review or authorize most ingredients before they are used in cosmetics and, with a few exceptions, it does not regulate the ingredients once they are in cosmetics.

People are exposed to chemicals in cosmetics when they breath them in, accidentally eat them, or through skin contact. However, people are not exposed equally. Some cosmetics are more likely to contain hazardous chemical than others. Some individuals use certain cosmetics more often than others because of cultural or religious differences, because of their occupation, or because of beauty standards that promote traditional European features, such as light skin tones. Because of these differences, women of color, especially Black women and women with dark skin, may be exposed to hazardous chemicals more frequently.

Ecology's work

To identify products used by Washington residents of color, we collaborated with the Department of Health and researched how different communities use cosmetics.

- We spoke with researchers and individuals from social justice organizations who studied differences in cosmetic usage outside of Washington state.
- We heard from Latinx, Black, and multiracial Washington residents about what cosmetic products they used and what concerns they had about chemicals in cosmetics.
- We listened to where people buy cosmetics and what they prioritize.

We used this information to guide our product testing.

Due to the Legislature's interest in having information as soon as possible, we planned our cosmetic product testing in two phases.

- Phase one product testing is complete. We give the results in this report.
- Phase two product testing will be completed by June 2023.

This second phase will provide product testing information on products we could not evaluate in the first phase. In both phases, we chose the chemicals to test for based on what cosmetic testing methods are accredited by Ecology. For many hazardous chemicals found in cosmetics, there are no established test methods, or there are no laboratories that can perform these tests to Ecology's standards.

In phase one, we bought lipsticks and tested them for the presence of heavy metals. We also obtained body lotions and hair products with preservatives that can release formaldehyde, and we determined the amount of formaldehyde in them. We tested dark-tint powder foundations for both heavy metals and formaldehyde.

For phase two, we acquired blushes and eyeshadows that contain talc to assess if these products contain asbestos, a known talc contaminant. We purchased nail products, hair sprays, feminine cleansers, and body washes to determine if these products contain ortho-phthalates.

To supplement testing results and provide additional information, we also reviewed product databases where companies report the presence of hazardous chemicals in cosmetics and scientific literature about prior cosmetic product testing.

Findings

We heard from Black or biracial Washington residents that they most frequently use skin lotion, hair conditioning treatments, and lip and eye makeup. Latinx teens and their parents living in Pierce County reported that that they most frequently use deodorant, skin lotion or oil, and hair styling or hair conditioning products.

In phase one product testing, we found:

- Formaldehyde in 26 out of the 30 body lotions and hair products.
- Formaldehyde levels from an estimated 39.2 parts per million (ppm) to 1660 ppm, with the highest level in a hair styling gel purchased from Walmart. Formaldehyde levels above 200 ppm are known to cause allergic reactions in sensitive individuals (SCCS, 2021).
- No formaldehyde in dark-tint powder foundations.
- Lead greater than 1 ppm was detected in two dark-tint powder foundations and one lipstick. There is no known safe amount of lead (CDC, 2021; WHO, 2022).
- A dark-tint powder foundation with a lead concentration of 5.5 ppm and an arsenic concentration of 2.1 ppm. Germany has determined that it is feasible for companies to keep lead levels below 5.0 ppm and arsenic levels below 0.5 ppm in makeup powders (BVL, 2017).

Our findings in the first phase of product testing, the scientific literature, and product databases demonstrate that many products used by Washington state residents can contain a number of hazardous chemicals. This includes products:

- That are intended for children.
- That Washington residents reported frequently using.
- That do not list the hazardous chemicals as ingredients on the label.

Several studies have found multiple hazardous chemicals in the same products.

We also identified products on the market that are made without the hazardous chemicals we studied in this report. Some of these alternative products have been evaluated to confirm the ingredients they use are less harmful to human health.

Next Steps

Phase two product testing will conclude by June 30, 2023. We will amend this report to include those results.

Conclusions

Hazardous substances in cosmetics may be intentionally added by manufacturers. They can also be added unintentionally with another ingredient, from packaging, or from the manufacturing process. Product labels may not include these substances on ingredient lists, even if they are intentionally added.

The widespread presence of hazardous chemicals in a variety of cosmetic products means it is possible for people to be exposed to many of them through their daily personal care routine. People of color in Washington may have more exposure to these or other harmful substances. For many people of color, the negative impact of harmful cosmetics is compounded by other environmental and social factors.

Introduction

Legislative directive

Section 302 of the 2022 Supplemental Operating Budget, ESSB 5693, directed the Department of Ecology (Ecology) as follows:

> (56) $266,000 of the model toxics control operating account—state appropriation is provided solely for the department, in consultation with the department of health and community and social justice organizations, to identify cosmetic products marketed to or used by people of color, including adults and children, and test those products for potentially harmful chemicals or chemical classes. The department must provide a technical report on the results of the tests to the appropriate committees of the legislature by December 31, 2022.

The following report describes the consultation, testing, and research we, with the Department of Health (Health), performed in fulfillment of this directive.

Widespread exposure to chemicals in cosmetics

Everyone uses cosmetics. The term "cosmetics" describes a group of consumer products that include both beauty and personal care products. Washington's Intrastate Commerce in Drugs and Cosmetics Act defines cosmetics as "(1) 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, and (2) articles intended for use as a component of any such article" (RCW 69.04.011[3]). This definition mirrors the U.S. Food and Drug Administration (FDA) definition. Neither of these definitions includes soap intended only for cleaning, which is defined and regulated separately from other cosmetics (FDA, 2022a). The term "cosmetics" covers not only makeup and perfume, but also items such as shampoo, body wash, deodorant, hand lotion, and shaving cream.

The cosmetics industry in the United States is large and diverse. According to a 2018 report from the trade association Personal Care Products Council (PCPC), the cosmetic products industry generated 267.3 billion dollars in gross domestic product in 2018.

PCPC represents over 600 companies involved in the cosmetics industry in the United States. Of those, 311 of those companies are manufacturers or distributors of cosmetic products (PCPC, 2022a). Many of these companies are small businesses. The same 2018 report stated that 34 percent of personal care product companies had fewer than 10 employees, compared to an average of 10 percent in other industries (PCPC, 2020).

Over 29,000 ingredients have been named and categorized in the *International Cosmetic Ingredient Dictionary & Handbook* maintained by PCPC (PCPC, 2022b). Almost all cosmetics are made using multiple ingredients found in this handbook. Some ingredients are added to provide the cosmetic function, such as removing oil or coloring lips. Others are added for

[3] https://app.leg.wa.gov/rcw/default.aspx?cite=69.04.011

performance purposes, such as extending the shelf life of the product, changing the feel of the cosmetic, or preventing the product from being rubbed or washed off.

In addition to ingredients that manufacturers add by design, other chemicals may be present as contaminants. Intentionally added ingredients may contain contaminants, such as when talc that contains asbestos is used in a cosmetic. Contaminants can also migrate into cosmetics from manufacturing equipment or packaging (Groh et al., 2019; Murat et al., 2020). Companies can test products for the presence of certain contaminants. But other contaminants are not well-studied, so their presence in cosmetics is difficult to monitor or control.

Most people use at least one type of personal care or beauty product regularly. When people use cosmetics or are around other people using cosmetics, they can be exposed to the substances in those products. People are exposed when they breathe in a product, such as hair spray, or breathe in air or dust that contains chemicals released by a cosmetic (Capela et al., 2016a). They can also eat small amounts of products like lipstick or absorb some of the substances through their skin (Schettler, 2006; Bekö et al., 2013). Chemicals in rinse-off cosmetics enter the wastewater system and can get into the environment (Stackelberg et al., 2004).

Some of these substances are hazardous to human health or the environment. Heavy metals like lead and mercury have been linked to damage in the brain and central nervous system and problems with reproduction and child development (ATSDR, 2022, 2020). Certain parabens and ortho-phthalates can disrupt the endocrine system, which regulates many bodily functions (EPA, 2022a). Many other chemicals can cause allergic reactions in some individuals (FDA, 2022b).

Current cosmetics regulations

Federal regulations

In the United States, cosmetic manufacturers are not required by law to submit safety data on cosmetic ingredients. FDA regulates the use of color additives in cosmetics, excepting coal tar compounds used in hair dyes. The agency also restricts the use of a small subset of chemicals and ingredients in cosmetics (FDA, 2022c), such as mercury or more recently, hydroquinone in skin lightening creams (FDA, 2022d). All other chemicals in cosmetics are voluntarily regulated by manufacturers.

Certain cosmetic products, like sunscreens or skin-lightening creams (FDA, 2022d), contain one or more ingredients that are regulated by the FDA as drugs. Unlike cosmetics, drugs generally must be approved by the federal government before being sold in products (FDA, 2022a). Non-drug ingredients used in the same products do not require agency approval.

United States law requires cosmetics that are sold to consumers to include an ingredient declaration on the packaging. However, certain ingredients are exempt from public disclosure (FDA, 2022e). For example, incidental ingredients do not need to be disclosed. An incidental ingredient is a term used by the FDA to describe ingredients added during cosmetic manufacture that are present at low levels and have no function in the final cosmetic product.

Many cosmetics also include ingredients that are added to change the taste or smell of the product. In the declaration, these ingredients can be listed as "fragrance," "parfum," or "flavor" (FDA, 2022f) rather than listing the specific substances added to achieve the final smell or taste. Fragrance ingredients that are not derived from natural sources (synthetic fragrances) can include chemicals like ortho-phthalates in addition to the synthetic substances that create the smell. These substances would also not be included in the ingredient declaration since they are part of the fragrance. In addition to hazard concerns associated with chemicals like ortho-phthalates, both synthetic and naturally derived fragrance ingredients can also cause allergic reactions in some individuals (Johansen, 2003).

State regulations

Certain states have passed additional restrictions on ingredients in cosmetics. These include laws in Washington, Minnesota, and California.

In Washington State, the Children's Safe Product Act[4] restricts the use of lead, cadmium, and certain ortho-phthalates in children's products. It also requires manufacturers that make children's cosmetics to report if their products contain any chemicals from the list of chemicals of high concern to children.

Additionally, Ecology is currently drafting regulation to restrict the use of ortho-phthalates in fragrances that are used in all cosmetics under the Safer Products for Washington program.[5]

In 2013, Minnesota passed a law prohibiting formaldehyde from being used in cosmetic products like lotion and bubble bath intended for use by children under eight years old.[6]

California has several laws that regulate cosmetic ingredients and labeling.

- The California Safe Cosmetics Act, adopted in 2005, requires manufacturers and distributors to report any cosmetics sold in California that contain ingredients found on authoritative lists of chemicals that are documented human or environmental health hazards, such as California's Proposition 65 list.[7]
- In 2020, California adopted the Cosmetic Fragrance and Flavor Ingredient Right to Know Act, which requires companies to disclose when certain ingredients are added to cosmetics to help create a flavor or fragrance.[8]
- In 2018, California adopted the California Professional Cosmetics Labeling Requirements Act requiring professional cosmetics, which are not intended to be sold to consumers, to carry labels that follow the federal requirements for cosmetic products that are sold to consumers.[9]

[4] Chapter 70A.430 RCW
[5] Chapter 70A.350 RCW
[6] Minnesota Statutes 325F.177
[7] California Health and Safety Code Sections 111791–111793.5
[8] California Health and Safety Code Section 111792.6
[9] California Health and Safety Code Section 110371

- In 2020, California adopted a law banning 24 chemicals from use in cosmetics products sold in California. These chemicals include mercury and formaldehyde, as well as several hazardous parabens, ortho-phthalates, and per- and polyfluoroalkyl substances (PFAS).[10]
- In 2022, the California legislature adopted a law banning any intentionally added PFAS in cosmetic products sold in the state, where PFAS are defined as "a class of fluorinated organic chemicals containing at least one fully fluorinated carbon atom."[11]

Regulations in other countries

The European Union Cosmetics Directive[12] bans cosmetics ingredients that are carcinogenic, mutagenic, or toxic for reproduction. Currently, this ban applies to over 1300 substances (ECHA, 2022a, b). Trace amounts of prohibited substances are allowed in cosmetics, as long as they are technically unavoidable when following good manufacturing practice as defined in the statute.

Additionally, the European Union requires that 26 fragrance ingredients that are known to cause allergic reactions must be disclosed on the label if they are added above a certain concentration (European Commission, 2012a). The European Commission recently proposed adding a further 56 fragrance ingredients to the list of fragrances that must be reported (European Commission, 2022).

People are not equally exposed to chemicals in cosmetics

Individuals who are low-income or are members of certain racial or ethnic groups are exposed more frequently to multiple environmental and social risk factors (Morello-Frosch et al., 2011). Focusing narrowly on specific chemicals and products ignores the impact of cumulative exposure to multiple chemicals and underestimates the risks to these groups (Morello-Frosch et al., 2011). These individuals face poorer health outcomes overall, and usage of cosmetics that contain hazardous chemicals may make health outcomes worse.

Studies on chemicals in cosmetics often focus on chemicals that affect the endocrine system or cause asthma because of known disparities in endocrine-related diseases (James-Todd et al., 2016) and asthma (CDC, 2020) in Black people compared to White people. Black women also have higher incidences of breast cancer in women younger than 45 years of age compared to White women. Black women are more likely to die of breast cancer (Yedjou et al., 2020).

Data from the nationally representative National Health and Nutrition Examination Survey show that women have higher levels of ortho-phthalates and parabens in their urine compared to men, indicating higher levels in the body. Ortho-phthalates and parabens are used in many consumer products, including cosmetics. These data also show that Black women have higher urinary concentrations of ortho-phthalates than White women (CDC, 2021b). In one study, researchers linked the higher use of vaginal douches by Black women with corresponding higher levels of ortho-phthalates (Branch et al., 2015).

[10] California Health and Safety Code Section 108980
[11] California Health and Safety Code Sections 108981–108982
[12] Regulation (EC) No 1223/2009 of the European Parliament

Hygiene and beauty routines can vary significantly between individuals. As such, both the number and type of cosmetics regularly used by individuals varies significantly. For example, researchers studying cosmetic usage among women determined that the median number of cosmetics used daily by women is eight products. However, some women participating in the same survey reported using 30 products daily (Dodson et al., 2021; Preston et al., 2021).

Individuals may use specific cosmetics to meet cultural beauty standards. In the United States, cultural beauty standards typically value attributes associated with whiteness. People may use skin lighteners and hair relaxers or straighteners to meet these standards (Zota and Shamasunder, 2017). The use of hair straightening products by Black women has been associated with a higher breast and uterine cancer risk (Eberle et al., 2019; Chang et al., 2022).

Some beauty standards are based on harmful stereotypes. Compared to White women, Black women have reported higher use of vaginal douches (up to four times higher than White women), which may be due to historical discrimination against Black women for perceived body odors (Branch et al., 2015; Ferranti, 2011).

For some people, using specific cosmetics is tied to specific cultural or religious traditions. Kohl is a traditional black eye cosmetic and eye medication that is still used in parts of Africa, Asia, the Middle East, and their diasporas (Mohta, 2010; McMichael and Stoff, 2017). Sindoor is a red cosmetic used for religious and medical purposes in India. These products can be 30 percent lead by weight or higher and have been linked to cases of acute lead poisoning (CDC, 2013; McMichael and Stoff, 2017; Shah et al., 2017). Kohl and sindoor are banned in the United States because they are considered illegal color additives by the FDA (FDA, 2022g). However, these products are still available in the United States, either online or in stores that import cosmetics (Shah et al., 2017).

Removing chemicals used in these products can reduce the levels of those chemicals in the body. The HERMOSA study found that higher levels of ortho-phthalates, parabens, and phenols in adolescent Latina girls was associated with higher uses of personal care products (Berger et al. 2018). When these girls switched to products that did not contain phthalates, parabens, and phenols, the amounts in their urine decreased (Harley et al., 2016).

Methods

Our legislative directive was to identify specific cosmetic products and test those products for the presence of harmful chemicals. We used the following approach to develop our product testing study:

- Identify products that are likely sources of chemicals of interest.
- Prioritize products that are disproportionately used in communities of color, identified either through prior research or conversations with community members.
- Prioritize products that can be sourced from the same/similar companies as those frequented by people of color.

We were directed to consult with community and social justice organizations and the Washington State Department of Health (Health) to identify cosmetics marketed to or used by people of color. We reviewed published surveys that identified cosmetics used by specific groups and spoke to the researchers to learn more about their work with communities.

We also spoke with individuals from communities of color in Washington. In these conversations, we asked about their experiences using cosmetics to see if their experiences differed significantly from the populations surveyed in the literature. Based on these conversations, we identified cosmetic products to test for each chemical or chemical group.

Working from an initial list of hazardous substances that can be found in cosmetics, we narrowed the list to those substances Ecology could evaluate by the end of the 2021 – 2023 biennium. We identified products that were likely sources of those chemicals, either because it could be intentionally added by manufacturers or because it may be present as a contaminant. We identified four chemicals or groups of related chemicals to test.

Cosmetics used in specific communities

Some products may be marketed to or used more by people of color in Washington state. In collaboration with Health, we looked at the scientific literature to understand observed differences in cosmetic usage between different communities. We also reached out to researchers working with social and environmental justice organizations to learn more about cosmetic products used in the communities they served. Finally, we leveraged active partnerships between Ecology, Health, and organizations that serve communities of color in Washington state to hear from their members about how they purchase and use cosmetics.

During our research, we primarily collected information about the specific types of cosmetics that Washington residents of color use regularly or were concerned about. Additionally, we also looked at whether research on cosmetic usage that was done outside of Washington state was relevant to our residents. Finally, we also asked where individuals were purchasing cosmetics, and what was most important to them when choosing a product. We used this information to make purchasing decisions in our product testing study.

