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Gender, self-care and toxic exposures: a narrative review of personal care product use and health equity implications

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ABSTRACT

Background Personal care products (PCPs) are widely used across populations, yet their composition includes a range of hazardous chemicals that pose risks to human health and the environment. Emerging evidence highlights how PCP-related exposures are not evenly distributed, but shaped by intersecting forces of gender, race and social inequality. Despite being framed as tools for empowerment and wellness, PCPs may contribute to disproportionate toxic exposures, particularly for women and girls.

Objective This narrative review critically examines the environmental health implications of gendered self-care practices through the lens of PCP use. It synthesises current evidence on chemical exposures, identifies high-risk subgroups, explores mechanisms of harm and outlines implications for regulation, clinical practice and environmental health literacy.

Methods Drawing on interdisciplinary peer-reviewed literature published between 2000 and 2025, the review focuses on endocrine-disrupting chemicals, perfluoroalkyl and polyfluoroalkyl substances, volatile organic compounds, heavy metals and microparticles and nanoparticles commonly found in PCPs. Particular attention is given to vulnerable populations, including beauty salon workers, pregnant individuals, adolescents, women of colour and infants.

Findings PCP use results in chronic low-level exposure to multiple hazardous compounds via dermal, inhalation and mucosal routes. These exposures have been linked to adverse reproductive, developmental and metabolic outcomes, increasing the risks of non-communicable diseases like cancer and obesity and possibly affecting infertility rates. Early evidence shows that interventions such as product substitution can yield rapid reductions in internal toxicant levels. However, individual behaviour change alone is insufficient to address systemic disparities in exposure risk.

Conclusions Self-care must be reframed as a public health and environmental justice issue. Stronger regulatory oversight, clinician education and population-level environmental health literacy are urgently needed to reduce harmful exposures. Equitable self-care should prioritise not only personal choice, but also structural accountability and collective safety.

INTRODUCTION

Self-care is increasingly recognised as a critical determinant of health, encompassing the everyday actions individuals take to maintain physical, mental and social well-being. This perspective is echoed by the WHO, which defines self-care as 'the ability of individuals, families and communities to promote health, prevent disease, maintain health and cope with illness and disability with or without the support of a healthcare provider'.[1] The Seven Pillars of Self-Care Framework,[2] the Self-Care Matrix[3] and the WHO's Guideline on Self-Care Interventions[4] highlight self-care as both a public health strategy and a human rights issue, requiring supportive systems, health literacy and policy frameworks to ensure equity, safety and accountability. Despite its promise, some modern self-care practices may inadvertently expose individuals to environmental health risks, particularly through the use of personal care products (PCPs).

PCPs are a routine feature of modern life and are widely marketed as essential tools for beauty, hygiene and wellness. A simple and pragmatic classification system of PCPs is proposed in table 1. However, mounting evidence links the use of many PCPs with exposure to a range of toxic chemicals, including endocrine-disrupting chemicals (EDCs), volatile organic compounds (VOCs), perfluoroalkyl and polyfluoroalkyl substances (PFAS) and heavy metals.[5–9] These substances are associated with adverse health outcomes such as hormone dysregulation, reproductive toxicity, cancer risk and neurodevelopmental impacts.[10] Exposure occurs primarily through dermal absorption and inhalation and may be exacerbated by frequent use, layering of multiple products and application to sensitive areas of the body.[11 12]

Critically, the burden of exposure is not equally shared. Women, particularly women

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Table 1 Categories of personal care products

Category	Primary function	Examples
Skin care	Hydration, cleansing, anti-ageing	Moisturisers, cleansers, serums, toners
Hair care	Cleaning, conditioning, styling	Shampoos, conditioners, hair masks, styling gels
Oral care	Clean teeth, freshen breath, protect gums	Toothpaste, mouthwash, dental floss, whitening strips
Body care	Cleanliness, hydration, fragrance	Body wash, soap, body lotion, scrubs
Sun care	UV protection	Sunscreen (SPF), after-sun lotions
Deodorants and antiperspirants	Control odour and sweat	Roll-ons, sprays, sticks
Makeup and tattoos (cosmetics)	Enhance or alter appearance	Foundation, lipstick, mascara, blush, tattoo inks
Menstrual hygiene	Absorb menstrual flow, maintain hygiene	Pads, tampons, menstrual cups, panty liners
Shaving and hair removal	Remove or reduce hair	Razors, shaving cream, wax strips, epilators
Fragrances	Provide scent	Perfumes, colognes, body sprays
Nail care	Aesthetic and protective nail treatment	Nail polish, polish remover, cuticle oil
Eye care	Hygiene and aesthetics around eyes	Eye drops, eyelid wipes,
Baby care	Gentle cleansing, rash prevention	Baby shampoo, nappy cream, baby wipes
Intimate hygiene	Gentle cleansing of genital area	Intimate wash, wipes, gels
Foot care	Moisturising, deodorising, exfoliating	Foot creams, powders, scrubs, antifungal sprays
Sexual care	Pleasure, intimacy, contraception, vaginal comfort, sexually transmitted disease protection	Lubricants, condoms, sex toys

