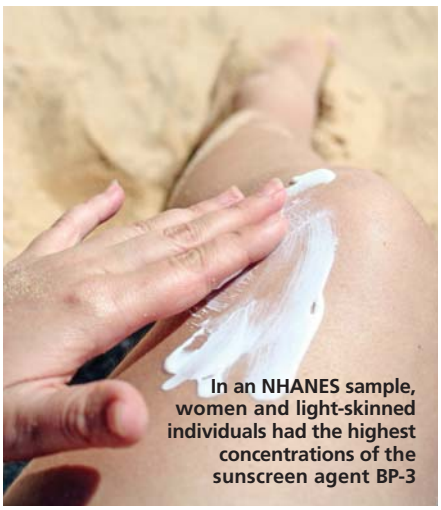
# Shining a Light on BP-3 Exposure

## Sunscreen Chemical Measured in U.S. Population

Sunscreens provide important protection against sunburn and squamous cell cancer, particularly for individuals who work outdoors or in situations where sun exposure is unavoidable. The widespread use of the common sunscreen agent benzophenone-3 (BP-3) and its detection in the environment suggest the need for more information about the extent of human exposure. Results of a new study now provide the first nationally representative data on BP-3 exposure among the U.S. population [***EHP* 116:893–897; Calafat et al.**].

BP-3 is used in personal care products to absorb and dissipate ultraviolet (UV) radiation. It is also used as a UV stabilizer in plastic surface coatings to prevent polymer or food photodegradation and has been approved by the Food and Drug Administration as an indirect food additive. Although BP-3 exposure has not been linked to adverse health effects in humans, results of animal studies by the National Toxicology Program have shown effects in liver, kidney, and reproductive organs, and studies by other groups have shown endocrine-disrupting effects.

Using data from the National Health and Nutrition Examination Survey (NHANES) 2003–2004 conducted by the Centers for Disease Control and Prevention, the current research team analyzed 2,517 urine samples from three major racial/ethnic groups: non-Hispanic black, non-Hispanic white, and Mexican American. NHANES includes household interviews, medical histories, standardized physical examinations, and a collection of biologic specimens that can be used to assess exposure to environmental chemicals, as in the current study.



**In an NHANES sample, women and light-skinned individuals had the highest concentrations of the sunscreen agent BP-3**

The scientists detected BP-3 in 96.8% of the urine samples, with a mean concentration of 22.9 μg/L and a concentration of 1,040 μg/L in the 95th percentile. The high level of detection likely resulted from routine use of personal care products such as sunscreen, moisturizers, lipstick, and hairspray.

Results of the current study suggest that females and non-Hispanic whites were the most highly exposed of all the demographic groups studied. Mean concentrations of BP-3 were significantly higher for females than for males, regardless of age, probably because women and girls use more sunscreen and other personal care products than men and boys do. At the 95th percentile of exposure, adult females had BP-3 concentrations 3.5 times greater than those of adult males.

Mean concentrations also differed significantly among the different racial/ethnic groups. Non-Hispanic whites were 6.8 times more likely and Mexican Americans were 4 times more likely to have BP-3 concentrations above the 95th percentile compared with non-Hispanic blacks. These differences likely result from increased use of sunscreens by people with lighter skin pigmentation.

According to the authors, the NHANES 2003–2004 data can be used to establish a nationally representative baseline assessment of exposure. Moreover, the data could aid risk assessments for BP-3 exposure if future toxicologic or epidemiologic studies suggest the need for such research, and may encourage further research to determine the potential public health impact of exposure at the levels reported. –John Tibbetts

# Is Arsenic "Lactation Intolerant"?

## Study Indicates Low Excretion in Breast Milk

Arsenic is known to readily cross the placenta, but few data exist on postnatal exposure to arsenic in breast milk. Results of a study conducted in Bangladesh now suggest that infants who are exclusively breastfed are protected against arsenic, despite high maternal exposures [***EHP* 116:963–969; Fängström et al.**].

Numerous studies have linked arsenic exposure in adults to various diseases, including cancer, cardiovascular disease, and diabetes mellitus. Exposure in school-age children has been associated with neurodevelopmental disorders. During fetal development, the brain is particularly vulnerable to arsenic exposure, as it readily crosses the placenta, possibly altering fetal programming and leading to a higher risk of susceptibility to disease later in life.

The subjects in the current study included 98 mothers and their 3-month-old infants who participated in the Maternal and Infant Nutrition Interventions of Matlab in Bangladesh, one of the most severely affected countries in terms of high prevalence of extremely elevated levels of arsenic in drinking water supplies. The investigators evaluated nutritional status and arsenic exposure as reflected by arsenic metabolites in infant urine and maternal blood, urine, and saliva samples. They also analyzed breast milk samples at 2 months postpartum for arsenic. Questionnaires completed by the mothers provided data on infant feeding practices.

The median sum of arsenic metabolites in infant urine was 1.2 μg/L, with significantly lower concentrations in infants who were exclusively breastfed compared with those who received some solid food. Arsenic concentrations in breast milk were low (median 1.0 μg/kg) and mostly in the form of trivalent inorganic arsenic. The researchers observed a significant association between arsenic in infant urine and breast milk, but noted that some mothers with low breast milk arsenic had infants with high urine concentrations, possibly because the infants had been given water to drink. Median maternal blood and urine concentrations were high (5.7 and 67 μg/L, respectively), whereas median maternal saliva concentrations were low (1.3 μg/L). Among infants who were exclusively breastfed, urine levels did not exceed 19 μg/L inorganic arsenic and its metabolites, whereas infants who received infant formula prepared with local drinking water in addition to some breast milk had urine levels up to 1,100 μg/L.