Trends in cosmetic usage identified in scientific literature

Studies in other states on the usage of cosmetics have found differences in use patterns for Black, Latina, and Asian women compared to White women. The CAPABLE study in California found Latina women typically used makeup most frequently, Black women used certain hair products most frequently, and Vietnamese women were most likely to use facial cleansing products compared to other races or ethnicities (Collins et al., 2021).

These results were similar to those in another study in California, Taking Stock (Dodson et al., 2021). In this study Black women reported using a higher number of hair products and more intimate hygiene products. Latina and Asian women used more makeup. These studies also found that Black women use shampoo and conditioner less frequently than White Women (Collins et al., 2021; Dodson et al., 2021; Preston et al., 2021).

WE ACT for Environmental Justice reported that in a study of women in New York City, more Black women used chemical straighteners (74 percent) compared to Latina (40 percent) and White women (35 percent) (Y. Vosper, personal communication, January 12, 2022). In addition, Black girls often start using hair straighteners at a young age. In one survey almost half of parents or guardians reported that they first applied chemical relaxers to their child's hair as early as at 4 years of age (Zota and Shamasunder, 2017).

These specific findings support previous research that beauty standards in the United States are based on a White or Caucasian ideal. For example, one recent study concluded, "Overall, the most consistent message received regarding lighter skin individuals was that skin tone, along with eye color, and soft, non-kinky hair texture, render them more physically attractive" (Abrams et al., 2020). Another found, "Results reveal that internalization of White beauty ideals [by women of color] predicted skin tone and hair texture dissatisfaction as well as skin bleaching" (Harper and Choma, 2019).

While this report focuses on home use, women of color are also more likely to be exposed to cosmetics and personal care products at work. Workers who are self-employed or work in informal settings in the beauty industry are likely to have fewer workplace protections (Zota and Shamasunder, 2017; CBCRP, nd).

We also noted what participants in these studies felt were important criteria when selecting cosmetic products. In the CAPABLE study, most women prioritized choosing products based on what works. Most Black women additionally reported choosing products that were labeled as natural or were "made for my race." Most Vietnamese women were interested in finding products that were the right price for them (Collins et al., 2021). Similarly, Taking Stock found that price and effectiveness were study participants' top considerations (Dodson et al., 2021).

Finally, we noted how participants reported purchasing cosmetics. A product testing study in Oakland, California, noted that most of the Asian teenagers participating in their study purchased their lip products in drug stores (Liu et al., 2013). We heard from researchers that many participants in their studies reported shopping at stores such as Target or Costco, online on Amazon.com, or at 99 cent stores.

Consultation with individuals from communities of color in Washington

We identified a number of trends observed in the literature that linked cosmetic use with specific demographics. However, these studies surveyed individuals living outside of Washington state. To confirm that these studies were relevant to our product testing study, we spoke with individuals from communities of color in Washington.

Due to the time constraints of this project, we primarily relied on established relationships between Ecology and Health and social justice or public health organizations. We spoke with organization staff and with community members served by these organizations. During these conversations, we collected information about products that these individuals use frequently and where they purchased these products. We also asked about what qualities helped them select a cosmetic product, such as the performance, longevity, ingredients, or cost.

We met with members of the "Fireproof Whales – Flame Retardant Education Project," a project run with funding from Ecology by the Tacoma Department of Public Health for teens and their families in the Tacoma area. Many of these families identify as Hispanic or Latinx and primarily spoke a language other than English at home. Working with the Tacoma Department of Public Health, we had two meetings with teens and their parents to discuss cosmetic products.

In these conversations, we heard that families tended to buy the same products from superstores like Walmart or from community members who sell cosmetics for Mary Kay. We also heard that folks consider the cost of cosmetic products more than other qualities. Attendees reported using deodorant, skin lotion or oil, and hair products including styling gel, hair spray, and leave-in conditioners at least once a month.

We also spoke with staff working for Mother Africa, a Washington organization that supports African immigrant and refugee women and their families. In conversations with organization members, we heard that community members were concerned about the presence of metals like lead in cosmetics, especially lipsticks. We also heard that some community members would bring cosmetics home with them after traveling to Africa.

From one community event run by Toxic Free Future, an environmental advocacy organization, and Horn of Africa Services, another organization that supports African immigrants and refugees, we heard that many members of the community served by Horn of Africa Services still use kohl and similar eye makeups. These individuals typically purchased these products overseas for their personal use.

Finally, we received feedback from Washington residents through a survey written by Ecology and administered by Toxic Free Future at community events and online. We heard from Black or biracial Washington residents that they most frequently use skin lotion, hair conditioning treatments, and lip and eye makeup. These respondents said they buy these products online through Amazon, or at brick-and-mortar grocery stores and drug stores. One respondent reported purchasing products at a dedicated beauty store while another mentioned shopping at discount department stores. Respondents highlighted performance and cost as key considerations when purchasing products.

Our key conclusions from these conversations were:

- Products that communities reported using in other states were also being used by similar communities in Washington state.
- Many individuals do not purchase products at dedicated beauty supply stores but instead buy products from stores that sell other goods and groceries, or online through Amazon. Some individuals purchase cosmetics from community members who work for multi-level marketing companies such as Mary Kay.
- Individuals purchase cosmetics overseas for their personal use. These individuals are often immigrants purchasing cosmetics that are not readily available to them in the United States.
- Many individuals think about the cost of cosmetics and what products they can afford to buy.

We created a list of the types of cosmetics Washington residents had reported using in our conversations. Once we had identified what chemicals we could test for, we used this list to identify candidate cosmetics for product testing.

Hazards associated with ingredients and contaminants

In 2022, SB 5703 proposed restricting a number of chemicals, chemical classes, and chemical mixtures in cosmetics sold or distributed in Washington. The listed substances included both:

- Chemicals intentionally added to cosmetics.
- Contaminants found in cosmetics.

This bill did not pass in 2022, but we used it as a framework for implementing the budget proviso.

Several of the substances are regulated in other consumer products under Washington law. For example, the presence of lead, cadmium, and mercury are regulated in packaging through RCW 70A.222.[13] Per- and polyfluoroalkyl substances (PFAS) in food packaging are also regulated under RCW 70A.222. PFAS, ortho-phthalates, and phenolic compounds like bisphenols are regulated in many consumer products, including thermal receipts, fragrances, and furniture and furnishings through the Safer Products for Washington program.

The substances included in SB 5703 all have the potential to harm human health or the environment. These substances include chemicals with well-documented hazardous traits. These hazardous traits are identified on authoritative lists for specific hazard endpoints of concern. For example, the California Proposition 65 list identifies chemicals that increase the likelihood of getting certain cancers.

In addition to listing specific chemicals, SB 5703 also proposed restrictions on several chemical classes, such as parabens or bisphenols. Each of these chemical classes includes well-studied chemicals on authoritative lists. The other chemicals in these classes have not been well-studied but are similar in structure. Thus, they may have similar potential to harm human

[13] https://app.leg.wa.gov/RCW/default.aspx?cite=70A.222

health or the environment. Regulating chemical classes instead of individual chemicals reduces the possibility that manufacturers will swap one hazardous substance for another hazardous chemical in the same class.

There are many hazard endpoints of concern for both human health and the environment. In Table 2, we focused on the following hazard endpoints that have been identified by authoritative bodies:

- Carcinogenicity: Increases likelihood of getting cancer.
- Developmental and reproductive toxicity: Decreases fertility or interferes with child development.
- Endocrine activity: Mimics hormones created by the body.
- Acute mammalian toxicity: Causes harm to humans or other mammals.
- Neurotoxicity: Causes harm to the brain or nervous system.
- Eye or skin irritation: Causes temporary damage to eyes or skin.
- Skin sensitization: Causes an allergic reaction when in contact with the skin.
- Systemic toxicity: Causes non-lethal damage to an organ in the body.
- Aquatic toxicity: Causes harm to aquatic life.
- Bioaccumulation: Accumulates within the body.
- Persistence: Does not break down quickly in the environment.

For each hazard endpoint, we include some of the relevant authoritative lists in Appendix A, Table 5. For a chemical class like ortho-phthalates, we characterized the hazards of the class based on the hazards associated with individual ortho-phthalates with known endpoints.

In Table 2, we made three minor changes to how SB 5703 listed substances:

- SB 5703 combined alkylphenols, alkylphenol ethoxylates, and bisphenols into one group called phenolic compounds. We report these as three separate chemical classes because, although they are similar, they do have different hazard endpoints.
- We combined the chemicals octamethylcyclotetrasiloxane, decamethyl-cyclopentasiloxane, and dodecamethylcyclohexasiloxane under a single class name, cyclosiloxanes.
- We discuss formaldehyde and methylene glycol interchangeably in this report. Methylene glycol is added to cosmetics as formalin, which contains both methylene glycol and formaldehyde. Methylene glycol can rapidly break down to formaldehyde. Safety assessors and regulators discuss them interchangeably (Boyer, et al. 2013; European Commission, 2012b).

Table 2. Hazard endpoints of specific chemicals or chemical classes used in cosmetics.

Chemical or chemical class	Carcinogenicity	Developmental and reproductive toxicity	Endocrine activity	Acute mammalian toxicity	Neurotoxicity	Eye irritation	Skin irritation	Skin sensitization	Systemic toxicity	Aquatic toxicity	Bioaccumulation	Persistence
Ortho-phthalates	X	X	X	-	-	-	-	-	-	X	-	-
Per- and polyfluoroalkyl substances	-	X	-	-	-	X	-	-	X	-	X	X
Alkylphenols	-	-	X	-	-	-	-	-	-	X	-	-
Alkylphenol ethoxylates	-	-	X	-	-	-	-	-	-	-	-	-
Bisphenols	X	X	X	-	-	X		X	-	-	-	-
Parabens	-	-	X	-	-	X	X	-	-	-	-	-
Formaldehyde and methylene glycol	X	-	-	X	-	-	-	X	-	-	-	-
Ethylene glycol	-	X	-	-	-	-	-	-	-	-	-	-
1,4-dioxane	X	-	-	-	-	X	-	-	-	-	-	-
Arsenic and arsenic compounds	X	-	-	X	X	-	-	-	-	X	-	-
Cadmium and cadmium compounds	X	-	-	-	X	-	-	-	-	-	X	X
Lead and lead compounds	X	X	-	-	X	-	-	-	-	X	X	X
Mercury and mercury compounds	-	X	-	X	X	-	-	-	X	X	X	X
Aluminum salts	-	-	-	-	-	X	-	-	-	-	-	-
Styrene	X	X	-	-	X	X	X	-	X	-	-	-
Cyclosiloxanes	-	X	-	-	-	-	-	-	-	X	X	X
Toluene	-	X	-	-	X	-	-	X	-	-	-	-
Asbestos	X	-	-	-	-	-	-	-	-	-	-	-
Hydroquinone	-	-	-	-	-	X	-	X	-	X	-	-
2-ethylhexyl acrylate	-	-	-	-	-		X	X	-	-	-	-
Ethyl acrylate	X	-	-	-	-	X	X	X	-	-	-	-
Sodium laurel sulfate	-	-	-	-	-	X	X	-	-	-	-	-
Sodium laureth sulfate	-	-	-	-	-	X	X	-	-	-	-	-
Benzalkonium chloride	-	-	-	-	-	X	X	-	-	-	-	-
Triclosan	-	-	-	-	-	X	X	-	-	X	-	-
Methylisothiazolinone	-	-	-	X	-	X	X	-	-	X	-	-

Chemical or chemical class	Carcinogenicity	Developmental and reproductive toxicity	Endocrine activity	Acute mammalian toxicity	Neurotoxicity	Eye irritation	Skin irritation	Skin sensitization	Systemic toxicity	Aquatic toxicity	Bioaccumulation	Persistence
Methylchloroisothiazolinone	-	-	-	X	-	X	X	X	-	X	-	-
o-phenylenediamine	X	-	-	X	-	X	-	X	-	X	-	-
m-phenylenediamine	-	-	-	-	-	X	-	X	-	X	-	-
p-phenylenediamine	-	-	-	X	-	X	-	X	-	X	-	-

Two other chemical groups were listed in SB 5703 but are not listed above: coal tar compounds and synthetic fragrance.

Coal tar compounds are mixtures of chemicals that include polycyclic aromatic hydrocarbons (PAHs), phenols, and benzene. To summarize the hazards associated with coal tar compounds, we gathered information on the hazard endpoints associated with some of the chemicals or chemical mixtures known to be in coal tar (Appendix A, Table 6). These hazard endpoints include carcinogenicity, developmental and reproductive toxicity, neurotoxicity, aquatic toxicity, skin and eye irritation, persistence, and bioaccumulation.

Many synthetic fragrance ingredients are used in cosmetics. For this report, we reviewed the 24 synthetic fragrances that the European Union requires manufacturers to explicitly label on cosmetics (Appendix A, Table 7) (European Commission, 2012a; 2009). These synthetic fragrances were chosen because they are documented allergens in consumer products. The most common hazard endpoints for these fragrances were skin sensitization and skin and eye irritation. Two fragrances were also listed as potentially causing aquatic toxicity. Two other fragrances were only listed as potential allergens and did not have document hazard endpoints. The fragrance lilial is listed as a Substance of Very High Concern (SVHC) by the European Chemicals Agency due to developmental and reproductive toxicity concerns (ECHA, 2022c).

Product testing study design

Ecology's testing procedures

Testing cosmetics for the presence of specific chemicals is not a quick or simple procedure. Typical product testing involves multiple steps, including sample preparation, chemical detection, and data validation. Many product testing methods detect only a few chemicals. Other chemicals and materials used in the cosmetic can interfere with sample preparation and detection.

Product testing at Ecology must follow Policy 22-01 — Establishing Quality Assurance (Ecology, 2006) and the agency's Quality Management Plan (Ecology, 2020). Testing follows an approved

Quality Assurance Project Plan (QAPP), which requires the use of accredited testing methods at authorized laboratories to ensure results meet Ecology's data quality standards. These policies ensure that proper data evaluation and peer review are conducted, and that reliable results are obtained.

There are no accredited testing methods for many of the substances identified in SB 5703. Development and accreditation of new test methods is a lengthy process, and we were not able to develop new test methods for this testing effort. Instead, we identified which chemicals listed in SB 5703 had Ecology-accredited test methods that could be used for cosmetics. We then spoke with labs that were authorized to test cosmetics using these methods and determined which chemicals could be tested for in cosmetics by our deadline.

Determining which chemicals to look for

In our research for this study, we identified a list of candidate cosmetics used by people of color in Washington state. We also confirmed that the substances listed in SB 5703 are all potentially hazardous to humans or the environment. We identified which substances could be evaluated using accredited testing methods. Based on these criteria, the full list of potential product tests we could perform exceeds the number of tests we could complete on schedule.

To determine which chemicals were higher priority for testing, we considered what cosmetic products were used the most by the individuals we spoke with, as well as information about test and lab availability. The following is our finalized list of chemicals we would look for in cosmetics:

- Heavy metals, including lead, arsenic, and cadmium.
- Formaldehyde.
- Nine ortho-phthalate chemicals.
- Asbestos.

Reasons for prioritizing heavy metals

- Heavy metals can cause cancer and developmental delays, are neurotoxic, and can be toxic to both mammals and other species, among other problems. Reducing exposure in both humans and the environment is a high priority for these and other reasons.
- Heavy metals such as lead, arsenic, and cadmium should no longer be purposefully added to cosmetics. Unfortunately, they have been detected as contaminants in a range of cosmetics including sunscreen, nail polish, and whitening toothpaste. FDA surveys have concluded that eyeshadows, blushes, and compact powders contained more heavy metals than other types of cosmetics, and that most of these heavy metals came from minerals used as pigments and fillers (FDA, 2022h).
- In conversations with social justice organizations, we learned that some individuals were concerned about the presence of heavy metals in cosmetics.
- We can test cosmetics for many heavy metals using EPA method 6020B (Ecology, 2022).

Reasons for prioritizing formaldehyde

- Formaldehyde causes cancer and skin reactions and is acutely toxic to mammals.
- Formaldehyde is used in many personal care products to prevent bacterial growth or to bond with other chemicals. Instead of adding formaldehyde, manufacturers often add methylene glycol or another chemical that releases formaldehyde. Formaldehyde can be found in nail polishes, hair-smoothing products, body wash, and makeup. As a preservative in these products, formaldehyde can be added directly, but more frequently is released from preservatives such as quaternium-15, DMDM hydantoin, imidazolidinyl urea, and diazolidinyl urea (CSC, 2022a).
- We can detect formaldehyde added by manufacturers as well as formaldehyde released from these other chemicals using EPA method 8270E-SIM (Ecology, 2022).

Reasons for prioritizing ortho-phthalates

- Ortho-phthalates can cause cancer, cause developmental and reproductive harm, can affect endocrine activity, and are highly toxic to aquatic life.
- Ortho-phthalates are a class of chemicals used in cosmetics to carry or stabilize other chemicals in the cosmetic, such as fragrances. They are also used to make nail polishes or other cosmetics more flexible. They are colorless, odorless, oily liquids that do not evaporate easily (FDA, 2022i). Ortho-phthalates may be found in cosmetics as ingredients or as contaminants that enter from cosmetics packaging or during the manufacturing process.
- In conversations with social justice organizations, we also heard that some groups were concerned about ortho-phthalates that might be used in cosmetics applied to sensitive areas, such as feminine hygiene products, or used for non-fragrance purpose.[14]
- We can test for nine specific ortho-phthalate chemicals in cosmetics using EPA method 8270E (Ecology, in publication).

Reasons for prioritizing asbestos

- Asbestos can cause cancer when inhaled.
- Asbestos contamination in cosmetics mainly comes from talc, which is a naturally occurring mineral found in close proximity to asbestos (FDA, 2022j). Talc is added to many cosmetics as a base material or a filler. Though the health risks of asbestos are well-documented, asbestos contamination can still be found in powdered cosmetics such as eyeshadows or baby powder (US PIRG, 2018).
- We can test cosmetics for asbestos using EPA method 600/R-93/116 (Ecology, in publication).