SPF, sun protection factor; UV, ultraviolet radiation.

of colour, experience disproportionately higher exposure to hazardous ingredients in PCPs due to socialised self-care behaviours, targeted marketing practices and systemic gaps in product regulation.[13] On average, women use significantly more PCPs than men, often in response to normative expectations around appearance, cleanliness and femininity.[14] These practices are further shaped by race, class, life stage and cultural norms, contributing to patterns of exposure that are both gendered and racialised.

Despite growing awareness, regulatory frameworks for PCPs remain limited.[15 16] Their classification as consumer goods rather than health products subjects them to weaker safety testing and labelling standards. In parallel, consumers are expected to make informed choices without access to clear or consistent information. Health and care professionals, who could act as critical mediators of risk awareness and prevention, often receive no training in environmental health. The European Union (EU)-funded project FREIA (Female Reproductive toxicity of EDCs: a human evidence-based screening and Identification Approach) has highlighted the need for environmental health training of health professionals as a key strategy to protect women's reproductive health from endocrine-disrupting exposures.[17] Yet, this guidance has not been widely implemented in clinical practice or medical education.

These intersecting patterns of chemical exposure, gendered self-care norms and regulatory gaps raise critical questions about environmental health equity, particularly given that women are already recognised as more vulnerable to toxic exposures due to a combination of biological susceptibility, social conditioning and occupational roles.[18] This review explores one under-recognised contributor to these disparities: the use of PCPs as part of gendered self-care routines. Drawing on research from environmental health, public health, gender studies and toxicology, we examine how PCPs act as vectors of exposure and how these risks vary across life stages and population groups. We apply a feminist environmental health lens to interrogate the biological harms of PCP-related chemicals with consideration of the social, cultural and structural forces that sustain them. A key aim of this review is to support more equitable approaches to public health, risk reduction and health professional education.

CONCEPTUAL FRAMEWORK

This review is informed by a feminist environmental health perspective, which situates chemical exposure within broader systems of inequality.[18 19] Rather than

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viewing self-care as a series of individual choices, we approach it as a socially constructed practice shaped by gender norms, commercial pressures and structural conditions.[20] It assumes the congruent assumption that from a young age, women are socialised into beauty and hygiene routines that reinforce ideals of purity, appearance and self-discipline.[21] This phenomenological standpoint assumes that these behaviours are not value-neutral, but they rather function within systems that externalise environmental risks onto individual bodies, particularly the bodies of women, children and racialised communities.[7 11 19]

To further ground this analysis, we also draw on the One Health and Planetary Health frameworks, which emphasise the interconnectedness of human health with broader ecological systems.[22] There is a growing recognition that many of the same chemicals that harm human endocrine, reproductive or neurodevelopmental health are also emerging environmental pollutants, contributing to long-term ecosystem degradation, biodiversity loss and increased pandemic risks.[23 24] Thus, the self-care behaviours that increase toxic exposures at the individual level simultaneously contribute to collective environmental harms.

Understanding self-care through this multidimensional lens challenges the assumption that all self-care behaviours are universally safe or beneficial. It highlights the need to reframe self-care as a matter of personal responsibility and simultaneously as a public health and environmental justice issue. This perspective supports a shift from individual blame to systemic accountability and lays the foundation for policies, education and interventions that promote safer and more equitable self-care practices.

METHODS

We conducted a narrative literature review to synthesise research on PCP use, chemical exposures and related health outcomes, with a gender and equity lens. Given the interdisciplinary scope, we searched across biomedical, environmental health, public health and social science domains, including feminist science and technology studies (STS) and high-quality grey literature from NGOs and global health agencies.

We prioritised literature from 2000 onward, using search terms combining concepts such as “personal care products”, “cosmetics”, “chemical exposure”, “endocrine disruptors”, “PFAS”, “phthalates”, “feminist”, “health equity”, “environmental justice” and population-specific terms (eg, “adolescents”, “occupational exposure” and “women of colour”). Searches were conducted in PubMed, Scopus, Web of Science and Google Scholar and extended to major organisations (eg, the WHO, United Nations Environment Programme (UNEP), Environmental Working Group (EWG). Reference lists of included articles were also reviewed.

