

Editorial

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Chemicals in personal care products: an important but understudied exposure source for both the human body and ecosystems

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Herein, personal care products refer to a broad definition, including personal hygiene products (e.g., toilet paper, paper diaper, sanitary pad), cleansing products (e.g., shampoo, body wash), and skin care products (e.g., body lotion, body powder). Recently, an increasing number of studies reported “forever chemicals” per- and polyfluoroalkyl substances (PFAS) in multiple hygiene products, e.g., toilet paper and paper diaper^[1,2]. These reports attracted global attention regarding the safety of personal care products again. In the early 21st century, the pollution issue of asbestos in body powder induced global concern, especially concerning the health of women and children^[3,4].

A number of toxic chemicals have been reported in commercial personal care products and have been verified to be associated with human health^[5-7]. In 1999, Anderson *et al.* found several volatile organic compounds (VOCs, e.g., m-xylene, toluene, and styrene) in disposable diapers^[8]. Via exposing mice to diapers, Anderson *et al.* also suggested that disposable paper diapers might be a risk factor for asthma onset and exacerbation because of these toxicants^[8]. Ding *et al.* reported a significantly positive association between the use frequency of vaginal douching (similar to feminine washes) and 1,4-dichlorobenzene in whole blood using the NHANES 2001-2004 data^[9]. The positive associations between chemicals in feminine hygiene products and those in the human body were further verified in a longitudinal pilot study^[6]. Higher



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n-nonane, benzene, and toluene detected in menstrual products were associated with higher levels in women's urine.

The chemicals in personal care products also induced exposure to ecosystems. A possible carcinogen, 1,4-dioxane, is ubiquitous in cleaners, detergents, shampoo, and cosmetics^[10]. However, for the environment, it is an emerging contaminant, especially in water ecosystems^[11]. It is also called "another forever chemical" concerning its resistance to degradation and long-term existence in water^[12]. A study reported a high level of 1,4-dioxane in cleansing products, e.g., body wash, up to 24 µg/g, which was over the regulation of 2 ppm by the New York State^[7]. Assuming 1 billion people taking showers every day for one year, the emission of 1,4-dioxane from only body wash into the water environment would be 87 tons. Actually, all cleaners, e.g., shampoo, hand wash, and laundry detergent, contain high levels of 1,4-dioxane and many other chemicals, which definitely expose the environment to these chemicals and the subsequent risks.

Although these chemicals in personal care products expose both the human body and the environment to risks, the relevant research is still very limited. People pay attention to the main exposure routes of these chemicals. For example, PFAS are mainly absorbed via aquatic food and water^[13], VOCs via inhalation, and 1,4-dioxane via drinking water^[14,15]. Dermal exposure is the main exposure route of chemicals in personal care products but may not be the major route from all sources^[5]. Several reports have verified that dermal exposure is an important exposure route and the bioavailability of dermal exposure is higher than inhalation and oral exposure^[7].

At present, a large number of problems have not been solved, e.g., the kinetics of chemical transport process via skin, and human behavior parameters. The release process and multi-media distribution of the chemicals in products also impact subsequent exposure^[5], but remain unknown. In the European Union, various chemicals including dioxins, furans, polycyclic aromatic hydrocarbons (PAHs) and VOCs were detected in disposable diapers, and France proposed to release a standard to limit chemicals in baby diapers in 2021^[16]; but the risk assessment did not carry out an in-depth analysis of effective exposures. Ultimately, the European Chemicals Agency rejected this proposal and induced a big discussion in society. As this issue has already been proposed, we anticipate more and more scientists will delve into the study of chemical exposure in personal care products.

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Authors' contributions

The author contributed solely to the article.

Availability of data and materials

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Conflicts of interest

The author declared that there are no conflicts of interest.

Ethical approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

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