[14] At the time of drafting this report, Ecology's Safer Products for Washington program is in the process of rulemaking to restrict the use of ortho-phthalates in fragrances in cosmetic products. However, other uses of ortho-phthalates would not be covered by this restriction.

Products selected for testing

We split product testing into two phases:

1. Phase one: Completed November 2022
    - Heavy metals in lipstick and powder foundations.
    - Formaldehyde in powder foundations, skin lotions, and hair products.
2. Phase two: Anticipated June 2023
    - Ortho-phthalates in nail polishes, hair spray, and feminine and body washes.
    - Asbestos in powder blushes and eye shadows.

For both phases of the project, we purchased products that were likely to contain the chemicals of interest. For asbestos, a potential contaminant in talc, we bought cosmetics that listed talc as one of the primary ingredients. When testing products for formaldehyde, we obtained products that listed formaldehyde-releasing chemicals as an ingredient.

We also attempted to purchase products in a manner that reflects how people reported buying cosmetics. We prioritized purchasing inexpensive versions of cosmetics when possible, to reflect consumers' interest in lower-cost products. Since individuals frequently reported buying cosmetics at large retail chains that sell many types of consumer products, we prioritized purchasing merchandise from similar locations.

Phase one product testing plan

In phase one, we purchased 50 cosmetic products and had them tested for heavy metals and formaldehyde at Manchester Environmental Laboratory between July and October 2022. We published a QAPP that discusses these tests in detail (Ecology, 2022).

To summarize, we purchased 10 lipsticks and 10 powder foundations. These were tested for lead, arsenic, or cadmium contaminants. Recent product testing studies have determined that these product types can be sources of heavy metals (Attard et al., 2022; FDA, 2022h). We prioritized purchasing inexpensive products and products that would be marketed to people with darker skin tones. Foundations are increasingly marketed to people with darker skin tones (Rodulfo, 2018). Therefore, we prioritized purchasing darker shades.

We also tested 40 products for formaldehyde. Formaldehyde may be present in cosmetics as a contaminant, but more often it is intentionally added by manufacturers as formaldehyde or a chemical that releases formaldehyde. We used EPA method 8270E-SIM to detect formaldehyde present in cosmetics as well as formaldehyde that is released from these other chemicals during testing.

We tested the same 10 low-cost, darker-tint foundations to see if formaldehyde was present as a contaminant.

We also purchased 30 products that listed a common formaldehyde-releasing chemical, DMDM hydantoin, to see how much formaldehyde could be released by these products. We purchased skin lotions, leave-in hair conditioners, and hair styling gels or creams that contain this

formaldehyde-releasing chemical because these types of products were frequently used by individuals we spoke with.

Phase two product testing plan

In phase two, we purchased 40 cosmetics and had them tested at Manchester Environmental Laboratory for ortho-phthalates. We also purchased 20 cosmetic products that are being tested for asbestos at a qualified external lab. We published an addendum to our QAPP that discusses these tests in detail (Ecology, in publication).

We purchased nail polishes and fragrance-free hair sprays for ortho-phthalate testing where ortho-phthalates may not have been added in fragrances, and therefore would not be addressed in forthcoming regulations from Ecology. For example, dibutyl phthalate has been commonly used as a plasticizer in nail polishes to reduce cracking, and dimethyl phthalate is used in hair sprays to reduce hair stiffness (FDA 2022i). Latina women have reported using hair sprays more frequently than other women (Collins et al., 2021). Many women report using nail polish (Dodson et al., 2021). In a survey of cosmetic usage within families in California, teenagers reported using nail polish at home at higher rates than adults (Wu et al., 2010).

We purchased feminine washes and body washes that claim to be unscented. Some women avoid products with fragrances to avoid ortho-phthalates. Products that are marketed as unscented may have added fragrances that contain ortho-phthalates. We are particularly concerned about ortho-phthalates in feminine hygiene products because:

- These chemicals may pass more easily into the body when they are used on the genitals.
- Black women report using these products more than other women (Branch et al., 2015; Dodson et al., 2021).

Finally, we purchased 20 powder-based blushes and eye shadows that contained high levels of talc. We plan to have these products tested for asbestos. Latina women have reported using blushes and other cosmetics more frequently than other women (Collins et al., 2021; Dodson et al., 2021). We prioritized purchasing inexpensive versions of these products to see if the talc used in these products will contain concerning levels of asbestos.

We expect that we will have the results from these tests in 2023 and plan to supplement this report at that time.

Results and Discussion

Product testing

Phase One

In phase one product testing, Ecology purchased 50 unique low-cost cosmetic products from Walmart, Target, Fred Meyer, and Dollar Tree in the Puget Sound area. The products included hair styling gels, leave-in conditioners, skin lotions, lipsticks, and powdered foundations, with ten products from each category.

A full presentation and discussion of the results of our product tests for lead, cadmium, arsenic, and formaldehyde is in Appendix B. We've summarized our findings here.

Heavy metals

We tested powder foundations and lipsticks for contamination by heavy metals. Our results include the following:

- Lead was detected at 5.55 ppm and arsenic at 2.15 ppm in a dark-tint CoverGirl Clean Fresh Pressed Powder Foundation.
- Lead was detected at levels between 1 and 2 ppm in a Black Radiance Pressed Powder Foundation and a CoverGirl Continuous Color Lipstick.
- Cadmium was not detected in any of the cosmetic products.

Arsenic and lead have been linked to brain and nervous system damage and cancer. They can also cause harm to aquatic life.

There is no known safe level of lead (CDC, 2021; WHO, 2022). The FDA has issued guidance on lead levels in cosmetics based on lead exposure studies and what lead level they considered readily achievable by cosmetics manufacturers. They determined that 99% of the products they tested between 2007 and 2013 contained 10 ppm lead or less. Based on this analysis, the FDA recommended that the amount of lead in cosmetics should not exceed 10 ppm (FDA, 2016).

Heavy metals are allowed in products sold in the European Union only if they are in an amount that is unavoidable even when following good manufacturing practice (1223/2009/EC). Germany uses product testing to define these "technically avoidable" concentrations for heavy metals. These limits are set such that 90 percent of the tested cosmetics are expected to pass. In 2017, Germany decreased these limits to:

- 2.5 ppm arsenic in "theater, fan or carnival make-up."
- 0.5 ppm arsenic in all other cosmetics.
- 0.1 ppm cadmium in all cosmetics.
- 5.0 ppm lead in makeup powder, rouge, eye shadow and eye liner.
- 2.0 ppm lead for all other cosmetics (BVL, 2017).

The dark-tint CoverGirl Clean Fresh Pressed Powder Foundation would not meet the stricter lead and arsenic levels set by Germany.

Formaldehyde

We tested 40 cosmetics for formaldehyde. Ten products were dark-tint foundations, which were also tested for heavy metals. These cosmetics did not list formaldehyde or a chemical that can release formaldehyde as an ingredient.

The remaining 30 cosmetics listed DMDM hydantoin as an ingredient. These products were hair styling gels, leave-in conditioners, and skin lotions. DMDM hydantoin is expected to break down into formaldehyde and other chemicals when it is used in a cosmetic. The test we used measured any formaldehyde present in the sample, as well as formaldehyde released by DMDM hydantoin during testing. Our results include the following:

- Formaldehyde was found in seven out of ten skin lotions, nine out of ten leave-in conditioners, and all ten hair styling gels.
- Hair styling gels and creams had generally more formaldehyde, ranging from 254 ppm to 1660 ppm.
- The highest level of formaldehyde was from a Shine 'n Jam Extra Hold Conditioning Styling Gel purchased at Walmart.
- Leave-in conditioners had detectable formaldehyde levels from an estimated 39.2 ppm to 654 ppm.
- A children's product purchased from Dollar Tree, Perfect Purity for Kids Watermelon Spritz Spray Detangler, contained formaldehyde at 214 ppm.
- Body lotions contained detectable formaldehyde from 202 ppm to 603 ppm.
- Formaldehyde was not detected in the powder foundations we tested.

Cosmetics that contain formaldehyde in concentrations greater than 200 ppm can cause an allergic reaction (de Groot et al., 2010; SCCS, 2021). We detected greater than 200 ppm in 24 of the 26 products we tested for formaldehyde. These products, which are applied to the skin or hair and left on, could cause allergic reactions in individuals who are sensitive to formaldehyde.

Phase Two

We anticipate results of our product tests for asbestos and ortho-phthalates in June 2023. We will publish the results of those tests online and will amend this report with the results as a separate appendix when they are available.

Other research

In addition to the product testing studies we performed, we looked for other cosmetics that are potential sources of hazardous chemicals. We focused on identifying which types of cosmetics contain hazardous chemicals, particularly those that are not disclosed on cosmetic ingredient labels. To do so, we:

- Reviewed product databases to identify which categories of cosmetics contain hazardous chemicals as reported by manufacturers.
- Conducted a literature search of peer-reviewed scientific studies that looked for the presence of chemicals in cosmetic products. These studies could reveal additional cosmetics that contain chemical contaminants or unlisted ingredients.

In these sections, we highlight the hazardous chemicals that can be found in the product types that are frequently used by people of color in Washington state based on our research.

Reported uses of chemicals in cosmetics

Several databases compile the chemicals used in specific cosmetic products. These databases are intended to help consumers make informed choices when purchasing cosmetics and to help governments understand what chemicals may be used in cosmetics. For this report, we reference only databases maintained by government agencies where businesses report the presence of chemicals in their products.

Databases run by non-profits or businesses, such as the Environmental Working Group's SkinDeep database or Clearya, are built using publicly available ingredient labels (EWG, nd.). These public databases include any substances that appear on ingredient labels and often flag potentially harmful products to help raise consumer awareness. But product entries may become outdated when a company reformulates or discontinues a product. Additionally, it is not clear to us how comprehensive these databases are, given the large number of cosmetics sold in the United States.

Other databases are managed by government agencies that require manufacturers to report any products that contain certain chemicals. These databases are focused on chemicals that are known to be hazardous to human health or the environment. Because companies are required to disclose this information, these databases also include chemicals that may be present as product contaminants rather than just the publicly listed ingredients. We focused our efforts on reviewing these databases to understand what hazardous chemicals may appear in cosmetics as both intentional ingredients and as contaminants.

Chemical use reported to Washington state

In Washington state, under the Children's Safe Products Act (CSPA), manufacturers must report whether certain chemicals are present in products used by children, including cosmetics. Companies that offer children's products for sale in Washington state must report on any product categories that contain one or more chemicals in the Chemicals of High Concern to Children list (Ecology, 2017). This list includes several chemicals that are on the list of substances in SB 5703.

These reports are publicly available in the High Priority Chemicals Database System, which is maintained by the Interstate Chemicals Clearinghouse (IC2, 2022). This system also contains reports submitted by companies to meet the requirements of the Oregon Toxic Free Kids Act (OHA, 2022). We compared reports submitted to Washington with reports submitted to Oregon to check for inconsistencies, because the two states have very similar reporting requirements, but only include reports from Washington.

We downloaded the CSPA database on October 20, 2022 and summarized our findings in Table 3 and Table 4. Because companies are required to report to Washington annually, we reviewed only the entries for cosmetic product types reported in the last three years. If we could not identify the specific body part a cosmetic product category referred to, then we did not include the product type.

Chemical use reported to the California Department of Public Health

Under the California Safe Cosmetics Act and the Cosmetic Fragrance and Flavor Ingredient Right to Know Act, large cosmetics manufacturers, packers, and distributors must report any cosmetics that contain certain known or suspected harmful ingredients to California Department of Public Health (CDPH). CDPH maintains a publicly accessible database of these reported cosmetic products (CDPH, 2022).

Companies are required to report the identity of the harmful ingredients, including scent or flavor ingredients that might otherwise not be disclosed on packaging. Additionally, companies must disclose certain "fragrance allergen" ingredients if they are added to products for any reason or are added in amounts over specified limits. Companies are only required to report contaminants that are present in significant amounts and intentionally added ingredients (CA HSC 111791.5[15]).

CDPH maintains a list of ingredients that companies must report on. This list is developed from authoritative lists of chemicals that are known or suspected to be hazardous to human health. These authoritative lists include the European Union's candidate list of Substances of Very High Concern (SVHC), California's Proposition 65 list, and EPA's Toxic Release Inventory list of Persistent, Bioaccumulative, and Toxic chemicals (PBTs) (ECHA, 2022d; ECHA, 2022f; EPA, 2022c; OEHHA, 2022).

We downloaded and reviewed the full CDPH cosmetics database on October 14, 2022, and summarize our findings in Table 3 and Table 4. The list of reportable chemicals expanded recently in response to the Cosmetic Fragrance and Flavor Ingredient Right to Know Act, which went into effect in January of this year. Some companies may not have submitted reports for these new chemicals yet. We only included products that have not been discontinued and ingredients that have not been removed from products.

Summary of reported chemical use in cosmetics

In Table 3 and Table 4, we list chemicals that companies report in their cosmetics. We indicate which chemicals occur in each type of cosmetic. These chemicals are also included in SB 5703. We combined data reported to California and Washington to create these tables.

For each chemical class, we searched for any reported chemical that met the criteria of that class. For chemical groups, we only looked at specific reported chemicals that could be tied to the group.

[15] https://leginfo.legislature.ca.gov/faces/codes_displayText.xhtml?lawCode=HSC&division=104.&title=&part=5.&chapter=7.&article=3.5.

For example, toluene can be found in cosmetics that contain coal tar distillates but can also be added to cosmetics on its own. We only identify cosmetic types that use coal tar distillates or similar substances as reported uses of coal tar compounds. The entry for formaldehyde also includes methylene glycol and other reportable chemicals that are known to release formaldehyde. For fragrances, we only reported cosmetics that used the 24 synthetic fragrances we previously identified (Appendix A, Table 7).

We used cosmetic categories based on the product type listed by the company in its report. They describe what part of the body the cosmetic is applied to and whether it is designed to be washed off, like shampoo, or left on, like hair styling products.

- Bath products, such as bath salts or bubble bath.
- Body art, such as temporary tattoos or face paint.
- Complexion products, such as foundation or blush.
- Conditioner, such as creams or oil designed to be rinsed off.
- Dental hygiene, such as toothpaste or mouthwash.
- Deodorant or other antiperspirants.
- Eye products, such as eye shadow or eyebrow liner.
- Hair color.
- Hair/scalp products, such as leave-on conditioner, hair spray, or hair extension glues.
- Lip products, such as lip liner or lip balm.
- Lotion.
- Nail products, such as nail polish, hardeners, or creams.
- Perfume or other personal fragrances.
- Shampoo.
- Skin products, such as skin toners or lightening creams.
- Sun protection, such as sunblock or sunscreen.
- Wash/cleanser, such as body wash or facial cleansers.
- Wipes.

We also note if any products are intended for children or are intended to be used for feminine hygiene.

Table 3 indicates the product categories where at least one company reported both:

- the presence of the substance in a product, and
- the function of the substance as anything except “contaminant” or “other.”

If the substance had a reported function, this indicated to us that the manufacturer likely intentionally added the chemical. We list the number of companies that reported at least one product that met these criteria.

Table 3. Substances that are likely intentionally added to products, self-reported by companies.

Chemical or chemical class	Bath products	Body art	Complexion products	Conditioner	Dental hygiene	Deodorant	Eye products	Hair color	Hair/scalp products	Lip products	Lotion	Nail products	Perfume	Shampoo	Skin products	Sun protection	Wash/cleanser	Wipes	Products for children?	Feminine care products?	Number of companies
Ortho-phthalates	X		X	X	-	X	-	X	X	-	-	X	X	X	X	-	X	X	Yes	No	28
Per- and polyfluoroalkyl substances	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	No	No	1
Bisphenol A	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	Yes	No	1
Alkylphenol ethoxylates	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	X	X	No	No	4
Alkylphenols	-	-	-	-	-	-	-	-	-	X	-	X	-	-	-	-	-	-	Yes	No	2
Formaldehyde and formaldehyde-releasing chemicals	-	-	-	-	-	-	-	-	X	-	X	X	-	-	-	-	X	-	No	Yes	6
Ethylene glycol	-	-	-	-	-	-	-	-	X	-	-	-	-	X	-	-	X	-	No	No	2
Styrene	-	X	-	X	X	-	X	-	X	X	-	X	-	X	X	-	X	-	Yes	Yes	9
Lead or lead acetate	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	No	No	1
Cyclosiloxanes	-	X	X	X	-	-	X	-	X	X	X	-	-	-	X	X	-	-	No	No	10
Toluene	-	-	-	-	-	-	-	-	-	X	X	-	X	-	-	-	X	-	No	No	6
Parabens	-	X	X	-	-	-	X	X	X	X	X	X	X	-	X	X	X	-	Yes	No	22
Asbestos (reported as talc containing asbestiform fibers)	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	No	No	1
Ethyl acrylate	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	Yes	No	1
Benzalkonium chloride	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	No	No	1
p-phenylenediamine	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	No	No	1

Chemical or chemical class	Bath products	Body art	Complexion products	Conditioner	Dental hygiene	Deodorant	Eye products	Hair color	Hair/scalp products	Lip products	Lotion	Nail products	Perfume	Shampoo	Skin products	Sun protection	Wash/cleanser	Wipes	Products for children?	Feminine care products?	Number of companies
Coal tar compounds	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	No	No	2
Synthetic fragrances	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	Yes	Yes	296

Synthetic fragrances, ortho-phthalates, styrene, cyclosiloxanes, and parabens were reported in most of the cosmetic categories in Table 3. Companies reported the function of both styrene and ortho-phthalates as relating to the product fragrance. Since recent reporting requirements in California were focused on fragrance and flavor ingredients, this may explain their frequency. Cyclosiloxanes are used to condition skin and hair but can also be used to improve the texture of cosmetics (anti-caking) or as a solvent (Johnson et al., 2011). Parabens are widely used as preservatives in many different types of cosmetics (CIR, 2018).