AI tools (ConsensusAI, Elicit) were used to enhance literature retrieval through natural language queries, particularly when keyword-based searches were limited. ChatGPT 4.0 supported the drafting process to improve readability and structure. All factual content was validated against peer-reviewed sources to prevent scepticism around AI-generated literature. AI use adhered to ethical guidance from the updated World Association of Medical Editors recommendation on chatbots and generative AI in relation to scholarly publications and the International Committee of Medical Journal Editors recommendations for the conduct, reporting, editing and publication of scholarly work in medical journals[25] (see online supplemental material, section S8).

We included peer-reviewed quantitative and qualitative studies, as well as theoretical and policy-focused literature, with particular attention to equity-oriented perspectives and global representation. No formal quality appraisal was performed due to the narrative nature of the review. Instead, we prioritised evidence from reputable open-access journals and influential reports. Scientific reasoning guided the synthesis, aiming to highlight patterns, equity gaps and actionable strategies. The review follows the Scale for the Assessment of Narrative Review Articles (SANRA) criteria to ensure transparency and rigour.[26] Further methodological details are provided as online supplemental material (sections S1-S6, S10, figure S1) and a summary of included evidence by domain and population focus is presented in the online supplemental material (section S7, table S1).

CHEMICALS OF CONCERN AND TOXICITY MECHANISMS

Among the wide array of substances used in PCPs, five chemical classes stand out as particularly concerning due to their well-documented links to both human health risks and environmental harm as itemised below:

1. EDCs such as phthalates, parabens, triclosan and phenols, commonly used as preservatives or fragrance components. These chemicals are biologically active at low doses, with evidence showing associations between EDC exposure and earlier onset of puberty, reduced fertility, adverse pregnancy outcomes and increased risk of hormone-related cancers.[17 27–31]
2. PFASs are commonly used in waterproof cosmetics, menstruation products and some creams. PFASs have been linked to immune system suppression, thyroid dysfunction and cancer risk.[9]
3. VOCs are released from fragranced sprays, aerosol deodorants and hair dyes.[32] VOCs are readily inhaled and have been associated with respiratory irritation, headaches and, in some cases, long-term neurotoxicity or carcinogenicity.[33 34] Inadequate ventilation and the use of multiple products can lead to elevated indoor air concentrations, especially in enclosed or frequently used spaces. In addition to affecting the direct consumer of the PCP, VOCs can also affect nearby individuals, especially when applied in enclosed spaces

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including beauty salons[33] or daycare centres.[35] Pertinently, many VOCs react with other molecules in the ambient environment, leading to the formation of various by-products that may exacerbate the detrimental effects of VOCs.[36]

4. Heavy metals such as lead, cadmium, chromium and nickel are frequently detected in PCPs. Prolonged exposure to these metals through daily use of cosmetics and personal care items can pose significant health risks, including cancer, neurological damage, skin disorders and other chronic conditions.[37 38] Multiple studies confirmed the presence of mercury in dangerously high concentrations in almost all skin-lightening products (SLPs) tested. Mercury in particular is hazardous as it could cause kidney and liver damage, neurological problems and childhood developmental issues, posing significant health risks to users and their offspring. The 'Eliminating Mercury Skin Lightening Products (SLPs)' project was developed by UNEP and WHO as a response to the global rise of this problem.[39]
5. Engineered microparticles and nanoparticles such as microplastics, silver nanoparticles and titanium dioxide are increasingly incorporated into PCPs for their antimicrobial, exfoliating or UV-protective properties. However, their small size allows them to penetrate the skin or mucosal membranes, raising concerns about cellular toxicity, oxidative stress and environmental bioaccumulation.[5 40]

The health risks of deleterious compounds and contaminants in PCPs are cumulative and dose dependent and influenced by their inherent toxicity and how they enter the body and accumulate over time. Dermal absorption is the main route, especially for leave-on products like moisturisers and deodorants, while sensitive areas such as the face, underarms and genitals have higher permeability. Inhalation of sprays and fragranced items coupled to mucosal absorption from menstrual or intimate hygiene products contributes to the exposure profile. Yet, risk assessments often overlook the reality that individuals use many products daily, which could lead to synergistic adverse effects and bioaccumulation. Recent studies highlight how a single personal hygiene routine may involve the use of dozens of chemicals, raising concerns about mixture toxicity, especially for EDCs with shared hormonal targets.[41–43]

