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Changing Trends in Phthalate Exposures

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Two articles in the March 2014 issue of *EHP* were of particular interest to exposure scientists and phthalate researchers. The news article by Nicole (2014) emphasized the importance of the vaginal epithelium as an exposure route for chemicals in personal care products and the general lack of research on this exposure route. However, the article did not mention adult toys as a possible source of exposure. Adult toys are made from a variety of plastics, including polyvinyl chloride, and they may contain phthalates, some of which are associated with developmental effects in males following *in utero* exposure in both animal and epidemiological studies. One report has suggested that certain combinations of vehicle (personal lubricant) and product may result in high phthalate exposures (Nilsson et al. 2006).

In their article, Zota et al. (2014) revealed that phthalate exposures in the United States are beginning to change after remaining relatively stable for a decade. The authors reported that urinary metabolite levels of certain phthalates associated with male developmental effects, including di(2-ethylhexyl) phthalate (DEHP) and di-*n*-butyl phthalate (DnBP), are decreasing while exposure to other phthalates, diisobutyl phthalate (DiBP) and diisononyl phthalate (DiNP), are increasing. The observed trend is something of a good news–bad news story. The good news is that exposures to DEHP and DBP are declining. The bad news is that exposure to DiBP and DiNP, which are associated with similar health effects, are increasing. However, DiNP is less potent as an antiandrogen than the other phthalates. Furthermore, exposure to phthalate substitutes (e.g., Schütze et al. 2014), as well as unregulated phthalates such as DiBP, are likely to increase. In the future, biomonitoring studies such as the National Health and Nutrition Examination Survey (NHANES) and the National Children's Study (NCS) may need to shift their focus to substitutes. Like phthalates, many of the phthalate substitutes (including citrates and adipates) are high production volume chemicals, with little adequate toxicological data, and humans are exposed from multiple sources.

Although the authors are members of the Chronic Hazard Advisory Panel on Phthalates and Phthalate Alternatives, U.S. Consumer Product Safety Commission (Division of Toxicology and Risk Assessment), they are writing independently of their panel activities.

The authors declare they have no actual or potential competing financial interests.

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Changing Trends in Phthalate Exposures: Zota and Woodruff Respond

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We appreciate Lioy et al.'s interest in our recent article (Zota et al. 2014) documenting temporal trends in phthalate exposures in the U.S. general population. Lioy et al. raise important points about the future implications of our findings.

We agree that the downward trend in exposures to phthalates such as di-*n*-butyl phthalate (DnBP) and di(2-ethylhexyl) phthalate (DEHP) is encouraging, but the rising trend in other phthalates, such as diisobutyl phthalate (DiBP) and diisononyl phthalate (DiNP), is worrisome. Lioy et al. note that DiNP is less potent as an antiandrogen than the other phthalates. However, its increasing presence in the U.S. general population warrants public health concern: The U.S. Environmental Protection Agency (EPA) has expressed concern about DiNP's use [Phthalates Action Plan (U.S. EPA 2012)]; DiNP was added to California's Proposition 65 List of Potential Carcinogens in 2013 (California Office of Environmental Health Hazard Assessment 2014); and it can act cumulatively with other phthalates to affect male reproductive end points (National Research Council 2008). Given the toxicological evidence of potential harm, further study on its adverse health effects in epidemiologic studies is warranted.

Lioy et al. also comment on the importance of studying phthalate substitutes. We agree that it is important for NHANES (National Health and Nutrition Examination Survey) and other large environmental health studies to evaluate the presence of potential "substitute" chemicals not only of phthalates but also of other environmental chemicals to provide the best human exposure information. In fact, for the most recent NHANES survey (2011–2012), scientists at the Centers for Disease Control and Prevention are beginning to release population-level data for the urinary metabolite of 1,2-cyclohexane dicarboxylic acid diisononyl ester (DINCH), a nonphthalate plasticizer that is used as a replacement for some of the high-molecular-weight phthalates (Centers for Disease Control and Prevention 2013). Indeed, biomonitoring data are extremely valuable for understanding population exposures to high production volume chemicals and helping to prioritize chemicals of concern. However, NHANES records only the actions of the past. To fully characterize public health risks of chemicals and develop effective exposure-reduction strategies, we need greater disclosure from manufacturers on chemical ingredients in consumer and other products; more complete data from the U.S. EPA on chemical production and use; and data to evaluate potential health hazards from these chemicals. With this information, we can make informed decisions about the use of chemicals in the market place, limit those that pose a risk to the population, and improve the public's health.

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