Table 4 indicates the product categories where at least one company reported using a substance in a product but reported its function as “other,” “contaminant,” or did not respond. For many cosmetics, manufacturers reported the chemical without a function or with the function listed as a “contaminant.” It is not clear if the companies reported the specific chemicals as a precaution, or if they had data indicating the chemical was a contaminant in the product.

Table 4. Substances that are possible contaminants in products, self-reported by companies.

Chemical or chemical class	Bath products	Body art	Complexion products	Conditioner	Dental hygiene	Deodorant	Eye products	Hair color	Hair/ scalp products	Lip products	Lotion	Nail products	Perfume	Shampoo	Skin products	Sun protection	Wash/cleanser	Wipes	Children's products?	Feminine care products?	Number of companies
Ortho-phthalates	-	X	-	-	-	-	X	-	X	X	-	X	X	-	-	-	X	-	Yes	No	6
Per- and polyfluoroalkyl substances	-	-	-	-	-	-	X	-	-	X	X	-	-	-	X	-	-	-	No	No	2
Bisphenol A	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	No	No	1
Formaldehyde and formaldehyde-releasing chemicals	-	X	-	X	-	-	X	X	X	-	X	X	-	X	X	-	X	-	No	No	20
Ethylene glycol	-	X	-	-	-	-	-	-	X	-	X	-	-	X	-	X	X	-	Yes	No	7
Styrene	X	-	-	-	-	-	-	-	X	X	X	X	X	X	-	-	X	-	Yes	No	9
1,4-dioxane	-	-	-	X	-	-	-	-	X	-	X	-	-	X	X	-	X	X	Yes	No	16
Lead or lead acetate	-	-	-	-	-	-	-	-	X	-	X	-	-	X	X	X	-	-	No	No	6
Arsenic or arsenic compounds	-	X	-	X	-	-	X	-	X	X	X	-	X	X	-	X	X	-	Yes	No	4
Cadmium or cadmium compounds	-	X	-	-	-	-	X	-	-	X	-	X	X	-	X	X	-	-	Yes	No	3
Mercury or mercury compounds	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	-	-	Yes	No	2
Cyclosiloxanes	-	-	X	X	-	-	X	-	X	X	X	X	-	-	X	X	X	-	No	Yes	13
Toluene	-	-	-	-	-	-	-	-	-	-	-	X	-	-	X	-	-	-	No	No	7
Asbestos (reported as talc containing asbestiform fibers)	-	-	X	-	-	-	X	-	-	X	-	-	-	-	-	-	-	-	No	No	2
2-ethylhexyl acrylate	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	No	No	2

Chemical or chemical class	Bath products	Body art	Complexion products	Conditioner	Dental hygiene	Deodorant	Eye products	Hair color	Hair/ scalp products	Lip products	Lotion	Nail products	Perfume	Shampoo	Skin products	Sun protection	Wash/cleanser	Wipes	Children's products?	Feminine care products?	Number of companies
Ethyl acrylate	X	-	X	-	-	-	-	-	-	-	-	-	-	X	X	-	X	-	No	No	4
o-phenylenediamine and its salts	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	No	No	1
Coal tar compounds	-	-	-	-	-	-	X	-	-	-	-	-	-	X	X	-	-	-	No	No	11
Synthetic Fragrances	-	-	X	X	X	X	-	-	X	X	X	X	X	X	X	X	X	-	Yes	No	18

Companies are only required to report on a subset of the chemicals we are interested in. They were not required to report the following substances:

- m-phenylenediamine (CASRN 108-45-2).
- Aluminum salts.
- Sodium laurel sulfate (CASRN 151-21-3).
- Sodium laureth sulfate (CASRN 3088-31-1).
- Methylisothiazolinone (CASRN 2682-20-4).
- Methylchloroisothiazolinone (CASRN 26172-55-4).

Additionally, two chemicals were included as reportable substances but no manufacturers reported their presence in any cosmetics.

- Triclosan (CASRN 3380-34-5).
- Hydroquinone (CASRN 123-31-9).

With the exception of synthetic fragrances, which almost 300 companies reported using in cosmetics, no substance was widely reported as being used by most manufacturers. Since several chemicals were added to the California reporting list due to the Cosmetic Fragrance and Flavor Ingredient Right to Know Act, companies must report only if these chemicals are used as a flavor or fragrance ingredient. There may be other cosmetics that contain these chemicals that are not reported in the database because they are not a “fragrance ingredient.”

We heard from specific Washington residents that the cosmetics they most frequently use are deodorant, lotion, lip makeup, eye makeup, and leave-in hair products such as styling gels or conditioners. Companies reported parabens, cyclosiloxanes, and synthetic fragrances in all these cosmetic types. Ortho-phthalates, styrene, and toluene could also be present in these products.

We also found examples where companies reported that chemicals such as bisphenols, alkylphenols, parabens, and mercury were in cosmetic products intended for children. These substances all have the potential to impact growth and development, and so are of particular concern when found in children's products (Ecology, 2021).

Results from other cosmetic product testing studies

Several of the chemicals we were interested in studying in this report have been the subject of previous cosmetic product testing studies. Non-governmental organizations, government organizations, and academic research labs conduct product testing studies, many of which have focused on cosmetic products like makeup, skin-lightening creams, and feminine hygiene products (Segedie, 2022; ZMWG, 2022; WVE, 2014, 2018).

We reviewed the results from peer-reviewed scientific literature and results from product testing studies conducted by government agencies. These product testing studies can provide useful information about the presence of chemicals in cosmetics, especially contaminants that get into the product during manufacture or transport. When considered alongside reported uses of chemicals in cosmetics, these studies can fill in information gaps that exist when companies fail to report or are unaware of chemicals in products.

We identified studies for some chemicals, such as triclosan or hydroquinone, that were not included in reports to California or Washington (Dodson et al., 2012; Helm et al., 2018; Liao and Kannan, 2014; MN DOH, 2021; Wang et al., 2015). We also identified product testing results for methylisothiazolinone and methylchloroisothiazolinone, which were not included in reportable substance lists for California or Washington (Wittenberg et al., 2015). We included a summary of all the product testing studies we reviewed for each substance in Appendix C.

Some of the studies included here were conducted on products purchased outside the United States. While many of the cosmetics Washington residents use are purchased in Washington, some residents buy items overseas for personal use, especially products like kohl that may be culturally important to individuals but difficult to find in the United States. Import stores and grocery or drug stores that specialize in goods from specific regions of the world may also carry products made outside the United States (Shah et al., 2017). Products such as kohl or sindoor were found to contain high levels of lead, and also small amounts of other heavy metals such as arsenic and cadmium (Navarro-Tapia et al., 2021; Shah et al., 2017).

A handful of these studies identified chemicals that are found in products marketed to or used by women of color. Skin-lightening creams are used more often by women of color, including Asian women, than white women (Zota and Shamasunder 2017; Collins et al., 2021). Both hydroquinone and mercury are still found in these products, including products purchased in the United States and Mexico (MN DOH, 2021; Peregrino et al., 2011; Wang et al., 2015).

A study by Helm and colleagues found several hazardous chemicals in hair care products that are primarily used by Black women, like hair relaxers and hot oil treatments (Helm et al., 2016). These included:

- Ortho-phthalates.
- Alkylphenols.

- Bisphenols.
- Cyclosiloxanes.
- Parabens.
- Triclosan.
- Synthetic fragrances like d-limonene and linalool.

One consistent finding in our research is that these product testing studies find chemicals that are not listed as an ingredient on the label (Dodson et al., 2012; Whitehead et al., 2021). Sometimes the chemical may be a contaminant and is not subject to disclosure (Hepp et al., 2014; Lin et al., 2020).

Other times it may be because a company is not required to disclose an intentionally added substance, such as when ortho-phthalates are used in an added fragrance or when alkylphenols are added but listed as "surfactants" on the ingredient label (Dodson et al., 2012). A recent cosmetic product testing study identified PFAS in many cosmetics products, including products such as foundation and other complexion products. These products were not reported as containing PFAS in the California database nor do their product ingredient labels report using PFAS (Whitehead et al., 2021). Regardless of the reason, when these substances are not on the label, cosmetic consumers may be exposed to hazardous chemicals without their knowledge.

Based on our examination of the product testing literature and ingredient reporting databases, hazardous chemicals may be found in almost all cosmetics. Most people use multiple cosmetic products daily. It is possible for an individual to be exposed to many different hazardous chemicals through their cosmetics. Chemicals in cosmetics may contribute to the overall chemical burden in a person.

Alternative cosmetics are available

Not all cosmetic products will contain known hazardous chemicals, and many if not all companies carry some products that do not contain these substances. Several cosmetic companies have begun purposefully restricting what substances they or their suppliers use in cosmetics to limit consumer exposure to potentially harmful chemicals. Companies like Credo, Sephora, and BeautyCounter all sell products that are intentionally made without most or all of the substances discussed here (Credo, 2020; BeautyCounter, 2022a; Sephora, 2022). Some also require routine product testing for contaminants (BeautyCounter, 2022b).

There are also cosmetics available to consumers where the cosmetic ingredients have all been evaluated and found to be less hazardous to human health and the environment (Ecology, 2022b). The U.S. Environmental Protection Agency's (EPA) Safer Products program has certified several moisturizing hand washes as using less hazardous ingredients (EPA, 2022b). Additionally, the Cradle-to-Cradle certification program (C2CC, 2022) has certified several cosmetic products, including hair and skin care products, makeup, and washes.

Conclusions

In 2022, the Washington State Legislature directed Ecology to test cosmetic products for hazardous chemicals. These chemicals may be added to cosmetics intentionally as ingredients or may be unintentional contaminants. We were directed to consult with the Department of Health and community and social justice organizations to identify cosmetics that are marketed to or used by people of color.

In the United States, cultural beauty standards typically value attributes associated with whiteness, such as lighter skin or straighter hair. Some beauty standards are also driven by harmful stereotypes. Black women and women with darker skin typically are burdened by these beauty standards and thus motivated to use cosmetics (Zota and Shamasunder, 2017).

In consultation with Health, we reviewed prior literature on cosmetic use and identified cosmetic products used by people of color, including adults and children. Working with community organizations, we spoke with Washington residents of color to identify cosmetics that were relevant to them. We used this information to develop a product testing study.

We have completed phase one of our product testing, where we looked for heavy metals and formaldehyde in makeup, lotions, and hair care products. We found that formaldehyde was detected in 7 out of 10 skin lotions, 9 out of 10 leave-in conditioners and 10 out of 10 hair styling gels. Twenty-four products had detectable formaldehyde above 200 ppm, which is high enough to cause allergic reactions in some individuals.

We also found lead in two dark-tint powdered foundations and one inexpensive lipstick. We found arsenic in one dark-tint foundation. The highest concentrations we measured exceed the thresholds set by Germany for “technically avoidable” levels. No levels of lead are safe. Both arsenic and lead have been linked to brain and nervous system damage and cancer.

Phase two of our product testing is currently under way. We are looking for the presence of asbestos in makeup and ortho-phthalates in nail polishes, hair sprays, and unscented washes. We plan to amend this report once we have received the results of these tests.

There are many hazardous substances added to cosmetics that we could not test for in this project. Ecology tests products for chemicals using accredited testing methods, and new methods take years to develop. Even when we identified accredited testing methods for some substances, we could not find labs that were willing and able to conduct those tests. To complement our laboratory testing, we reviewed databases in which companies reported using hazardous substances in specific products. We also compiled information from other product testing studies, which often identify unreported ingredients and contaminants. We found examples of hazardous chemicals in most cosmetic product types.

Focusing on a specific chemical or cosmetic product underestimates their overall impacts. Low-income people and members of certain racial or ethnic groups are exposed more frequently to multiple environmental and social risk factors. They are affected by cumulative exposure to many chemicals over long periods of time (Morello-Frosch et al., 2011). Removing harmful substances used in cosmetics can reduce the levels of some of those chemicals in the body.

There are options for cosmetics made without known hazardous substances. Companies like Credo, Sephora, and BeautyCounter all sell products that are made without most or all of the substances discussed here (Credo, 2020; BeautyCounter, 2022a; Sephora, 2022). BeautyCounter also includes routine product testing for contaminants (BeautyCounter, 2022b). Several cosmetic products have been certified through the Cradle-to-Cradle and EPA's Safer Choice certification programs (C2CC, 2022). These programs verify that products are made with ingredients that are less harmful to human health.

References

Abrams, J. A., Belgrave, F. Z., Williams, C. D., & Maxwell, M. L. (2020). African American adolescent girls' beliefs about skin tone and colorism. *Journal of Black Psychology*, *46*, 169–194. https://doi.org/10.1177/0095798420928194

Agency for Toxic Substances and Disease Registry (ATSDR). (2022). Toxicological Profile for Mercury. Retrieved from https://www.atsdr.cdc.gov/toxprofiles/tp46.pdf

Agency for Toxic Substances and Disease Registry (ATSDR). (2020). Toxicological Profile for Lead. Retrieved from https://www.atsdr.cdc.gov/ToxProfiles/tp13.pdf

Agency for Toxic Substances and Disease Registry (ATSDR). (2011). Toxic Substances Portal-Health Effects of Toxic Substances and Carcinogens: Nervous System. Retrieved from https://wwwn.cdc.gov/tsp/substances/ToxOrganListing.aspx?toxid=18

Alvarez-Rivera, G., Vila, M., Lores, M., Garcia-Jares, C., & Llompart, M. (2014). Development of a multi-preservative method based on solid-phase microextraction–gas chromatography–tandem mass spectrometry for cosmetic analysis. *Journal of Chromatography A*, *1339*, 13–25. https://doi.org/10.1016/j.chroma.2014.02.075

Attard, T., & Attard, E. (2022). Heavy metals in cosmetics. In *Environmental Impact and Remediation of Heavy Metals*. IntechOpen. https://doi.org/10.5772/intechopen.102406

BeautyCounter. (2022a). The Never List. Retrieved from https://www.beautycounter.com/the-never-list

BeautyCounter. (2022b). BeautyCounter's Blueprint for Clean. Retrieved from https://www.beautycounter.com/safety

Bekö, G., Weschler, C. J., Langer, S., Callesen, M., Toftum, J., & Clausen, G. (2013). Children's phthalate intakes and resultant cumulative exposures estimated from urine compared with estimates from dust ingestion, inhalation and dermal absorption in their homes and daycare centers. *PloS ONE*, *8*, e62442. https://doi.org/10.1371/journal.pone.0062442

Berger, K. P., Kogut, K. R., Bradman, A., She, J., Gavin, Q., Zahedi, R., Parra, K. L., & Harley, K. G. (2019). Personal care product use as a predictor of urinary concentrations of certain phthalates, parabens, and phenols in the HERMOSA study. *Journal of Exposure Science & Environmental Epidemiology*, *29*, 21–32. https://doi.org/10.1038/s41370-017-0003-z

Boyer, I. J., Heldreth, B., Bergfeld, W. F., Belsito, D. V., Hill, R. A., Klaassen, C. D., Liebler, D. C., Marks, J. G., Shank, R. C., Slaga, T. J., Snyder, P. W., & Andersen, F. A. (2013). Amended safety assessment of formaldehyde and methylene glycol as used in cosmetics. *International Journal of Toxicology*, *32*, 5S-32S. https://doi.org/10.1177/1091581813511831

Branch, F., Woodruff, T. J., Mitro, S. D., & Zota, A. R. (2015). Vaginal douching and racial/ethnic disparities in phthalates exposures among reproductive-aged women: National Health and

Nutrition Examination Survey 2001–2004. *Environmental Health*, *14*, 57. https://doi.org/10.1186/s12940-015-0043-6

Bundesamt für Verbraucherschutz und Lebensmittelsicherheit (BVL). (2017). Technically avoidable heavy metal contents in cosmetic products. *Journal of Consumer Protection and Food Safety, 12,* 51-53. https://doi.org/10.1007/s00003-016-1044-2

California Breast Cancer Research Program (CBCRP). (n.d.). Exploring Chemical Exposure for California's Women Workers. Retrieved from https://cbcrp.org/worker-exposure/

California Department of Public Health (CDPH). (2022). California Safe Cosmetics Program. Retrieved from https://www.cdph.ca.gov/Programs/CCDPHP/DEODC/OHB/CSCP/Pages/CSCP.aspx

California Office of Environmental Health Hazard Assessment (OEHHA). (2022). The Proposition 65 List. Retrieved from https://oehha.ca.gov/proposition-65/proposition-65-list

Campaign for Safe Cosmetics (CSC). (2022). Formaldehyde and Formaldehyde Releasing Preservatives. Retrieved from https://www.safecosmetics.org/get-the-facts/chemicals-of-concern/formaldehyde/

Capela, D., Alves, A., Homem, V., & Santos, L. (2016a). From the shop to the drain — volatile methylsiloxanes in cosmetics and personal care products. *Environment International*, *92–93*, 50–62. https://doi.org/10.1016/j.envint.2016.03.016

Capela, D., Homem, V., Alves, A., & Santos, L. (2016b). Volatile methylsiloxanes in personal care products – using QuEChERS as a "green" analytical approach. *Talanta*, *155*, 94–100. https://doi.org/10.1016/j.talanta.2016.04.029

Centers for Disease Control and Prevention (CDC). (2021a). CDC Updates Blood Lead Reference Value for Children. Retrieved on November 8, 2022, from https://www.cdc.gov/nceh/pressroom/2021/CDC-Updates-Blood-Lead-Reference-Value-for-Children.html

Centers for Disease Control and Prevention (CDC). (2021b). Phthalates Factsheet. Retrieved on November 4, 2022, from https://www.cdc.gov/biomonitoring/Phthalates_FactSheet.html