Importantly, many of the chemicals found in PCPs are not effectively removed by wastewater treatment plants, leading to their dissolution in rivers, lakes and eventually the sea, where they act as environmental contaminants.[24] Once in aquatic ecosystems, these substances can disrupt the reproductive systems of marine organisms, contribute to biodiversity loss and degrade water quality. Some compounds like mercury bioaccumulate in the food chain, posing long-term risks to both ecosystem and human health. As highlighted in the literature on pharmaceuticals and PCPs as emerging contaminants, the contemporary and widespread use of PCPs is a pressing human health issue and an emerging environmental problem of significant concern.[23 24]

PATTERNS OF USE AND HIGH-RISK GROUPS

Numerous studies have shown that women use significantly more PCPs than men, both in terms of product diversity and frequency of application. Estimates suggest that women apply between 12 and 20 distinct products daily, compared with an average of 6–8 for men.[6 44] According to a survey by EWG, the average woman uses PCPs containing 168 unique ingredients every day.[14] This huge discrepancy in the number of potentially harmful compounds used reflects individual preference and the pervasive influence of societal norms and gendered expectations surrounding cleanliness, attractiveness and grooming. In many cultures, personal appearance is inextricably linked to perceptions of social value, employability and self-worth, such that pressures are disproportionately imposed on women and girls from an early age.[45 46] Paradoxically, marketing practices reinforce these norms by promoting increasingly specialised and aesthetic-focused products to female consumers, often under the guise of empowerment and self-care.[20]

Women of colour

Women of colour face disproportionate exposure to harmful chemicals in PCPs due to a combination of cultural beauty norms, targeted marketing and limited access to safer alternatives. Studies have shown that products commonly used by black and Latina women, such as skin lighteners, hair relaxers and fragrances, are more likely to contain hazardous substances including mercury, formaldehyde and high levels of VOCs.[7 11 13 19 47] These exposures are not incidental but reflect a broader system of environmental injustice rooted in colourism, a legacy of colonialism, that continues to shape racialised beauty standards and deregulated consumer markets.[13]

Socioeconomically vulnerable women

Socioeconomic status plays a key role in shaping PCP use and exposure.[48 49] This is primarily because consumers with lower incomes may have limited access to safer alternatives, which are often more expensive or poorly available in mainstream retail outlets. Limited health literacy in marginalised communities may further inhibit consumers from making informed decisions. In some cases, the 'natural' or 'organic' labels that consumers rely on are largely unregulated, often misleading and offer little protection against exposure to hazardous substances.[50] Lacking the needed environmental health literacy, even women who are health conscious and try to reduce these exposures (eg, by using less make-up products or buying what is marketed as 'non-toxic') do not have the appropriate evidence-based guidance and easily fall prey to greenwashing practices or pseudoscientific products and services.[50]

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Pregnant women and women facing infertility issues

The perinatal period represents a critical window of susceptibility to chemical exposures.[51 52] Pregnant women may continue or even increase their use of PCPs under the assumption that maintaining hygiene and appearance is beneficial to maternal and foetal health.[53] However, studies have consistently linked the use of PCPs during pregnancy to increased exposure to EDCs resulting in adverse outcomes including impaired foetal neurodevelopment, preterm birth and altered reproductive organ development.[28 54 55] EDCs have also been shown to reduce the success rates of assisted reproductive technologies, including in vitro fertilisation.[56 57] Despite the concerning findings of earlier studies, awareness of these risks remains low even among fertility specialists[58 59] and individuals undergoing infertility treatment, who are seldom informed about the potential impact of EDC exposure on their reproductive outcomes.[60]

Infants and young children

Infants and young children represent another high-risk population, both due to physiological immaturity and societal assumptions of product safety. Infants have higher surface area-to-body weight ratios, underdeveloped metabolic and detoxification systems and they fall within the critical epigenetic and developmental window where toxic exposures have higher and long-term adverse effects.[51 52] Baby PCPs, including pacifiers, teethers, shampoos, lotions, diapers, diaper creams and wipes, are commonly used in the belief that they are gentle, non-toxic and specifically formulated for delicate skin. However, analyses of baby products have detected the presence of preservatives (eg, parabens), fragrance chemicals and contaminants including formaldehyde-releasing agents and 1,4-dioxane.[54 61–63]