The authors demonstrate for the first time that arsenic in human breast milk is mostly the inorganic arsenite form. Although there was a significant relationship between arsenic concentrations in milk and in maternal blood, arsenic concentrations in breast milk were relatively low despite the mothers' high exposures. The findings suggest that breastfeeding exclusively can protect infants from arsenic exposure during this critical development period, but the authors note that researchers have yet to determine the extent to which breastfeeding decreases the health risks associated with prenatal arsenic exposure. –Tanya Tillett

# New Window into Breast Cancer Risk

## Assessing Lifetime Exposures to POPs

Persistent organic pollutants (POPs) such as polychlorinated biphenyls (PCBs) are ubiquitous chemical compounds that persist in the environment and bioaccumulate through the food web. Although experiments have shown that POPs stimulate the proliferation of human cancer cell lines, epidemiologic studies of POP-associated cancer risk have yielded inconsistent results, possibly because of the lack of tools for estimating lifetime exposures to these chemicals. Now, however, researchers have developed a new physiologically based pharmacokinetic (PBPK) modeling approach that can potentially be used in epidemiologic studies to simulate lifetime toxicokinetics of POPs in women [***EHP* 116:886–892; Verner et al.**].

Previous biological assessments have been limited to measuring POP levels in blood or tissue samples collected around the time of breast cancer diagnosis. However, such assessments may not reflect the body burden during earlier, potentially critical exposure points in a woman's life such as the fetal, postnatal, and adolescent periods.

In contrast, the new model integrates the relevant processes of absorption, distribution, metabolism, and elimination to estimate lifetime blood and tissue exposure and levels during any hypothesized time window of susceptibility in breast cancer development. The model also predicts how various types of relevant lifetime physiologic changes—such as body weight variation, pregnancy, excretion of POPs through lactation, and aging—will influence the kinetics of a compound in a woman throughout her life. The model enables the estimation of interindividual differences in POP exposures through the use of physiologic information obtained from questionnaires in epidemiologic studies.

The researchers found that lactation and weight change histories had the greatest impact on the toxicokinetic profile throughout life. According to the model, the longer and later in life lactation occurred, the lower the woman's blood POP concentration at age 55 (a surrogate time representing the typical age at breast cancer diagnosis). Similarly, variations in body weight throughout life had a greater impact than average body weight on blood POP concentrations, possibly because weight loss is accompanied by unloading of POPs into the blood via lost adipose tissue. This means that quantitative information on both lactation and body weight histories is critical when evaluating past POP exposures.

If, as some researchers hypothesize, breast cancer is related to POP exposures at specific time windows of susceptibility during a woman's lifetime, lactation and body weight histories must be considered in studies of POP exposures and breast cancer risk. Depending on when such physiologic events occur, women having similar POP concentrations at the age of diagnosis may have had completely different internal levels at a time that may be critical to the formation of breast cancer. The proposed PBPK modeling approach therefore could be used in environmental epidemiology research to circumvent limitations inherent in relying on late-life sampling for past exposure assessments. –M. Nathaniel Mead

# Mischief Makers

## Secondhand Smoke, Lead Linked to Conduct Disorder

A study of 3,081 U.S. children now confirms the results of smaller studies associating exposure to secondhand tobacco smoke and lead with conduct disorder (CD), a persistent disruptive behavior pattern that includes aggression, lying, stealing, and destruction of property [***EHP* 116:956–962; Braun et al.**]. According to the study authors, postnatal lead exposure and both pre- and postnatal exposure to secondhand smoke can significantly increase the risk of CD in children. Children with CD face a higher risk of anxiety disorders and substance abuse.

Using data from the National Health and Nutrition Examination Survey (NHANES) 2001–2004, the researchers obtained a nationally representative sample of children aged 8–15 years (earlier studies by other researchers relied on smaller regional samples collected from clinic visits). Caregiver responses to a questionnaire known as the Diagnostic Interview Schedule for Children determined whether children met CD diagnositic criteria established by the *Diagnostic and Statistical Manual of Mental Disorders IV*. Prenatal exposure to secondhand smoke was estimated based on caregiver responses to questions regarding smoking habits during pregnancy; postnatal exposure was measured using blood serum concentrations of cotinine, a nicotine metabolite. Lead exposure was determined by measuring blood lead concentrations.

The research team identified CD in 2.1% of the subjects, corroborating earlier prevalence estimates. The team determined that children exposed prenatally to secondhand smoke were 3-fold more likely to meet CD diagnostic criteria than those not exposed. Youngsters exposed postnatally to the highest levels of secondhand smoke were 9.15 times more likely to exhibit CD symptoms than those exposed to the lowest levels.

The research team also examined the association between behavior and lead exposure, the results of which support those of previous studies suggesting that elevated blood lead also is a risk factor for CD. Children with blood lead levels higher than 1.5 μg/dL were 8.64 times more likely to have met CD diagnostic criteria in the past year than children with levels lower than 0.7 μg/dL.

Limitations to the study include inability to infer causal relationships because of the cross-sectional nature of the data. In addition, the reported prevalence of CD could be underestimated because caregivers completing the DISC module may not recognize disruptive behaviors in their children. Nevertheless, the authors suggest that millions of children are currently being exposed to levels of secondhand smoke and lead that could increase the risk for persistent, disruptive, and even violent behavior, despite reductions in recent years in children's exposure to these toxicants. –Cynthia Washam

Recurrent disruptive behavior may be linked to lead or secondhand smoke exposure

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