Centers for Disease Control and Prevention (CDC). (2020). 2020 National Health Interview Survey (NHIS) Data. Retrieved from https://www.cdc.gov/asthma/nhis/2020/table4-1.htm

Centers for Disease Control and Prevention (CDC). (2013). Childhood Lead Exposure Associated with the Use of Kajal, an Eye Cosmetic from Afghanistan — Albuquerque, New Mexico, 2013. Retrieved from https://www.cdc.gov/mmwr/preview/mmwrhtml/mm6246a3.htm

Chang, C.-J., O'Brien, K. M., Keil, A. P., Gaston, S. A., Jackson, C. L., Sandler, D. P., & White, A. J. (2022). Use of straighteners and other hair products and incident uterine cancer. *JNCI: Journal of the National Cancer Institute*. https://doi.org/10.1093/jnci/djac165

Collins, H. N., Johnson, P. I., Calderon, N. M., Clark, P. Y., Gillis, A. D., Le, A. M., Nguyen, D., Nguyen, C., Fu, L., O'Dwyer, T., & Harley, K. G. (2021). Differences in personal care product use by race/ethnicity among women in California: implications for chemical exposures. *Journal of Exposure Science & Environmental Epidemiology*. https://doi.org/10.1038/s41370-021-00404-7

Cosmetic Ingredient Review (CIR). (2018). Safety Assessment of Parabens as Used in Cosmetics. Retrieved from https://www.cir-safety.org/sites/default/files/parabens.pdf

Cosmetic Ingredient Review (CIR). (2008). Final safety assessment of coal tar as used in cosmetics. *International Journal of Toxicology*, *27*, 1–24. https://doi.org/10.1080/10915810802244405

Cradle to Cradle Certified (C2CC). (2022). Cradle to Cradle Certified Products Registry. Retrieved from https://www.c2ccertified.org/products/registry

Credo. (2020). The Dirty List. Retrieved from https://cdn.shopify.com/s/files/1/0637/6147/files/The_Dirty_List_PDF_August_Update.pdf?v=1598294504

Dodson, R. E., Cardona, B., Zota, A. R., Robinson Flint, J., Navarro, S., & Shamasunder, B. (2021). Personal care product use among diverse women in California: Taking Stock Study. *Journal of Exposure Science & Environmental Epidemiology*, *31*, 487–502. https://doi.org/10.1038/s41370-021-00327-3

Dodson, R. E., Nishioka, M., Standley, L. J., Perovich, L. J., Brody, J. G., & Rudel, R. A. (2012). Endocrine disruptors and asthma-associated chemicals in consumer products. *Environmental Health Perspectives*, *120*, 935–943. https://doi.org/10.1289/ehp.1104052

Dudzina, T., von Goetz, N., Bogdal, C., Biesterbos, J. W. H., & Hungerbühler, K. (2014). Concentrations of cyclic volatile methylsiloxanes in European cosmetics and personal care products: prerequisite for human and environmental exposure assessment. *Environment International*, *62*, 86–94. https://doi.org/10.1016/j.envint.2013.10.002

Eberle, C. E., Sandler, D. P., Taylor, K. W., & White, A. J. (2020). Hair dye and chemical straightener use and breast cancer risk in a large US population of black and white women. *International Journal of Cancer*, *147*, 383–391. https://doi.org/10.1002/ijc.32738

Environmental Working Group (EWG). (n.d.). Learn how Skin Deep® works. Retrieved from https://www.ewg.org/skindeep/learn_more/about/

European Chemicals Agency (ECHA). (2022a). Cosmetic Products Regulation, Annex II – Prohibited Substances. Retrieved from https://echa.europa.eu/cosmetics-prohibited-substances

European Chemicals Agency (ECHA). (2022b). Cosmetic Products Regulation, Annex III – Restricted Substances. Retrieved from https://echa.europa.eu/cosmetics-restricted-substances

European Chemicals Agency (ECHA). (2022c). Substance Infocard: 2-(4-tert-butylbenzyl) propionaldehyde. Retrieved from https://echa.europa.eu/substance-information/-/substanceinfo/100.001.173

European Chemicals Agency (ECHA). (2022d). Authorisation List: List of substances included in Annex XIV of REACH. Retrieved from https://echa.europa.eu/authorisation-list

European Chemicals Agency (ECHA). (2022e). PBT Assessment List. Retrieved from https://echa.europa.eu/pbt

European Chemicals Agency (ECHA). (2022f). Candidate List of Substances of Very High Concern for Authorisation. Retrieved from https://echa.europa.eu/candidate-list-table

European Commission. (2012). Perfume Allergies. Retrieved from https://ec.europa.eu/health/scientific_committees/opinions_layman/perfume-allergies/en/l-3/1-introduction.htm

European Commission. (2012). Opinion on Methylene Glycol. Retrieved from https://ec.europa.eu/health/scientific_committees/consumer_safety/docs/sccs_o_097.pdf

European Commission. (2009). Regulation (EC) No 1223/2009 of the European Parliament and of the Council of 30 November 2009 on cosmetic products. Retrieved from https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:02009R1223-20190813

European Commission. (2022). Commission Regulation amending Regulation (EC) No 1223/2009 of the European Parliament and of the Council as regards labelling of fragrance allergens in cosmetic products. Retrieved from https://members.wto.org/crnattachments/2022/TBT/EEC/22_6171_01_e.pdf

Ferranti, M. (2011). An odor of racism: vaginal deodorants in African-American beauty culture and advertising. *Advertising & Society Review*, *11*. https://doi.org/10.1353/asr.2011.0003

Fujii, Y., Harada, K. H., & Koizumi, A. (2013). Occurrence of perfluorinated carboxylic acids (PFCAs) in personal care products and compounding agents. *Chemosphere*, *93*, 538–544. https://doi.org/10.1016/j.chemosphere.2013.06.049

Guo, Y., & Kannan, K. (2013). A survey of phthalates and parabens in personal care products from the United States and its implications for human exposure. *Environmental Science & Technology*, *47*, 14442–14449. https://doi.org/10.1021/es4042034

Guo, Y., Wang, L., & Kannan, K. (2014). Phthalates and parabens in personal care products from China: concentrations and human exposure. *Archives of Environmental Contamination and Toxicology*, *66*, 113–119. https://doi.org/10.1007/s00244-013-9937-x

Harley, K. G., Kogut, K., Madrigal, D. S., Cardenas, M., Vera, I. A., Meza-Alfaro, G., She, J., Gavin, Q., Zahedi, R., Bradman, A., Eskenazi, B., & Parra, K. L. (2016). Reducing phthalate, paraben, and phenol exposure from personal care products in adolescent girls: findings from the HERMOSA intervention study. *Environmental Health Perspectives*, *124*, 1600–1607. https://doi.org/10.1289/ehp.1510514

Harper, K., & Choma, B. L. (2019). Internalised White ideal, skin tone surveillance, and hair surveillance predict skin and hair dissatisfaction and skin bleaching among African American and Indian women. *Sex Roles*, *80*, 735–744. https://doi.org/10.1007/s11199-018-0966-9

Helm, J. S., Nishioka, M., Brody, J. G., Rudel, R. A., & Dodson, R. E. (2018). Measurement of endocrine disrupting and asthma-associated chemicals in hair products used by Black women. *Environmental Research*, *165*, 448–458. https://doi.org/10.1016/j.envres.2018.03.030

Hubinger, J. C. (2010). A survey of phthalate esters in consumer cosmetic products. *Journal of Cosmetic Science*, *61*, 457–465. http://www.ncbi.nlm.nih.gov/pubmed/21241635

International Agency for Research on Cancer (IARC). (2022). List of classifications – IARC monographs on the identification of carcinogenic hazards to humans. Retrieved from https://monographs.iarc.who.int/list-of-classifications/

Interstate Chemicals Clearinghouse (IC2). (2022). High Priority Chemicals Database System (HPCDS). Retrieved from https://www.theic2.org/hpcds#gsc.tab=0

Jairoun, A. A., Al-Hemyari, S. S., Shahwan, M., Zyoud, S. H., & Ashames, A. (2020). Hidden formaldehyde content in cosmeceuticals containing preservatives that release formaldehyde and their compliance behaviors: bridging the gap between compliance and local regulation. *Cosmetics*, *7*, 93. https://doi.org/10.3390/cosmetics7040093

James-Todd, T. M., Chiu, Y.-H., & Zota, A. R. (2016). Racial/ethnic disparities in environmental endocrine disrupting chemicals and women's reproductive health outcomes: epidemiological examples across the life course. *Current Epidemiology Reports*, *3*, 161–180. https://doi.org/10.1007/s40471-016-0073-9

Johansen, J. D. (2003). Fragrance contact allergy. *American Journal of Clinical Dermatology*, *4*, 789–798. https://doi.org/10.2165/00128071-200304110-00006

Johnson, W., Bergfeld, W. F., Belsito, D. V., Hill, R. A., Klaassen, C. D., Liebler, D. C., Marks, J. G., Shank, R. C., Slaga, T. J., Snyder, P. W., & Andersen, F. A. (2011). Safety assessment of cyclomethicone, cyclotetrasiloxane, cyclopentasiloxane, cyclohexasiloxane, and cycloheptasiloxane. *International Journal of Toxicology*, *30*, 149S-227S. https://doi.org/10.1177/1091581811428184

Koo, H. J., & Lee, B. M. (2004). Estimated exposure to phthalates in cosmetics and risk assessment. *Journal of Toxicology and Environmental Health, Part A*, *67*, 1901–1914. https://doi.org/10.1080/15287390490513300

Liao, C., & Kannan, K. (2014). A survey of alkylphenols, bisphenols, and triclosan in personal care products from China and the United States. *Archives of Environmental Contamination and Toxicology*, *67*, 50–59. https://doi.org/10.1007/s00244-014-0016-8

Liou, Y. L., Ericson, M. E., & Warshaw, E. M. (2019). Formaldehyde release from baby wipes: analysis using the chromotropic acid method. *Dermatitis*, *30*, 207–212. https://doi.org/10.1097/DER.0000000000000478

Liou, Y. L., Voller, L. M., Liszewski, W., Ericson, M. E., Siegel, P. D., & Warshaw, E. M. (2021). Formaldehyde release from predispersed tattoo inks: analysis using the chromotropic acid method. *Dermatitis*, *32*, 327–332. https://doi.org/10.1097/DER.0000000000000663

Liu, S., Hammond, S. K., & Rojas-Cheatham, A. (2013). Concentrations and potential health risks of metals in lip products. *Environmental Health Perspectives*, *121*, 705–710. https://doi.org/10.1289/ehp.1205518

Maneli, M. H., Smith, P., & Khumalo, N. P. (2014). Elevated formaldehyde concentration in "Brazilian keratin type" hair-straightening products: a cross-sectional study. *Journal of the American Academy of Dermatology*, *70*, 276–280. https://doi.org/10.1016/j.jaad.2013.10.023

McDonald, J. A., Llanos, A. A. M., Morton, T., & Zota, A. R. (2022). The environmental injustice of beauty products: toward clean and equitable beauty. *American Journal of Public Health*, *112*, 50–53. https://doi.org/10.2105/AJPH.2021.306606

McMichael, J. R., & Stoff, B. K. (2018). Surma eye cosmetic in Afghanistan: a potential source of lead toxicity in children. *European Journal of Pediatrics*, *177*, 265–268. https://doi.org/10.1007/s00431-017-3056-z

Mohta, A. (2010). Kajal (Kohl) – a dangerous cosmetic. *Oman Journal of Ophthalmology*, *3*, 100. https://doi.org/10.4103/0974-620X.64242

Morello-Frosch, R., Zuk, M., Jerrett, M., Shamasunder, B., & Kyle, A. D. (2011). Understanding the cumulative impacts of inequalities in environmental health: implications for policy. *Health Affairs*, *30*, 879–887. https://doi.org/10.1377/hlthaff.2011.0153

Murat, P., Harohalli Puttaswamy, S., Ferret, P.-J., Coslédan, S., & Simon, V. (2020). Identification of potential extractables and leachables in cosmetic plastic packaging by microchambers-thermal extraction and pyrolysis-gas chromatography-mass spectrometry. *Molecules*, *25*, 2115. https://doi.org/10.3390/molecules25092115

National Toxicology Program (NTP). (2021). 15th Report on Carcinogens. https://ntp.niehs.nih.gov/whatwestudy/assessments/cancer/roc/index.html

Nikle, A., Ericson, M., & Warshaw, E. (2019). Formaldehyde release from personal care products: chromotropic acid method analysis. *Dermatitis*, *30*, 67–73. https://doi.org/10.1097/DER.0000000000000434

Oregon Health Authority (OHA). (2022). Reporting for the Toxic Free Kids Act. Retrieved from https://www.oregon.gov/oha/PH/HEALTHYENVIRONMENTS/HEALTHYNEIGHBORHOODS/TOXICSUBSTANCES/Pages/Toxic-Free-Kids-Reporting.aspx

Personal Care Products Council (PCPC). (2020). Driving the Economy, Shaping the Future: Economic & Social Contributions Report 2020. Retrieved from https://www.personalcarecouncil.org/wp-content/uploads/2020/10/PCPC_EcoReport_2020_report.pdf

Personal Care Products Council (PCPC). (2022). Member Companies. Retrieved from https://www.personalcarecouncil.org/about-us/member-companies/

Personal Care Products Council (PCPC). (2022). INCIpedia. Retrieved from https://incipedia.personalcarecouncil.org/

Preston, E. V., Chan, M., Nozhenko, K., Bellavia, A., Grenon, M. C., Cantonwine, D. E., McElrath, T. F., & James-Todd, T. (2021). Socioeconomic and racial/ethnic differences in use of endocrine-disrupting chemical-associated personal care product categories among pregnant women. *Environmental Research*, *198*, 111212. https://doi.org/10.1016/j.envres.2021.111212

Rodulfo, K. (2018). For New Foundation Ranges, "Fenty 40" Is the Magic Number. *Elle*. Retrieved from https://www.elle.com/beauty/makeup-skin-care/a20967710/makeup-companies-40-foundation-shades-fenty-beauty-influence/

Sardar, S. W., Choi, Y., Park, N., & Jeon, J. (2019). Occurrence and concentration of chemical additives in consumer products in Korea. *International Journal of Environmental Research and Public Health*, *16*, 5075. https://doi.org/10.3390/ijerph16245075

Schettler, T. (2006). Human exposure to phthalates via consumer products. *International Journal of Andrology*, *29*, 134–139. https://doi.org/10.1111/j.1365-2605.2005.00567.x

Schultes, L., Vestergren, R., Volkova, K., Westberg, E., Jacobson, T., & Benskin, J. P. (2018). Per- and polyfluoroalkyl substances and fluorine mass balance in cosmetic products from the Swedish market: implications for environmental emissions and human exposure. *Environmental Science: Processes & Impacts*, *20*, 1680–1690. https://doi.org/10.1039/C8EM00368H

Segedie, L. (2022). Green Beauty Cosmetic Guide — PFAS "Forever Chemicals" & Makeup: Measuring Parts Per Trillion in Water vs. Parts Per Million in Makeup. *Mamavation.* Retrieved from https://www.mamavation.com/beauty/green-beauty-cosmetic-makeup-guide-pfas-forever-chemicals.html#Measuring_Parts_Per_Trillion_in_Water_vs_Parts_Per_Million_in_Makeup

Sephora. (2022). Clean Beauty Products. Retrieved from https://www.sephora.com/beauty/clean-beauty-products

Shah, M. P., Shendell, D. G., Strickland, P. O., Bogden, J. D., Kemp, F. W., & Halperin, W. (2017). Lead content of sindoor, a Hindu religious powder and cosmetic: New Jersey and India, 2014–2015. *American Journal of Public Health*, *107*, 1630–1632. https://doi.org/10.2105/AJPH.2017.303931

Stackelberg, P. E., Furlong, E. T., Meyer, M. T., Zaugg, S. D., Henderson, A. K., & Reissman, D. B. (2004). Persistence of pharmaceutical compounds and other organic wastewater contaminants in a conventional drinking-water-treatment plant. *Science of The Total Environment*, *329*, 99–113. https://doi.org/10.1016/j.scitotenv.2004.03.015

Sukuroglu, A. A., Battal, D., & Burgaz, S. (2017). Monitoring of lawsone, p -phenylenediamine and heavy metals in commercial temporary black henna tattoos sold in Turkey. *Contact Dermatitis*, *76*, 89–95. https://doi.org/10.1111/cod.12702

United Nations Environmental Programme (UNEP). (2019). All POPs listed in the Stockholm Convention. Retrieved from http://chm.pops.int/TheConvention/ThePOPs/AllPOPs/tabid/2509/Default.aspx

US Environmental Protection Agency (EPA). (2022a). What is Endocrine Disruption? Retrieved from https://www.epa.gov/endocrine-disruption/what-endocrine-disruption

US Environmental Protection Agency (EPA). (2022b). Search Products that Meet the Safer Choice Standard. Retrieved from https://www.epa.gov/saferchoice/products

US Environmental Protection Agency (EPA). (2022c). Persistent Bioaccumulative Toxic (PBT) Chemicals Covered by the TRI Program. Retrieved from https://www.epa.gov/toxics-release-inventory-tri-program/persistent-bioaccumulative-toxic-pbt-chemicals-covered-tri

US Food and Drug Administration (FDA). (2022a). Is It a Cosmetic, a Drug, or Both? (Or Is It Soap?). Retrieved from https://www.fda.gov/cosmetics/cosmetics-laws-regulations/it-cosmetic-drug-or-both-or-it-soap

US Food and Drug Administration (FDA). (2022b). Allergens in Cosmetics. Retrieved from https://www.fda.gov/cosmetics/cosmetic-ingredients/allergens-cosmetics

US Food and Drug Administration (FDA). (2022c). Prohibited & Restricted Ingredients in Cosmetics. Retrieved from https://www.fda.gov/cosmetics/cosmetics-laws-regulations/prohibited-restricted-ingredients-cosmetics