Moreover, the use of multiple products in routine care (eg, bathing, nappy changes) may result in cumulative exposures to a complex mixture of chemicals.[41] Regulatory oversight of baby products remains inconsistent, where ‘natural’ or ‘hypoallergenic’ labelling often lacks scientific validation.[61] Caregivers may assume that products sold for babies meet higher safety standards, but this is rarely the case.[62] Improving transparency, regulation and public awareness is vital to reducing early-life exposures with potentially lifelong consequences. Concerningly, some of these chemicals bioaccumulate and may be detected in breast milk, resulting in continued infant exposure postpartum[64] while awareness of these risks among breastfeeding women and breastfeeding support health professionals (eg,midwives, lactation consultants, paediatricians) remains low.[8]

Together, these findings underline how physiological vulnerability, cultural assumptions of safety, inadequate regulation and low awareness among caregivers and healthcare professionals impact safety. These factors converge to make infancy a critical yet often overlooked period of chemical exposure that demands targeted policy, education and regulatory action.

Adolescents

Adolescence is another period of increased vulnerability due to both physiological sensitivity and behavioural patterns. Adolescent girls often begin using PCPs at higher frequency during this time, influenced by peer norms, media portrayals and gendered marketing that targets insecurity and conformity.[21] In the USA, adolescents use an average of 8–10 products daily,[21 27] compared with an average of 24.1 products in Korea.[65] During puberty, the endocrine system is undergoing significant changes and exposure to even low levels of hormone-disrupting compounds can interfere with the timing and progression of development.[29] The increasing prevalence of premature or earlier onset of puberty in girls is a topic of concern where the use of PCPs is hypothesised to play a significant role.[29 31 66] Earlier puberty has been associated with increased risk of later-life health conditions, including breast cancer, metabolic disorders and mental health issues.[67]

These concerns are particularly pressing given the high levels of exposure documented among adolescent populations. Notably, the HERMOSA study, which focused specifically on Latina adolescents, demonstrated that even just 3 days of avoiding conventional PCPs resulted in significant reductions in urinary concentrations of four types of EDCs.[27 68] This finding highlights the potential for behavioural interventions to reduce internal chemical burdens quickly and effectively, even in a group with high baseline exposure.

Despite these findings, adolescents are rarely considered in regulatory risk assessments and adolescent-specific exposure scenarios are under-represented in toxicological modelling.[69] Preventive action in this age group requires both targeted education and stronger oversight of youth-oriented PCP marketing.

Beauty salon workers

Occupational exposures represent a distinct and significant source of risk for women working in beauty salons, nail studios, spas and related fields.[70] These workers, who are predominantly women, are regularly exposed to formaldehyde-based straighteners, acetone, toluene, VOCs and other hazardous substances used to provide these services. These exposures are often inhalational, occur in poorly ventilated indoor spaces and are chronic over years of employment. Scientific studies link such exposures to increased risk of respiratory conditions, skin disorders, menstrual irregularities, fertility problems and some cancers.[33 70 71] Despite the scale of this occupational burden, worker protections and industry regulations vary widely and often fail to reflect the cumulative and gendered nature of these risks.

Men and gender-diverse individuals

Although this review primarily focuses on the disproportionate burden of PCP-related exposures among women and girls, it is important to acknowledge that men and gender-diverse individuals also face significant, yet

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Table 2 Gendered use of personal care products and associated chemical exposures

Product category	Commonly used by	Purpose/cultural driver	Key chemicals of concern	Potential health effects	References
General cosmetics (make-up, lotions)	Women (general)	Appearance, social expectations, self-esteem	Parabens, phthalates, phenols, PFAS, heavy metals	Endocrine disruption, cancer risk	6 44
Skin lighteners, hair relaxers	Women of colour	Beauty norms, colourism, cultural standards	Mercury, formaldehyde, parabens	Neurotoxicity, endocrine disruption, reproductive toxicity	11 13 19
PCPs during pregnancy and breastfeeding	Pregnant and lactating women	Self-care, perceived safety, prenatal marketing	Phthalates, phenols, parabens, heavy metals	Foetal development interference, bioaccumulation in breastmilk	54 55
Feminine hygiene products	Women (general)	Menstruation, odour control, societal taboos	PFAS, heavy metals, VOCs, phenols, fragrances, biocides	Mucosal absorption, long-term toxic effects	9 12
Puberty-related products (eg, lotions, fragrances, teenage make-up)	Adolescent girls	Peer pressure, beauty norms, early grooming behaviours	Phthalates, parabens, VOCs, fragrances, metals	Early puberty, hormonal dysregulation, early sexualisation	27 63
Baby-care products (lotions, diapers, shampoos)	Infants, babies and young children	Perceived safety, routine infant hygiene, caregiver norms	Parabens, formaldehyde releasers, fragrance chemicals,	Neurotoxicity, immune disruption, dermal irritation, cumulative exposure	54 62 63
Beauty salon products (eg, hair dyes, nail products, straighteners, sprays)	Beauty industry workers (hairdressers, nail artists, beauticians, spa workers)	Occupational exposure, professional beauty care, lack of safety regulations	formaldehyde, toluene, acetone, phthalates, parabens, triclosan, organophosphate esters	Endocrine disruption, fertility issues, respiratory problems, cancer risk, microbiome changes	33 70 71

