

## Endocrine Disruptors and Asthma-Associated Chemicals in Consumer Products

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**BACKGROUND:** Laboratory and human studies raise concerns about endocrine disruption and asthma resulting from exposure to chemicals in consumer products. Limited labeling or testing information is available to evaluate products as exposure sources.

**OBJECTIVES:** We analytically quantified endocrine disruptors and asthma-related chemicals in a range of cosmetics, personal care products, cleaners, sunscreens, and vinyl products. We also evaluated whether product labels provide information that can be used to select products without these chemicals.

**METHODS:** We selected 213 commercial products representing 50 product types. We tested 42 composited samples of high-market-share products, and we tested 43 alternative products identified using criteria expected to minimize target compounds. Analytes included parabens, phthalates, bisphenol A (BPA), triclosan, ethanalamines, alkylphenols, fragrances, glycol ethers, cyclosiloxanes, and ultraviolet (UV) filters.

**RESULTS:** We detected 55 compounds, indicating a wide range of exposures from common products. Vinyl products contained > 10% bis(2-ethylhexyl) phthalate (DEHP) and could be an important source of DEHP in homes. In other products, the highest concentrations and numbers of detections were in the fragranced products (e.g., perfume, air fresheners, and dryer sheets) and in sunscreens. Some products that did not contain the well-known endocrine-disrupting phthalates contained other less-studied phthalates (dicyclohexyl phthalate, diisononyl phthalate, and di-*n*-propyl phthalate); also endocrine-disrupting compounds), suggesting a substitution. Many detected chemicals were not listed on product labels.

**CONCLUSIONS:** Common products contain complex mixtures of EDCs and asthma-related compounds. Toxicological studies of these mixtures are needed to understand their biological activity. Regarding epidemiology, our findings raise concern about potential confounding from co-occurring chemicals and misclassification due to variability in product composition. Consumers should be able to avoid some target chemicals—synthetic fragrances, BPA, and regulated active ingredients—using purchasing criteria. More complete product labeling would enable consumers to avoid the rest of the target chemicals.

**KEY WORDS:** alkylphenols, asthma, bisphenol A, consumer products, cyclosiloxane, endocrine disruptors, fragrance compounds, parabens, phthalates, UV filters. *Environ Health Perspect* 120:935–943 (2012). <http://dx.doi.org/10.1289/ehp.1104052> [Online 8 Mar 2012]

Chemicals contained in consumer products are ubiquitous in human tissues, sometimes at high concentrations [Centers for Disease Control and Prevention (CDC) 2009] and in household air and dust (Rudel and Perovich 2009; Rudel et al. 2003, 2010; Weschler 2009). Studies of pesticides, polychlorinated biphenyls (PCBs), polybrominated diphenyl ether (PBDE) flame retardants, and volatile organic compounds (VOCs) in homes provide some information about sources, exposure pathways, and exposure reduction options (Dodson et al. 2008; Lorber 2008; Rudel et al. 2008; Zota et al. 2008). However, for many common commercial chemicals, limited information is available about how specific consumer products contribute to exposure. In particular, little information is available about exposures from personal care and cleaning products.

Many of these products may be sources of chemicals that have a diverse spectrum of health effects, including endocrine disruption and associations with asthma. Endocrine-disrupting compounds (EDCs) are chemicals

that can alter hormonal signaling and have potential effects on developing reproductive and nervous systems, metabolism, and cancer (Colborn et al. 1993). Some phthalates inhibit testosterone synthesis (Howdeshell et al. 2008), and antimicrobials such as triclosan suppress thyroid hormone (Paul et al. 2010) and are estrogenic (Stoker et al. 2010) in mammalian models. Some parabens, alkylphenols, cyclosiloxanes, ultraviolet (UV) filters, and synthetic musk fragrance compounds are weakly estrogenic in a variety of experimental models (Bitsch et al. 2002; Bonfeld-Jørgensen et al. 2007; Quinn et al. 2007; Routledge et al. 1998; Schlumpf et al. 2004; Schreurs et al. 2005). Factors related to home environments are associated with asthma, although there has been limited study of the role of chemical contaminants (Douwes and Pearce 2002). Fragrances have been shown to exacerbate asthma (Kumar et al. 1995). The phthalate bis(2-ethylhexyl) phthalate (DEHP) in dust was associated with asthma and wheezing in children (Bornehag et al. 2004), and several

phthalates show an adjuvant effect in animal studies (Bornehag and Nanberg 2010). The sum of propylene glycol and glycol ethers was associated with increased asthma prevalence in preschool-age children (Choi et al. 2010). The ethanalamines monoethanolamine and diethanolamine are occupational asthmagens (Association of Occupational and Environmental Clinics 2010).

Previous research suggests that consumer products are a source of these compounds in homes. We found a wide range of phthalates, alkylphenols, parabens, flame retardants, PCBs, and current-use and banned pesticides in air and dust samples from homes, with 13–28 compounds in air and 6–42 compounds in dust (Rudel et al. 2003). Analysis of paired indoor and outdoor air samples in California demonstrated that indoor concentrations were considerably higher than outdoor concentrations for many compounds, indicating the constant presence of indoor sources (Brody et al. 2009; Rudel et al. 2010).

Efforts to identify the contribution of specific products to home environments or personal exposure are hindered by limited and inconsistent disclosure of chemical ingredients in consumer products. Regulations require only limited labeling. For example, sunscreens, antiperspirant deodorants, and antibacterial hand soaps are regulated as over-the-counter drugs by the U.S. Food and Drug Administration (FDA), and “active”

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Supplemental Material is available online (<http://dx.doi.org/10.1289/ehp.1104052>).

We thank N. Maxwell for her help in organizing and revising the text.

This work was funded by the Goldman Fund, the Hurricane Voices Breast Cancer Foundation, and a grant from the Centers for Disease Control and Prevention (1 R01 EH000632-01).

R.E.D., L.J.S., L.J.P., J.G.B., and R.A.R. are or were previously employed at Silent Spring Institute, a scientific research organization dedicated to studying environmental factors in women's health. The Institute is a 501(c)3 public charity funded by federal grants and contracts, foundation grants, and private donations, including those from breast cancer organizations. M.N. is employed by Battelle Memorial Institute, and L.J.S. is currently employed by Clear Current, LLC. The authors declare they have no actual or potential competing financial interests.

Received 9 June 2011; accepted 21 February 2012.