US Food and Drug Administration (FDA). (2022d). FDA works to protect consumers from potentially harmful OTC skin lightening products. Retrieved from https://www.fda.gov/drugs/drug-safety-and-availability/fda-works-protect-consumers-potentially-harmful-otc-skin-lightening-products

US Food and Drug Administration (FDA). (2022e). Summary of Cosmetics Labeling Requirements. Retrieved from https://www.fda.gov/cosmetics/cosmetics-labeling-regulations/summary-cosmetics-labeling-requirements#Cosmetic_Labeling

US Food and Drug Administration (FDA). (2022f). Fragrances in Cosmetics. Retrieved from https://www.fda.gov/cosmetics/cosmetic-ingredients/fragrances-cosmetics#how

US Food and Drug Administration (FDA). (2022g). Kohl, Kajal, Al-Kahal, Surma, Tiro, Tozali, or Kwalli: By Any Name, Beware of Lead Poisoning. Retrieved from https://www.fda.gov/cosmetics/cosmetic-products/kohl-kajal-al-kahal-surma-tiro-tozali-or-kwalli-any-name-beware-lead-poisoning

US Food and Drug Administration (FDA). (2022h). FDA's Testing of Cosmetics for Arsenic, Cadmium, Chromium, Cobalt, Lead, Mercury, and Nickel Content. Retrieved from https://www.fda.gov/cosmetics/potential-contaminants-cosmetics/fdas-testing-cosmetics-arsenic-cadmium-chromium-cobalt-lead-mercury-and-nickel-content

US Food and Drug Administration (FDA). (2022i). Phthalates in Cosmetics. Retrieved from https://www.fda.gov/cosmetics/cosmetic-ingredients/phthalates-cosmetics

US Food and Drug Administration (FDA). (2022j). Talc. Retrieved from https://www.fda.gov/cosmetics/cosmetic-ingredients/talc

US Food and Drug Administration (FDA). (2016). Draft Guidance for Industry: Lead in Cosmetic Lip Products and Externally Applied Cosmetics: Recommended Maximum Level. Retrieved from https://www.fda.gov/regulatory-information/search-fda-guidance-documents/draft-guidance-industry-lead-cosmetic-lip-products-and-externally-applied-cosmetics-recommended

US PIRG. (2018). In Your Face: Makeup found to be contaminated with asbestos. Retrieved from https://pirg.org/edfund/resources/in-your-face/

Vállez-Gomis, V., Grau, J., Benedé, J. L., Chisvert, A., & Salvador, A. (2020). Reduced graphene oxide-based magnetic composite for trace determination of polycyclic aromatic hydrocarbons in cosmetics by stir bar sorptive dispersive microextraction. *Journal of Chromatography A*, *1624*, 461229. https://doi.org/10.1016/j.chroma.2020.461229

van der Schyff, V., Suchánková, L., Kademoglou, K., Melymuk, L., & Klánová, J. (2022). Parabens and antimicrobial compounds in conventional and "green" personal care products. *Chemosphere*, *297*, 134019. https://doi.org/10.1016/j.chemosphere.2022.134019

Voller, L. M., Persson, L., Bruze, M., Ericson, M. E., & Hylwa, S. A. (2019). Formaldehyde in "Nontoxic" Nail Polish. *Dermatitis*, *30*, 259–263. https://doi.org/10.1097/DER.0000000000000493

Wang, P. G., & Zhou, W. (2013). Rapid determination of parabens in personal care products by stable isotope GC-MS/MS with dynamic selected reaction monitoring. *Journal of Separation Science*, *36*, 1781–1787. https://doi.org/10.1002/jssc.201201098

Wang, R., Moody, R. P., Koniecki, D., & Zhu, J. (2009). Low molecular weight cyclic volatile methylsiloxanes in cosmetic products sold in Canada: implication for dermal exposure. *Environment International*, *35*, 900–904. https://doi.org/10.1016/j.envint.2009.03.009

Washington State Department of Ecology (Ecology). (2006). Executive Policy 22-01: Establishing Quality Assurance. Internal Document. Olympia.

Washington State Department of Ecology (Ecology). (2017). Chemicals of high concern to children (CHCC). Retrieved from https://ecology.wa.gov/Regulations-Permits/Reporting-requirements/Reporting-for-Childrens-Safe-Products-Act/Chemicals-of-high-concern-to-children

Washington State Department of Ecology (Ecology). (2020). Quality Management Plan, 2020: Washington State Department of Ecology. Publication No. 20-03-014. Retrieved from https://apps.ecology.wa.gov/publications/SummaryPages/2003014.html

Washington State Department of Ecology (Ecology). (2021). Rationale for Reporting List of Chemicals of High Concern to Children 2011–2017. Publication No. 18-04-025. Retrieved from https://apps.ecology.wa.gov/publications/documents/1804025.pdf

Washington State Department of Ecology (Ecology). (2022a). Quality Assurance Project Plan: Toxic Chemicals in Cosmetics. Publication No. 22-03-113. Retrieved from https://apps.ecology.wa.gov/publications/documents/2203113.pdf

Washington State Department of Ecology (Ecology). (2022b). Regulatory Determinations Report to the Legislature: Safer Products for Washington Cycle 1 Implementation Phase 3. Publication No. 22-04-018. Retrieved from https://apps.ecology.wa.gov/publications/summarypages/2204018.html

Washington State Department of Ecology (Ecology). (In publication). Addendum to Quality Assurance Project Plan: Toxic Chemicals in Cosmetics: Phthalates and Asbestos. Publication No. 23-03-108. Olympia.

Whitehead, H. D., Venier, M., Wu, Y., Eastman, E., Urbanik, S., Diamond, M. L., Shalin, A., Schwartz-Narbonne, H., Bruton, T. A., Blum, A., Wang, Z., Green, M., Tighe, M., Wilkinson, J. T., McGuinness, S., & Peaslee, G. F. (2021). Fluorinated compounds in North American cosmetics. *Environmental Science & Technology Letters*, *8*, 538–544. https://doi.org/10.1021/acs.estlett.1c00240

Wittenberg, J. B., Canas, B. J., Zhou, W., Wang, P. G., Rua, D., & Krynitsky, A. J. (2015). Determination of methylisothiazolinone and methylchloroisothiazolinone in cosmetic products by ultra high performance liquid chromatography with tandem mass spectrometry. *Journal of Separation Science*, *38*, 2983–2988. https://doi.org/10.1002/jssc.201500365

Women's Voices for Earth (WVE). (2014). Always Pads Testing Results. Retrieved from https://womensvoices.org/menstrual-care-products/detox-the-box/always-pads-testing-results/

Women's Voices for Earth (WVE). (2018). What's in your tampon? Retrieved from https://womensvoices.org/menstrual-care-products/whats-in-your-tampon/

World Health Organization (WHO). (2022). Lead poisoning. Retrieved from https://www.who.int/news-room/fact-sheets/detail/lead-poisoning-and-health

Wu, X. (May), Bennett, D. H., Ritz, B., Cassady, D. L., Lee, K., & Hertz-Picciotto, I. (2010). Usage pattern of personal care products in California households. *Food and Chemical Toxicology*, *48*, 3109–3119. https://doi.org/10.1016/j.fct.2010.08.004

Yedjou, C. G., Sims, J. N., Miele, L., Noubissi, F., Lowe, L., Fonseca, D. D., Alo, R. A., Payton, M., & Tchounwou, P. B. (2019). *Health and Racial Disparity in Breast Cancer* (pp. 31–49). https://doi.org/10.1007/978-3-030-20301-6_3

Zero Mercury Working Group (ZMWG). (2022). Mercury-Added Skin-Lightening Creams Campaign. Retrieved from https://www.zeromercury.org/mercury-added-skin-lightening-creams-campaign/

Zota, A. R., Shamasunder, B. (2017). The environmental injustice of beauty: framing chemical exposures from beauty products as a health disparities concern. *American Journal of Obstetrics and Gynecology*, *217,* 418.e1 – 418.e6. https://doi.org/10.1016/j.ajog.2017.07.020

Appendix A. Hazard Endpoints of Concern for Substances Listed in SB 5703

This appendix has three tables detailing the relevant authoritative lists we consulted to identify hazard endpoints of concern for the substances listed in SB 5703. Table 5 reports lists for chemicals and chemical classes. Table 6 reports lists for coal tar compounds. Table 7 reports lists for synthetic fragrances.

Chemicals and chemical classes

Table 5. Hazard endpoints of concern identified for chemicals and chemical classes based on authoritative lists.

Chemical or chemical class	Hazard endpoints of concern based on authoritative listings
Ortho-phthalates	**Carcinogenicity** CA Prop 65 U.S. NIH Report on Carcinogens **Developmental and reproductive toxicity** CA Prop 65 EU GHS (H360Df) **Endocrine disruption** EU SVHC Authorisation List **Aquatic toxicity** EU GHS (H400)
Per- and polyfluoroalkyl substances	**Developmental and reproductive toxicity** EU Annex VI CMRs Category 1B EU REACH Annex XVII CMRs Category 2 CA Prop 65 **Systemic toxicity** EU GHS (H372) **Eye irritation** EU GHS (H318) **Persistence and bioaccumulation** WA Ecology PBT UNEP Persistent Organic Pollutant
Alkylphenols	**Endocrine activity** EU SVHC – Candidate List EU SVHC – Authorisation List **Acute aquatic toxicity** EU – GHS (H400)
Alkylphenol ethoxylates	**Endocrine activity** EU SVHC – Candidate List EU SVHC – Authorisation List

Chemical or chemical class	Hazard endpoints of concern based on authoritative listings
Bisphenols	**Carcinogenicity** CA Prop 65 IARC (2A) **Developmental and reproductive toxicity** CA Prop 65 EU – GHS (H360F) **Endocrine activity** EU – SVHC Candidate List EU – SVHC Prioritisation List **Eye irritation** EU – GHS (H318) **Skin sensitization** EU – GHS (H317)
Parabens	**Endocrine activity** EU SVHC – Candidate List **Eye irritation** EU – GHS (H319) **Skin irritation** EU – GHS (H315)
Formaldehyde (CAS 50-00-0) and methylene glycol[16] (CAS 463-57-0)	**Carcinogenicity** CA Prop 65 IARC (1) EU – Annex VI CMRs (Carc 1B) **Skin sensitization** EU – GHS (H317) **Acute mammalian toxicity** EU – GHS (H331, H311, H301)
Ethylene glycol (CAS 107-21-1)	**Developmental and reproductive toxicity** CA Prop 65
1,4-dioxane (CAS 123-91-1)	**Carcinogenicity** CA Prop 65 IARC (2B) **Eye irritation** EU – GHS (H319)
Arsenic and arsenic compounds (CAS 7440-38-2)	**Carcinogenicity** CA Prop 65 IARC (1) **Neurotoxicity** ASTDR Neurotoxicants **Acute mammalian toxicity**

[16] Methylene glycol can turn into formaldehyde, and vice versa, in water.

Chemical or chemical class	Hazard endpoints of concern based on authoritative listings
	EU – GHS (H331, H301) **Acute and chronic aquatic toxicity** EU – GHS (H400, H410)
Cadmium and cadmium compounds (CAS 7440-43-9)	**Carcinogenicity** CA Prop 65 **Neurotoxicity** ASTDR Neurotoxicants **Persistence and bioaccumulation** U.S. EPA – TRI PBT
Lead and lead compounds (CAS 7439-92-1)	**Carcinogenicity** CA Prop 65 IARC (2A) **Developmental and reproductive toxicity** CA Prop 65 EU – GHS (H360FD) **Neurotoxicity** ASTDR Neurotoxicants **Acute and chronic aquatic toxicity** EU – GHS (H400, H410) **Persistence and bioaccumulation** WA Ecology PBT U.S. EPA – TRI PBT
Mercury and mercury compounds (CAS 7439-97-6)	**Developmental and reproductive toxicity** CA Prop 65 EU – GHS (H360F) **Neurotoxicity** ASTDR Neurotoxicants **Acute mammalian toxicity** EU – GHS (H330) **Systemic toxicity** EU – GHS (H372) **Acute and chronic aquatic toxicity** EU – GHS (H400, H410) **Persistence and bioaccumulation** U.S. EPA – TRI PBT
Aluminum chlorohydrate, aluminum sulfate (aluminum salts)	**Eye irritation** EU – GHS (H318)
Styrene (CAS 100-42-5)	**Carcinogenicity** CA Prop 65 IARC (2A)

Chemical or chemical class	Hazard endpoints of concern based on authoritative listings
	Developmental and reproductive toxicity EU – GHS (H361D) **Neurotoxicity** ASTDR Neurotoxicants **Systemic toxicity** EU – GHS (H372) **Eye irritation** EU – GHS (H319) **Skin irritation** EU – GHS (H315)
Octamethylcyclotetrasiloxane (CAS 556-67-2), Decamethylcyclopentasiloxane (CAS 541-02-6), Dodecamethylcyclohexasiloxane (CAS 540-97-6)	**Developmental and reproductive toxicity** EU – GHS (H361f) **Chronic aquatic toxicity** EU – GHS (H410) **Persistent, Bioaccumulative and Toxic** EU SVHC – Candidate List
Toluene (CAS 108-88-3)	**Developmental and reproductive toxicity** CA Prop 65 EU – GHS (H361d) **Neurotoxicity** ASTDR Neurotoxicants **Skin irritation** EU – GHS (H315)
Asbestos	**Carcinogenicity** CA Prop 65 IARC (1)[17]
Hydroquinone (CAS 123-31-9)	**Eye irritation** EU – GHS (H318) **Skin sensitization** EU – GHS (H317) **Acute aquatic toxicity** EU – GHS (H400)
2-Ethylhexyl acrylate (CAS 103-11-7)	**Skin irritation** EU – GHS (H315) **Skin sensitization** EU – GHS (H317)
Ethyl acrylate (CAS 140-88-5)	**Carcinogenicity** CA Prop 65 **Skin irritation, sensitization** EU – GHS (H315, H317)

[17] Talc containing asbestiform fibers is categorized by IARC as a possible carcinogen (2B).

Chemical or chemical class	Hazard endpoints of concern based on authoritative listings
	Eye irritation EU – GHS (H319)
Sodium laurel sulfate (CAS 151-21-3)	**Skin irritation** EU – GHS (H315) **Eye irritation** EU – GHS (H318)
Sodium laureth sulfate (CAS 3088-31-1)	**Skin irritation** EU – GHS (H315) **Eye irritation** EU – GHS (H318)
Benzalkonium chloride (CAS 8001-54-5)	**Skin irritation** EU – GHS (H314) **Eye irritation** EU – GHS (H318)
Triclosan (CAS 3380-34-5)	**Skin irritation** EU – GHS (H315) **Eye irritation** EU – GHS (H319) **Acute and chronic aquatic toxicity** EU – GHS (H400, H410)
Methylisothiazolinone (CAS 2682-20-4)	**Acute mammalian toxicity** EU – GHS (H311, H301) **Skin irritation,** EU – GHS (H314, H315) **Eye irritation** EU – GHS (H319) **Acute and chronic aquatic toxicity** EU – GHS (H400, H410)
Methylchloroisothiazolinone (CAS 26172-55-4)	**Acute mammalian toxicity** EU – GHS (H310, H300) **Skin irritation, sensitization** EU – GHS (H314, H317) **Eye irritation** EU – GHS (H318) **Acute aquatic toxicity** EU – GHS (H400)
o-phenylenediamine (CAS 95-54-5)	**Carcinogenicity** CA Prop 65 **Acute mammalian toxicity** EU – GHS (H301) **Skin sensitization**

Chemical or chemical class	Hazard endpoints of concern based on authoritative listings
	EU – GHS (H317) **Eye irritation** EU – GHS (H319) **Acute and chronic aquatic toxicity** EU – GHS (H400, H410)
m-phenylenediamine (CAS 108-45-2)	**Skin sensitization** EU – GHS (H317) **Eye irritation** EU – GHS (H319) **Acute and chronic aquatic toxicity** EU – GHS (H400, H410)
p-phenylenediamine (CAS 106-50-3)	**Acute mammalian toxicity** EU – GHS (H331, H311, H301) **Skin sensitization** EU – GHS (H317) **Eye irritation** EU – GHS (H319) **Acute and chronic aquatic toxicity** EU – GHS (H400, H410)

Coal tar compounds

The original version of SB 5703 included a ban on "coal tar compounds."[18] Coal tar compounds contain chemicals from several chemical classes, including PAHs and phenolic compounds. Coal tars can be refined into other products, many of which are associated with carcinogenicity (CIR, 2008). In Table 6, we identify the hazard endpoints of concern for a few of these chemicals and chemical mixtures based on their presence on authoritative lists.

Table 6. Hazard endpoints of concern identified for specific chemicals and chemical mixtures found in coal tar.

Coal tar-derived chemical or chemical mixture	Hazard endpoints of concern based on authoritative listings
Distillates from coal tar (CAS 65996-92-1)	**Carcinogenicity** EU – GHS (H350) IARC (1)
Pitch, coal tar (CAS 65996-93-2)	**Carcinogenicity** EU – GHS (H350) IARC (1) **Developmental and reproductive toxicity** EU – GHS (H360FD)

[18] This substance was removed from subsequent versions of the bill due to federal preemption of state restrictions.