PCP, personal care product; PFAS, perfluoroalkyl and polyfluoroalkyl substances; VOCs, volatile organic compounds.

under-recognised, risks. Men's grooming routines which frequently involve deodorants, shaving foams, aftershaves, hair styling products and colognes contribute to regular exposure to VOCs, EDCs and synthetic fragrances.[44] Gender-diverse individuals, including transgender and non-binary people, may engage in more intensive self-care practices as part of gender-affirming behaviours. These include the use of depilatory creams, skin lightening agents, makeup, binding or tucking garments and intimate hygiene products, all of which may involve dermal, inhalational or mucosal exposure to potentially hazardous compounds.[11 19] Furthermore, these populations often face systemic barriers to accessing safer alternatives due to exclusionary product design, lack of inclusive labelling or stigma in healthcare settings.[72 73] Despite these challenges, toxicological assessments and public health campaigns remain largely binary and overlook the specific vulnerabilities of gender-diverse communities. Moving forward, more inclusive exposure research, regulatory risk assessment and community-informed interventions are needed to address these gaps and ensure environmental health equity for all genders.

In summary, the patterns outlined in table 2 indicate that PCP-related exposures are not only the consequence of individual behaviours but are instead deeply rooted within sociocultural, economic and regulatory systems. Understanding these dynamics is essential to identifying at-risk populations, informing public health interventions and advocating for regulatory reform.

POLICY IMPLICATIONS

The widespread and under-regulated use of hazardous chemicals in PCPs presents a significant public health and environmental justice concern. As shown in previous sections, exposures from these products are not randomly distributed; they reflect entrenched social inequalities shaped by gender norms, racialised beauty standards, socioeconomic status and life stage. In this context, relying solely on individual awareness or consumer-driven harm reduction is inadequate. Instead, a coordinated response is needed that integrates regulatory reform, clinical education and public health literacy to support safer and more equitable self-care environments.

In many jurisdictions, regulatory oversight of PCPs remains fragmented and minimal compared with pharmaceuticals or food. For example, the US Food and Drug Administration does not require cosmetic manufacturers to prove the safety of their products or ingredients before they reach the market.[74] Labelling standards worldwide

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are also inconsistent and often allow vague terms like 'fragrance' or 'parfum" to conceal complex chemical mixtures that may contain allergens or endocrine disruptors.[75] In the EU, while the EU Cosmetics Regulation (EC No. 1223/2009) prohibits the use of certain substances and mandates labelling requirements, gaps remain in the regulation of chemical mixtures, endocrine disruptors and nanomaterials. Ongoing legislative discussions under the Chemicals Strategy for Sustainability and proposed revisions to the Registration, Evaluation, Authorisation and Restriction of Chemicals, the EU's chemicals regulation framework, signal a growing recognition of these issues, though updates have been limited and mainly focus on labelling transparency and in naming certain chemicals, rather than chemical groups.[76] Meanwhile, civil society initiatives have played a crucial role in raising awareness and pushing for reform. Organisations such as the EWG, through its Skin Deep database,[77] Women's Voices for the Earth[78] and the Campaign for Safe Cosmetics[79] have become essential sources of information and advocacy. These efforts emphasise the need for stronger, harmonised policies that prioritise precaution and transparency over profit and corporate secrecy.

Health and care professionals, especially those in primary care, dermatology, obstetrics and paediatrics, are uniquely positioned to identify and mitigate chemical exposures related to PCP use. However, environmental health remains an under-represented topic in most medical and allied health education programmes.[80] As planetary health becomes increasingly recognised as a core competency in medical education,[72 73 81–83] it becomes essential to also explicitly consider chemical exposures from consumer products and to integrate these factors into frameworks. Without this integration, planetary health education for health and care professionals risks remaining overly abstract, while failing to equip clinicians with the practical tools needed to address everyday environmental health risks. Embedding environmental health into clinical training is crucial for enabling health professionals to take exposure histories, guide safer choices and support systemic change.

At the population level, improving environmental health literacy requires a combination of modern tools and culturally relevant public education. Digital applications such as Ingredio,[84] which enables consumers to scan and assess chemical risks in PCPs, represent a promising step toward democratising information. However, these tools are often underused and may lack support for multiple languages or localised product databases. Governments, academic institutions and non-profits should invest in the development and promotion of such digital tools, ensuring they are accessible across socioeconomic and linguistic divides.

Complementing these tools, public health campaigns must go beyond generic warnings and offer action-oriented and empowering messages. Education should enable individuals to interpret product labels, understand sources of exposure and question marketing narratives that glamorise potentially harmful practices. Popular social media platforms like YouTube, Instagram and TikTok provide powerful avenues for reaching broad and diverse audiences. But rather than funding new content on academic channels of low visibility, public health authorities should collaborate with trusted, evidence-based science communicators who already possess large and engaged followings. Cocreating campaigns with the affected communities and leveraging credible influencers can build trust, improve relevance and ensure meaningful impact.

Nevertheless, educational initiatives alone are insufficient. To meaningfully reduce harm, the burden of responsibility must shift from individual consumers to institutions with greater systemic power like governments, regulators, manufacturers and public health bodies. This requires investment in 'green chemistry', which refers to the design of chemical products and processes that reduce or eliminate the use and generation of hazardous substances,[85] coupled with promoting incentives for safer product reformulation and stronger regulatory accountability. Policies must centre gender, race and class to meaningfully address disparities in exposure. Ultimately, reframing self-care as a matter of consumer choice and simultaneously as a collective issue of public health, environmental justice and regulatory governance under the One Health paradigm[86] is essential. Ensuring that self-care does not come at the cost of systemic harm will require sustained, coordinated action across science, healthcare, industry and civil society.

The growing recognition of Planetary Health as a critical framework for understanding human–environment interactions highlights the urgency of addressing toxic exposures from consumer practices within ecological limits.[81] The Stockholm Resilience Centre's planetary boundaries model identifies several thresholds including chemical pollution (novel entities), freshwater use and biodiversity loss that are being dangerously transgressed by anthropogenic activity, including the unregulated proliferation of synthetic chemicals in everyday products.[87] Many of the substances found in PCPs such as EDCs, persistent organic pollutants and microplastics qualify as 'novel entities' that are not adequately monitored or governed, yet have lasting and often irreversible impacts on environmental systems.[88] These compounds not only accumulate in aquatic ecosystems and disrupt wildlife reproduction and endocrine function, but also threaten water quality, soil health and food chain integrity. The cumulative result is that routine consumer self-care practices, though individually minor, collectively contribute to the destabilisation of biophysical systems that underpin human and planetary well-being. Integrating planetary boundaries into the discourse on self-care expands the frame of responsibility beyond the individual and even beyond population health to encompass environmental sustainability, intergenerational equity and ecological justice.

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The WHO Guideline on Self-Care Interventions also calls for the integration of self-care into national health strategies, grounded in rights-based, gender-responsive and equity-focused approaches.[4] Our findings suggest that this framework must also extend to environmental health governance, particularly in regulating PCP safety, reducing toxic exposures and ensuring that self-care practices do not exacerbate health inequities.

STRENGTHS AND LIMITATIONS

This review makes a distinct contribution by situating PCP exposures within a gender and equity framework, extending analysis beyond toxicological effects to encompass self-care practices, marketing dynamics, structural determinants and planetary health. The broad interdisciplinary scope of this review, which draws on toxicology, environmental health, public health and gender studies, enables a more holistic synthesis than is typically offered in this domain. Methodological transparency was enhanced through adherence to the SANRA criteria and by incorporating both peer-reviewed and high-quality grey literature, which allowed us to capture policy-relevant insights and emerging perspectives from civil society.

The principal limitation of this narrative review lies in its design, which precludes formal quality appraisal or quantitative synthesis, thereby limiting the ability to assess and compare the strength of evidence across studies. The limitations are also addressed in the online supplemental material (section S9). We acknowledge that the literature remains geographically skewed, with most empirical data derived from North America and Europe, leaving exposures in low-income and middle-income countries (LMICs) and the Global South under-represented. Pertinently, given that evidence on specific subpopulations, including gender-diverse individuals, informal beauty workers and communities with limited access to safer alternatives, remains scarce, it constrains the breadth of equity analysis. We also acknowledge that given the rapidly evolving regulatory landscape, some observations risk becoming outdated as new policy measures and safer-by-design innovations are implemented. Addressing these gaps requires longitudinal and biomonitoring research to strengthen causal inference, expanded global and intersectional perspectives to capture overlooked populations and systematic evaluation of regulatory reforms and clinical interventions. Such efforts are essential to generate robust evidence capable of guiding health policy and ensuring that self-care practices do not perpetuate toxic exposures or exacerbate existing health inequities.