Coal tar-derived chemical or chemical mixture	Hazard endpoints of concern based on authoritative listings
	Persistent, Bioaccumulative and Toxic EU SVHC – Candidate List
Toluene (CAS 108-88-3)	**Developmental and reproductive toxicity** CA Prop 65 EU – GHS (H361d) **Neurotoxicity** ASTDR Neurotoxicants **Skin irritation** EU – GHS (H315)
Benzene (CAS 71-43-2)	**Carcinogenicity** EU – GHS (H350) CA Prop 65 **Developmental and reproductive toxicity** EU – GHS (H360FD) CA Prop 65 **Skin irritation** EU – GHS (H315) **Eye irritation** EU – GHS (H319) **Systemic toxicity** EU – GHS (H372)
Naphthalene (CAS 91-20-3)	**Carcinogenicity** EU – GHS (H351) IARC (1) **Acute and chronic aquatic toxicity** EU – GHS (H400, H410)
Phenol (CAS 108-95-2)	**Acute mammalian toxicity** EU – GHS (H331, H311, H301) **Skin irritation** EU – GHS (H314)
Cresol (CAS 106-44-5)	**Acute mammalian toxicity** EU – GHS (H311, H301) **Skin irritation** EU – GHS (H314)
Anthracene (CAS 120-12-7)	**Eye irritation** EU – GHS (H319) **Persistent, Bioaccumulative and Toxic** EU SVHC – Candidate List

Synthetic fragrances

SB 5703 included a ban on "undisclosed synthetic fragrances."[19] For this report, we used the 24 synthetic fragrances that the European Union requires manufacturers to explicitly label on cosmetics (European Commission, 2009, 2012). Elsewhere in the report, we refer to these ingredients collectively as "synthetic fragrances." We reported on the hazards of synthetic fragrances generally in Table 2 based on hazards we identified for these 24 fragrances (Table 7).

Table 7. Hazard endpoints of concern identified for specific synthetic fragrances.

Fragrance chemical	Hazard endpoints of concern based on authoritative listings
Eugenol (CAS 97-53-0)	**Skin sensitization** EU – GHS (H317) **Eye irritation** EU – GHS (H319)
Amyl cinnamal (CAS 122-40-7)	**Skin sensitization** EU – GHS (H317)
Amylcinnamyl alcohol (CAS 101-85-9)	**Skin irritation, sensitization** EU – GHS (H315, H317) **Eye irritation** EU – GHS (H319)
Benzyl alcohol (CAS 100-51-6)	**No high or very high endpoints listed**
Benzyl salicylate (CAS 118-58-1)	**Skin sensitization** EU – GHS (H317) **Eye irritation** EU – GHS (H319)
Cinnamyl alcohol (CAS 104-54-1)	**Skin sensitization** EU – GHS (H317)
Cinnamal (CAS 104-55-2)	**Skin irritation, sensitization** EU – GHS (H315, H317) **Eye irritation** EU – GHS (H319)
Citral (CAS 5392-40-5)	**Skin irritation, sensitization** EU – GHS (H315, H317)
Coumarin (CAS 91-64-5)	**Skin sensitization** EU – GHS (H317)
Geraniol (CAS 106-24-1)	**Skin sensitization** EU – GHS (H317)
Hydroxycitronellal (CAS 107-75-5)	**Skin sensitization** EU – GHS (H317) **Eye irritation** EU – GHS (H319)

[19] This restriction was removed from later versions of the legislation.

Fragrance chemical	Hazard endpoints of concern based on authoritative listings
Hydroxymethylpentyl-cyclohexenecarboxaldehyde (CAS 31906-04-4)	**Skin sensitization** EU – GHS (H317)
Isoeugenol (CAS 97-54-1)	**Skin sensitization** EU – GHS (H317)
Anisyl alcohol (CAS 105-13-5)	**Skin sensitization** EU – GHS (H317) **Eye irritation** EU – GHS (H318)
Benzyl benzoate (CAS 120-51-4)	**No high or very high endpoints listed**
Benzyl cinnamate (CAS 103-41-3)	**Skin sensitization** EU – GHS (H317)
Citronellol (CAS 106-22-9)	**Skin irritation, sensitization** EU – GHS (H315, H317) **Eye irritation** EU – GHS (H319)
Farnesol (CAS 4602-84-0)	**Skin irritation, sensitization** EU – GHS (H315, H317) **Eye irritation** EU – GHS (H319)
Hexyl cinnamaldehyde (CAS 101-86-0)	**Skin sensitization** EU – GHS (H317) **Acute aquatic toxicity** EU – GHS (H400)
Lilial (CAS 80-54-6)	**Developmental and reproductive toxicity** EU – GHS (H360Fd)
d-limonene (CAS 5989-27-5)	**Skin irritation, sensitization** EU – GHS (H315, H317) **Acute and chronic aquatic toxicity** EU – GHS (H400, H410)
Linalool (CAS 78-70-6)	**Skin sensitization** EU – GHS (H317)
Methyl heptane carbonate (CAS 111-12-6)	**Skin sensitization** EU – GHS (H317)
3-Methyl-4-(2,6,6-trimethyl-2-cyclohexen-1-yl)-3-buten-2-one (CAS 127-51-5)	**Skin irritation, sensitization** EU – GHS (H315, H317) **Eye irritation** EU – GHS (H319)

Appendix B.
Results from Toxic Chemicals in Cosmetics Study Phase One:
Formaldehyde, Lead, Cadmium, and Arsenic

This appendix provides a summary of the study methods, data quality assessment, and results for this study.

Data for this project are available in Ecology's Product Testing Database https://fortress.wa.gov/ecy/ptdbpublicreporting/, by searching:
Study: *Toxic Chemicals in Cosmetics Phase 1: Formaldehyde, Lead, Cadmium, and Arsenic.*

Methods

All methods for product collection, sample processing, and laboratory procedures for this study were followed as outlined in the *Quality Assurance Project Plan: Toxic Chemicals in Cosmetics* (Ecology, 2022a).

Product Collection

In July 2022, Department of Ecology (Ecology) staff purchased 50 unique low-cost cosmetic products from four Puget Sound-area retail chain stores, following selection guidelines in the study Quality Assurance Project Plan (QAPP), Appendix A (Ecology, 2022a).

- 33 products from three Walmart locations.
- 4 products from a Target.
- 2 products from a Fred Meyer.
- 11 products from a Dollar Tree.

Ecology purchased some products in multiples in order to meet the weight requirements for lab analysis. All cosmetic products purchased for this study are presented in Table 8.

Ecology did not make any online purchases for this study.

Table 8. Cosmetics products purchased for the study.

Store	Ecology ID	Product Name	Category	QTY
Target	TG-48-1	Herbal Essences Curl Defining Styling Cream	Hair Styling Gel	1
Target	TG-48-4	Old Spice Styling Putty with Beeswax	Hair Styling Gel	1
Walmart	WM-50-1	ORS Lock & Twist Styling Gel	Hair Styling Gel	1
Walmart	WM-50-2	Shine 'n Jam Extra Hold Conditioning Styling Gel	Hair Styling Gel	1
Walmart	WM-50-3	Ampro Pro Styl Protein Styling Gel	Hair Styling Gel	1
Walmart	WM-50-4	Next Of Us Styling Gel w/ Avocado Oil	Hair Styling Gel	1
Walmart	WM-50-5	Herbal Essences Totally Twisted Curl Scrunching Styling Gel	Hair Styling Gel	1
Walmart	WM-50-6	Pantene Flexible Waves & Curls Styling Gel	Hair Styling Gel	1
Walmart	WM-50-7	Aussie Head Strong Volume Styling Gel	Hair Styling Gel	1
Walmart	WM-51-7	Pantene Gold Series Curl Defining Pudding	Hair Styling Gel	1
Dollar Tree	DT-32-10	Salon Selectives Frizz Control Leave in Conditioner	Leave-in Conditioner	1
Dollar Tree	DT-32-11	Salon Selectives Curl Control Curl Stretch Cream	Leave-in Conditioner	1
Dollar Tree	DT-32-8	Perfect Purity for Kids Watermelon Spritz Spray Detangler	Leave-in Conditioner	1
Dollar Tree	DT-32-9	Salon Selectives Instant Repair Leave in Conditioner	Leave-in Conditioner	1
Fred Meyer	FM-43-1	ORS Replenishing Conditioner	Leave-in Conditioner	1
Fred Meyer	FM-43-2	Paul Mitchell Original Leave-In Conditioner	Leave-in Conditioner	1
Walmart	WM-51-2	Hawaiian Silky 14-in-1 Miracle Worker Leave-in Conditioner	Leave-in Conditioner	1
Walmart	WM-51-3	Infusium Original Leave-in Treatment Conditioner	Leave-in Conditioner	1
Walmart	WM-51-4	Luster's S Curl Activator Moisturizer Leave-in Conditioner	Leave-in Conditioner	1
Walmart	WM-52-1	Aussie Miracle Curls Creme Pudding	Leave-in Conditioner	1
Target	TG-48-2	Milani Color Fetish Lipstick (180 Seduce)	Lipsticks	1
Walmart	WM-50-15	CoverGirl Continuous Color Lipstick (Bronzed Glow)	Lipsticks	1
Walmart	WM-50-16	L.A. Colors Cream Lipstick (Angelic)	Lipsticks	1
Walmart	WM-50-17	NYX Suede Matte Lipstick (STFU)	Lipsticks	1
Walmart	WM-50-18	Revlon Super Lustrous Lipstick (Raisin Rage)	Lipsticks	1
Walmart	WM-50-19	Rimmel London Lasting Finish Lipstick (Red-Y?)	Lipsticks	1
Walmart	WM-50-20	L'Oreal Paris Colour Riche Lipstick (Matte-Traction Red)	Lipsticks	2
Walmart	WM-50-21	Black Radiance Perfect Tone Lipstick (Copper Glow)	Lipsticks	1
Walmart	WM-50-22	Maybelline Color Sensational Lipstick (Plum Rule)	Lipsticks	1
Walmart	WM-50-23	Wet n Wild Megalast High-Shine Lipstick (Raining Rubies)	Lipsticks	1
Target	TG-48-3	NYX Mattifying Powder (CSWSM10 Rich)	Powder Foundations	2
Walmart	WM-50-10	CoverGirl Outlast Extreme Wear Pressed Powder Foundation (Soft Sable)	Powder Foundations	1
Walmart	WM-50-11	CoverGirl Clean Fresh Pressed Powder Foundation (Dark Ebene)	Powder Foundations	1
Walmart	WM-50-12	L'Oreal Paris True Match Super Blendable Powder Foundation (Cappuccino)	Powder Foundations	1
Walmart	WM-50-13	Black Radiance Pressed Powder Foundation (Black Coffee)	Powder Foundations	1

Store	Ecology ID	Product Name	Category	QTY
Walmart	WM-50-14	Maybelline Fit Me Pressed Powder Foundation (Java)	Powder Foundations	1
Walmart	WM-50-8	L'Oreal Paris Age Perfect Creamy Powder Foundation (Chestnut)	Powder Foundations	1
Walmart	WM-50-9	CoverGirl Simply Ageless Pressed Powder Foundation (Soft Sable)	Powder Foundations	1
Walmart	WM-51-8	e.l.f. Powder Foundation (Rich 620 W)	Powder Foundations	1
Walmart	WM-51-9	Milani Cream to Powder Foundation (Mahogany)	Powder Foundations	1
Dollar Tree	DT-32-1	Nuvel Men's Body Lotion	Lotions	1
Dollar Tree	DT-32-2	PerCara Baby Lotion	Lotions	1
Dollar Tree	DT-32-3	SPA Luxury Rose and Vanilla Scented Body Lotion	Lotions	1
Dollar Tree	DT-32-4	XtraCare Diabetics' Hydrating Lotion	Lotions	1
Dollar Tree	DT-32-5	PerCara Aloe Vera Deep Moisturizing Daily Lotion	Lotions	1
Dollar Tree	DT-32-6	Pond's Perfect Colour Complex Cream	Lotions	1
Dollar Tree	DT-32-7	Spa Naturals Coconut Oil Moisturizing Cream	Lotions	1
Walmart	WM-51-1	Keri Original Daily Moisturizing Body Lotion	Lotions	1
Walmart	WM-51-5	Olay Firming Night Cream	Lotions	1
Walmart	WM-51-6	Olay Original Active Hydrating Beauty Fluid Lotion	Lotions	1

Sample Processing

All lipsticks and powder-based foundations (solid or semi-solid) were processed into sample jars the day before the courier transported the samples to Manchester Environmental Laboratory (MEL). Ecology avoided opening any of the hair care and skin lotion products and sent them to the lab in their original bottles to minimize sample exposure to the atmosphere.

After purchasing, the products were categorized as seal intact, seal unknown, or no seal. Lipsticks and powdered foundation products had packaging where the seals were clearly visible; these were characterized as “seal intact” or “no seal” samples. Most of the lotions, hair styling gels, and conditioners were characterized as “seal unknown” because they would need to be opened to verify if an internal seal were present. Ecology requested that MEL open these samples just prior to analysis preparation.

Information on the status of the seal was documented in the product notes as informational, and no qualifications were made based on a product’s seal at the time of purchase. However, Ecology’s project manager added qualifiers to the samples based on the condition of the product sample during storage. Qualifiers were added for products found to be leaking during storage.

MEL received all samples in good condition, as indicated in the Chain of Custody (COC).

Laboratory Procedures

MEL staff analyzed the product samples for formaldehyde and metals. They followed a developed method, based on EPA Method 8315A, for the extraction of total[20] formaldehyde in consumer products. The performance-based modifications to the preparation technique (EPA 8315A-PREP) includes a reduction in sample size and extraction chemicals, as well as the addition of surrogates to monitor extraction efficiency. Analysis for formaldehyde was performed using EPA Method 8270E-SIM.

MEL prepared the samples for the analysis of lead, cadmium, and arsenic using EPA method 3052, less the addition of hydrofluoric acid. MEL performed the analysis using EPA method 6020B.

Data Quality and usability

A team at MEL carried out data validation. Data were manually reviewed in accordance with the technical specifications and quality assurance/quality control (QA/QC) requirements of the laboratory method and the study's QAPP. MEL provided written case narratives to the project manager with a description of the quality of the data. The data were deemed useable for all purposes, as reported with qualifications. The following qualifiers were assigned to some data:

- "J" indicating that the associated result is an estimate.
- "U" indicating that the analyte was not detected at the quantitation limit.
- "UJ" signifying that the quantitation limit is an estimate.

All QC tests were performed as described in the QAPP. Measurement quality objectives (MQOs) were met, except as noted in the sections below.

Formaldehyde Data

MEL's data validation team conducted a Level 4 data validation on the complete set of formaldehyde data. With few exceptions, the results met acceptance criteria for all formaldehyde analyses.

All samples were extracted in two batches. All samples, batch QC samples, and instrument QC samples had surrogate standards added prior to extraction. The lab also added internal standards to the extracted samples prior to analysis.

Two of the samples were qualified due to complications during the extraction process:

- WM-51-9 (Mahogany, Cream to Powder Foundation) was insoluble in the extraction fluid and was qualified as not detected at the estimated lower limit of quantitation (UJ).
- DT-32-10 (Frizz Control Leave in Conditioner) dissolved in toluene obscuring the final extraction layer and was qualified as an estimate (J).

Both observations indicate an incomplete extraction with the potential for low bias.

[20] Total formaldehyde here is defined as the free formaldehyde available in the product plus the formaldehyde that may be released from any formaldehyde releaser present in the product during analysis.

A leave-in conditioner was identified as leaking inside the Ziploc bag during storage. After wiping off the bottle and transferring to a new Ziploc bag, extra care was taken to ensure that the bottle was kept upright during the entire process of storage and shipping in order to avoid further leaks. This sample was qualified as an estimate.

- WM-51-3 (Infusium Original Leave-in Treatment Conditioner) was found leaking in its storage bag and was qualified as an estimate (J).

For the two method blanks extracted and analyzed with each batch of data, no analytes were detected above the method reporting limits. Laboratory control sample (LCS) recoveries across both batches for formaldehyde ranged from 97 to 103%. The sample duplicate for one batch was found to be below the reporting limit, and no relative percent difference (RPD) could be calculated. The sample duplicate for the second batch had a RPD of 14% which was within the 40% control limit.

Surrogate recoveries across all samples were also found to be within the acceptable range of 50 to 150%. One pair of matrix spike and matrix spike duplicate sample was also extracted and analyzed with each batch. The percent recoveries and RPDs met the QAPP criteria for matrix spike samples, with exceptions noted below.

The amount of formaldehyde detected in TG-48-4 (Old Spice Styling Putty), chosen as the matrix spike sample for one of the batches, exceeded 10 times the amount spiked. Due to insufficient spiking levels, meaningful percent recoveries for the matrix spiked samples could not be calculated. Data were not qualified on this basis. The RPD for this set of matrix spike samples, calculated using the final formaldehyde concentrations, was at 15%, which is within the 40% control limit

Another set of matrix spike samples had recoveries of 83% and 79%, and the RPD was 7%.

Lead, Cadmium, and Arsenic Data

MEL conducted a Stage 3 validation on the complete set of metals data. Although a Stage 4 validation was requested in the QAPP, Stage 4 validations are not customarily performed for the components used in review for a metals data set.

No analytes were detected above the method reporting limits for the two method blanks extracted and analyzed with each batch of data. Bias was assessed by performance of LCS and matrix spike samples. The LCS recoveries across all analytes and batches ranged from 99 to 104%. Matrix spike recoveries ranged from 99 to a 106%. Precision was also within the control limits as demonstrated by the RPD values for the set of matrix spike samples ranging from 1 to 5% and for LCS ranging from 0.08 to 2%. The results met acceptance criteria for all analysis, and no data qualifiers were added.

The reporting limits were raised for the following two samples across all analytes because a smaller sample volume had to be used to complete the digestion without overheating:

- The reporting limit for WM-50-20 (Matte Traction Red, Colour Riche Lipstick) was raised to 4.63 ppm. Lead and cadmium were not detected above this concentration.

- The reporting limit for WM-51-9 (Mahogany, Cream to Powder Foundation) was raised to 2.43 ppm. Lead and cadmium were not detected above this concentration.

There are no limitations on the use of the data as reported.