FUTURE DIRECTIONS

Several avenues for future research emerge from this synthesis. First, there is a pressing need to advance mechanistic understanding of how chemicals in PCPs exert harm through endocrine, immune and metabolic pathways. Current evidence points to low-dose and mixture effects, yet most toxicological studies still examine single compounds in isolation. Greater emphasis on mixture toxicity, cumulative exposures and windows of heightened susceptibility such as puberty, pregnancy and early childhood is required to clarify causal pathways and inform risk assessment. Longitudinal biomonitoring studies that integrate molecular endpoints with clinical outcomes would strengthen the evidence base on the biological plausibility of observed associations.

Second, significant research gaps persist in LMICs, where regulatory oversight is often weaker, informal markets flourish and cultural norms around beauty and hygiene may drive unique patterns of exposure. Existing literature remains dominated by studies from North America and Europe, limiting the ability to generalise findings globally. Priorities include mapping the chemical composition of products commonly used in LMICs, documenting usage behaviours and assessing exposure among vulnerable groups such as informal beauty workers and adolescents. Such efforts would also advance global environmental justice by ensuring that populations facing the highest risks are not left out of the scientific and policy discourse.

Third, there is a need for translational research that bridges toxicological evidence with policy and practice. Policy-relevant studies should evaluate the effectiveness of interventions such as ingredient disclosure, labelling reforms and safer-by-design product innovation, alongside health promotion strategies to build environmental health literacy. Clinician-focused research is also critical, particularly on how best to integrate exposure histories, patient counselling and preventive strategies into routine care. Embedding these insights within broader Planetary Health and One Health frameworks will support regulatory reform and guide equitable self-care practices that minimise toxic exposures while protecting both human and environmental health.

SUMMARY AND CONCLUSION

This narrative review has highlighted how PCPs that are widely marketed as tools for empowerment, hygiene and self-care can paradoxically contribute to substantial health and environmental risks, particularly among women and vulnerable populations. Although often perceived as benign or beneficial, routine use of PCPs exposes individuals to EDCs, VOCs, heavy metals, nanoparticles and other hazardous substances associated with significant reproductive, developmental and chronic health impacts. The risks are amplified by gendered and racialised beauty standards, targeted marketing practices and inadequate regulatory oversight, resulting in pronounced inequities among subgroups such as women of colour, pregnant individuals, adolescents, beauty industry workers and infants.

Critically, this review reframes self-care as not only an individual responsibility but as an essential aspect of public health, environmental justice and structural accountability. Current regulatory frameworks, including

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recent EU initiatives and US legislative gaps, are insufficient, often leaving consumers uninformed and vulnerable to unregulated chemical exposures. To achieve meaningful progress, self-care practices must be integrated into broader discussions of environmental health and social equity. This shift requires stronger regulatory policies, including mandatory premarket testing, comprehensive ingredient transparency and the adoption of precautionary principles, especially for PCPs targeted at vulnerable groups.

Equally essential is the transformation of the education of health and care professionals to explicitly incorporate environmental health competencies. While planetary health education is increasingly embraced in medical curricula,[80] specific training on everyday chemical exposures from consumer products remains limited or absent. Effective environmental health education will enable caregivers, including health and care professionals, to better recognise and address chemical risks, guide patient choices and advocate for safer environments, bridging the current gap between planetary health concepts and clinical practice.

Finally, improving population-level environmental health literacy demands innovative strategies and digital solutions. Tools like Ingredio[84] that enable consumers to identify chemical hazards in everyday products should be expanded, localised and promoted broadly. Complementing digital innovation, public health messaging must leverage trusted social media platforms and collaborate with existing, influential, evidence-based science communicators. Rather than funding isolated campaigns with limited reach, public health authorities should strive to harness established channels to achieve meaningful societal engagement and behavioural change.

In conclusion, addressing the health inequities driven by PCP-related exposures requires a coordinated, systemic response that prioritises regulatory reform, educational advancement for healthcare providers, innovative digital solutions and strategic communication. Only by reframing self-care within this comprehensive environmental health perspective can we ensure equitable, safe and sustainable self-care practices for all.

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