Results

Formaldehyde

A total of 40 product samples were tested for formaldehyde. All hair care products and lotions had the formaldehyde releaser "DMDM Hydantoin" listed as an ingredient. For all products, including those with formaldehyde releasers listed in the ingredients, "total formaldehyde" represents the total amount of formaldehyde recovered at the time of testing. Results reported here are concentrations in units of parts per million (ppm).

Sixty-five percent of the samples (26 of the 40) tested had detectable levels of formaldehyde. All 26 products with detectable levels of formaldehyde had a formaldehyde releaser DMDM Hydantoin listed as an ingredient.

Table 9 shows the levels of formaldehyde detected for all hair styling products. All 10 hair styling gels or creams had detectable levels of formaldehyde, ranging from 254 to 1660 ppm. Shine 'n Jam Extra Hold Conditioning Styling Gel (WM-50-2), purchased at Walmart, had the highest level of formaldehyde, at 1660 ppm.

Table 9. Formaldehyde results for hair styling gels and creams.

Ecology ID	Product Name	Concentration (ppm)
WM-50-2	Shine 'n Jam Extra Hold Conditioning Styling Gel	1660
WM-50-1	ORS Lock & Twist Styling Gel	716
WM-50-3	Ampro Pro Styl Protein Styling Gel	593
WM-51-7	Pantene Gold Series Curl Defining Pudding	529
TG-48-1	Herbal Essences Curl Defining Styling Cream	524
WM-50-7	Aussie Head Strong Volume Styling Gel	500
TG-48-4	Old Spice Styling Putty with Beeswax	496
WM-50-4	Next Of Us Styling Gel w/ Avocado Oil	426
WM-50-5	Herbal Essences Totally Twisted Curl Scrunching Styling Gel	412
WM-50-6	Pantene Flexible Waves & Curls Styling Gel	254

Table 10 shows the levels of formaldehyde detected for all the leave-in conditioner products tested. Ninety percent of the leave-in hair conditioner products (9 out of 10) had detectable levels of formaldehyde, ranging from 39.2 (J) to 654 ppm. The lowest level detected was in DT-32-10 (Salon Selectives Frizz Control Leave in Conditioner) purchased at Dollar Tree. This sample was qualified as an estimate (J) that is biased low because the sample dissolved in toluene, obscuring the final extraction layer. A leave-in conditioner purchased as Walmart, WM-51-3 (Infusium Original Leave-in Treatment Conditioner), was found to be leaking during storage. The result for this product sample was also qualified as an estimate (J).

Table 10. Formaldehyde results for leave-in hair conditioners.

Ecology ID	Product Name	Concentration (ppm)
WM-51-4	Luster's S Curl Activator Moisturizer Leave-in Conditioner	654
WM-52-1	Aussie Miracle Curls Creme Pudding	488
DT-32-9	Salon Selectives Instant Repair Leave in Conditioner	411
WM-51-3	Infusium Original Leave-in Treatment Conditioner	342 J
DT-32-11	Salon Selectives Curl Control Curl Stretch Cream	332
FM-43-1	ORS Replenishing Conditioner	322
FM-43-2	Paul Mitchell Original Leave-In Conditioner	265
DT-32-8	Perfect Purity for Kids Watermelon Spritz Spray Detangler	214
DT-32-10	Salon Selectives Frizz Control Leave in Conditioner	39.2 J
WM-51-2	Hawaiian Silky 14-in-1 Miracle Worker Leave-in Conditioner	8.71 U

U indicates that the analyte was not detected above the quantitation limit.

J indicates that the amount of analyte detected is an estimate.

Luster's S Curl Activator Moisturizer Leave-in Conditioner (WM-51-4), purchased at a Walmart, had the highest level of formaldehyde, at 654 ppm. Formaldehyde was also detected at 214 ppm in a children's leave-in conditioner product, Watermelon Spritz Spray Detangler (DT-32-8), purchased at a Dollar Tree. Hawaiian Silky 14-in-1 Miracle Worker Leave-in Conditioner (WM-51-2), purchased at Walmart, did not have detected levels of formaldehyde, even with DMDM Hydantoin listed as an ingredient.

Table 11 shows the formaldehyde levels detected for all body lotions and creams tested. Seventy percent of the body lotion products (7 out of 10) had detectable levels of formaldehyde, ranging from 202 to 603 ppm.

Table 11. Formaldehyde results for lotions and creams.

Ecology ID	Product Name	Concentration (ppm)
DT-32-7	Spa Naturals Coconut Oil Moisturizing Cream	603
DT-32-4	XtraCare Diabetics' Hydrating Lotion	535
DT-32-5	PerCara Aloe Vera Deep Moisturizing Daily Lotion	343
WM-51-1	Keri Original Daily Moisturizing Body Lotion	271
WM-51-5	Olay Firming Night Cream	230
WM-51-6	Olay Original Active Hydrating Beauty Fluid Lotion	210
DT-32-3	SPA Luxury Rose and Vanilla Scented Body Lotion	202
DT-32-2	PerCara Baby Lotion	9.34 U
DT-32-6	Pond's Perfect Colour Complex Cream	8.26 U
DT-32-1	Nuvel Men's Body Lotion	8.01 U

U indicates that the analyte was not detected above the quantitation limit.

DT-32-7 (Spa Naturals Coconut Oil Moisturizing Cream), purchased at the Dollar Tree, had the highest levels of formaldehyde detected, at 603 ppm.

Three skin lotion products did not have detectable levels of formaldehyde, even with DMDM Hydantoin as a listed ingredient. These three products were all purchased at Dollar Tree: DT-32-2 (PerCara Baby Lotion), DT-32-6 (Pond's Perfect Colour Complex Cream), and DT-32-1 (Nuvel Men's Body Lotion).

Table 12 shows the results of formaldehyde for all 10 powdered foundation products tested. None had detectable levels of formaldehyde.

Table 12. Formaldehyde results for powdered foundations.

Ecology ID	Product Name	Concentration (ppm)
TG-48-3	NYX Mattifying Powder (CSWSM10 Rich)	9.59 U
WM-50-11	CoverGirl Clean Fresh Pressed Powder Foundation (Dark Ebene)	9.59 U
WM-51-8	e.l.f. Powder Foundation (Rich 620 W)	9.55 U
WM-50-10	CoverGirl Outlast Extreme Wear Pressed Powder Foundation (Soft Sable)	9.08 U
WM-50-13	Black Radiance Pressed Powder Foundation (Black Coffee)	8.84 U
WM-50-8	L'Oreal Paris Age Perfect Creamy Powder Foundation (Chestnut)	8.84 U
WM-50-9	CoverGirl Simply Ageless Pressed Powder Foundation (Soft Sable)	8.47 U
WM-51-9	Milani Cream to Powder Foundation (Mahogany)	8.36 UJ
WM-50-12	L'Oreal Paris True Match Super Blendable Powder Foundation (Cappuccino)	8.30 U
WM-50-14	Maybelline Fit Me Pressed Powder Foundation (Java)	8.27 U

U indicates that the analyte was not detected above the quantitation limit.

UJ indicates that the analyte was not detected above the quantitation limit and the quantitation limit is an estimate.

Lead, Cadmium, and Arsenic

Twenty products, 10 lipsticks and 10 powder based foundations, were tested for lead, cadmium, and arsenic as contaminants in cosmetic products. Results reported here are concentrations in units of parts per million (ppm).

Table 13 provides metals analysis results for lead, cadmium, and arsenic detected in all the lipstick products tested. One lipstick purchased from Walmart, WM-50-15 (Bronzed Glow, CoverGirl Continuous Color Lipstick), had a detectable level of lead at 1.08 ppm. Cadmium and arsenic were not detected above the reporting limit in any of the lipstick products.

Table 13. Results for lead, cadmium, and arsenic in lipstick products.

Ecology ID	Product Name	Lead (ppm)	Cadmium (ppm)	Arsenic (ppm)
TG-48-2	Milani Color Fetish Lipstick (180 Seduce)	1 U	1 U	0.906 U
WM-50-15	CoverGirl Continuous Color Lipstick (Bronzed Glow)	1.08	1 U	0.862 U
WM-50-16	L.A. Colors Cream Lipstick (Angelic)	1 U	1 U	0.996 U
WM-50-17	NYX Suede Matte Lipstick (STFU)	1 U	1 U	0.958 U
WM-50-18	Revlon Super Lustrous Lipstick (Raisin Rage)	1 U	1 U	0.926 U
WM-50-19	Rimmel London Lasting Finish Lipstick (Red-Y?)	1 U	1 U	0.926 U
WM-50-20	L'Oreal Paris Colour Riche Lipstick (Matte-Traction Red)	4.63 U	4.63 U	4.63 U
WM-50-21	Black Radiance Perfect Tone Lipstick (Copper Glow)	1 U	1 U	0.988 U
WM-50-22	Maybelline Color Sensational Lipstick (Plum Rule)	1 U	1 U	0.912 U
WM-50-23	Wet n Wild Megalast High-Shine Lipstick (Raining Rubies)	1 U	1 U	0.988 U

U indicates that the analyte was not detected above the quantitation limit.

Table 14 provides metals analysis results for lead, cadmium, and arsenic in all the powdered foundation products tested. One product purchased from Walmart, WM-50-11 (Dark Ebene, CoverGirl Clean Fresh Pressed Powder Foundation), had both lead and arsenic concentrations above the target reporting limit, at 5.55 ppm and 2.15 ppm, respectively. One other foundation purchased from Walmart, WM-50-13 (Black coffee, Black Radiance Pressed Powder Foundation), had lead above the target reporting limit, at 1.52 ppm.

Table 14. Results for lead, cadmium, and arsenic concentration in foundation powders.

Ecology ID	Product Name	Lead (ppm)	Cadmium (ppm)	Arsenic (ppm)
TG-48-3	NYX Mattifying Powder (CSWSM10 Rich)	1 U	1 U	0.996 U
WM-50-10	CoverGirl Outlast Extreme Wear Pressed Powder Foundation (Soft Sable)	1 U	1 U	1 U
WM-50-11	CoverGirl Clean Fresh Pressed Powder Foundation (Dark Ebene)	5.55	1 U	2.15
WM-50-12	L'Oreal Paris True Match Super Blendable Powder Foundation (Cappuccino)	1 U	1 U	0.951 U
WM-50-13	Black Radiance Pressed Powder Foundation (Black Coffee)	1.52	1 U	0.936 U
WM-50-14	Maybelline Fit Me Pressed Powder Foundation (Java)	1 U	1 U	0.996 U
WM-50-8	L'Oreal Paris Age Perfect Creamy Powder Foundation (Chestnut)	1 U	1 U	1 U
WM-50-9	CoverGirl Simply Ageless Pressed Powder Foundation (Soft Sable)	1 U	1 U	0.973 U
WM-51-8	e.l.f. Powder Foundation (Rich 620 W)	1 U	1 U	0.984 U
WM-51-9	Milani Cream to Powder Foundation (Mahogany)	2.43 U	2.43 U	2.43 U

U indicates that the analyte was not detected above the quantitation limit.

Conclusions

Based on the results discussed above, the following conclusions from this study can be reached:

- Formaldehyde was found in 87% (26 of 30) of the products tested that had the formaldehyde releaser, DMDM Hydantoin, listed as an ingredient.
- Hair care products, such as styling gels and leave-in conditioners, had high detection rates for formaldehyde, with 95% (19 of 20) of products showing some level of formaldehyde. The highest level was detected in a styling gel product, at 1660 ppm.
- One leave-in conditioner spray detangler product marketed for children's use contained formaldehyde, at 214 ppm.
- Formaldehyde was not detected in 30% (3 of 10) of the lotion products, even with the formaldehyde releaser, DMDM Hydantoin, listed as an ingredient.
- Formaldehyde was not detected in the limited number of powder-based foundation products tested in this study.
- Both lead and arsenic were detected in one powder-based foundation product, at 5.55 ppm and 2.15 ppm, respectively.
- Lead was detected in one additional powder-based foundation, at 1.52 ppm, and in a lipstick product, at 1.08 ppm.
- Cadmium was not detected in any of the cosmetic products tested.

Appendix C. Summary of Other Product Testing Studies

In Table 15, we summarized the results from peer-reviewed scientific literature or results from product testing studies conducted by government agencies. We grouped together similar cosmetic products that are applied to related parts of the body for comparable uses. We included studies where the chemical of interest was detected in any amount and did not determine whether the chemical was likely intentionally added or a contaminant.

Table 15. Substances found in cosmetics in previous product testing studies.

Substance	Cosmetic products	Reference
Ortho-phthalates	Body art, conditioner, deodorant, hair products, lip products, lotion, nail products, perfume, shampoo, shaving products, skin products, sun protection, washes/cleanser; includes children's products	DTSC, 2012; Dodson et al., 2012; ECY Pub 1404017; ECY Pub 1604029; Guo & Kannan, 2013; Guo, Wang & Kannan, 2013; Helm et al., 2018; Hubinger, 2010; Koo & Lee, 2004; Sardar et al., 2019
Per- and polyfluoroalkyl substances	Eye products, lip products, lotion, nail products, shaving products, skin products, sun protection	Danish EPA, 2018; Fujii et al., 2013; Schultes et al., 2018; Whitehead et al., 2021
Alkylphenols and alkylphenol ethoxylates	Dental hygiene, eye products, hair products, lip products, lotion, nail products, shaving products, skin products, washes/cleanser, includes feminine care	Dodson et al., 2012; Helm et al., 2018; Liao & Kannan, 2014
Bisphenols	Conditioner, dental hygiene, eye products, hair products, lip products, lotion, skin products, washes/cleansers, includes feminine care	Dodson et al., 2012; Helm et al., 2018; Liao & Kannan, 2014
Parabens	Conditioner, dental hygiene, deodorant, eye products, hair products, lip products, lotion, menstrual pads, nail products, shampoo, shaving products, skin products, sun protection, tampons, washes/cleansers, wipes, includes children's products and feminine care	Alvarez-Rivera et al., 2014; Danish EPA, 2013; der Schyff et al., 2022; Dodson et al., 2012; ECY Pub 1604029; Gao & Kannan, 2020; Guo & Kannan, 2013; Guo, Wang & Kannan, 2013; Helm et al., 2018; Wang & Zhou, 2013

Substance	Cosmetic products	Reference
Formaldehyde and formaldehyde releasing chemicals	Hair products, lotion, nail products, tattoo ink, washes/cleansers, wipes, includes children's products	DTSC, 2012; Jairoun et al., 2020; Liou et al., 2019; Liou et al., 2021; Maneli et al., 2014; Nikle et al., 2019; Voller et al., 2019
Arsenic and arsenic compounds	Eye products, kohl eyeliner, skin lightening creams, skin products	Alqadami et al., 2017; FDA, 2013; Hepp et al., 2014; Navarro-Tapia et al., 2021
Cadmium and cadmium compounds	Eye products, kohl eyeliner, lip products, lotion, skin lightening creams, skin products, includes children's products	Ababneh & Al-Momani, 2018; Alqadami et al., 2017; Hepp et al., 2014; Liu, Hammond & Rojas-Cheatham, 2013; Navarro-Tapia et al., 2021; Pawlaczyk et al., 2021
Lead or lead compounds	Eye products, henna products, kohl/surma eyeliner, lip products, lotion, skin lightening creams, skin products, sindoor	Ababneh & Al-Momani, 2018; Alqadami et al., 2017; Hepp et al., 2014; Liu, Hammond & Rojas-Cheatham, 2013; McMichael & Stoff, 2017; Navarro-Tapia et al., 2021; Pawlaczyk et al., 2021; Shah et al., 2017; Sukuroglu, Battal & Burgaz, 2017
Mercury and mercury compounds	Lip products, lotion, skin lightening creams, skin products	Ababneh & Al-Momani, 2018; Alqadami et al., 2017; MN DOH, 2021; Peregrino et al., 2011
Styrene	Scented menstrual pads	Lin et al., 2020
1,4-dioxane	Bath products, hair products, lotion, washes/cleanser, wipes, includes children's products and feminine hygiene	Alsohaimi et al., 2020; Lin et al., 2020; Tahara, Obama & Ikarashi, 2013; Zhou, 2019
Cyclosiloxanes	Conditioner, dental hygiene, deodorant, hair products, lotion, perfume, shaving products, shampoo, skin products, sun protection, washes/cleansers, includes children's products	Capela et al., 2016b; Dodson et al., 2012; Dudzina et al., 2016; Helm et al., 2018; Wang et al., 2009

Substance	Cosmetic products	Reference
Toluene	Nail products, scented menstrual pads	DTSC, 2012; Gonzalvez et al., 2010; Lin et al., 2020; Zhou et al., 2016
Asbestos	Talcum powder, skin products, includes children's products	FDA, 2019; Fitzgerald et al., 2019; Gordon, Fitzgerald & Millette, 2014
Hydroquinone	Skin lightening products	MN DOH, 2021; Wang et al., 2015
Sodium laureth sulfate	Washes/cleansers	Ziółkowska et al., 2021
Triclosan	Conditioners, deodorant, hair products, lip products, lotions, nail products, skin products, washes/cleanser, includes feminine care	Alvarez-Rivera et al., 2014; Dodson et al., 2012; Helm et al., 2018; Liao & Kannan, 2014
Methylisothiazolinone	Condition, lotion, shampoo, washes/cleansers	Wittenberg et al., 2015
Methylchloroisothiazolinone	Condition, lotion, shampoo, washes/cleansers	Wittenberg et al., 2015
p-phenylenediamine and its salts	Henna temporary tattoos	Almeida et al.; Sukuroglu, Battal & Burgaz; Wang & Krynitsky, 2011
Benzene, naphthalene from coal tar- and petroleum-derived ingredients	Lotion, skin products, washes/cleanser, includes feminine care	Lin et al., 2020; Vállez-Gomis et al., 2020
Synthetic fragrances	Hair products, feminine washes and wipes	Helm et al., 2018; Lin et al., 2020