

Identification of Selected Hormonally Active Agents and Animal Mammary Carcinogens in Commercial and Residential Air and Dust Samples

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ABSTRACT

In order to characterize typical indoor exposures to chemicals of interest for research on breast cancer and other hormonally mediated health outcomes, methods were developed to analyze air and dust for target compounds that have been identified as animal mammary carcinogens or hormonally active agents and that are used in commercial or consumer products or building materials. These methods were applied to a small number of residential and commercial environments to begin to characterize the extent of exposure to these classes of compounds. Phenolic compounds, including nonylphenol, octylphenol, bisphenol A, and the methoxychlor metabolite 2,2-bis (p-hydroxyphenyl)-1,1,1-trichloroethane (HPTE), were extracted, derivatized, and analyzed by gas chromatography/mass spectrometry (GC/MS)-selective ion monitoring (SIM). Selected phthalates, pesticides, polycyclic aromatic hydrocarbons (PAHs), and polychlorinated biphenyls (PCBs) were extracted and

analyzed by GC/MS-SIM. Residential and workplace samples showed detectable levels of twelve pesticides in dust and seven in air samples. Phthalates were abundant in dust (0.3–524 $\mu\text{g/g}$) and air (0.005–2.8 $\mu\text{g/m}^3$). Nonylphenol and its mono- and di-ethoxylates were prevalent in dust (0.82–14 $\mu\text{g/g}$) along with estrogenic phenols such as bisphenol A and *o*-phenyl phenol. In this 7-sample pilot study, 33 of 86 target compounds were detected in dust, and 24 of 57 target compounds were detected in air. In a single sample from one home, 27 of the target compounds were detected in dust and 15 in air, providing an indication of chemical mixtures to which humans are typically exposed.

INTRODUCTION

Breast cancer is the most common malignancy among women in the United States and western Europe¹ and the leading cause of cancer death in women aged 35–54.² Wide variations in breast cancer incidence around the world³ and a steady increase in rates over time⁴ suggest that many breast cancers are preventable. Epidemiologic studies have identified several risk factors for breast cancer, including family history, certain inherited genetic mutations, several aspects of a woman's reproductive history, physical exercise, smoking, exposure to ionizing radiation, and use of alcohol or pharmaceutical hormones.^{5–8} However, geographic variation in breast cancer rates and individual breast cancer risk are not well predicted by these risk factors,^{9–11} indicating that additional preventable causes of breast cancer remain to be identified.

Animal cancer bioassays and laboratory studies identifying chemicals that are hormonally active suggest that certain environmental contaminants may affect breast

IMPLICATIONS

Methods pilot-tested in this study can contribute to assessment of exposures to complex mixtures of hormonally active agents in homes. The 33 compounds detected, including phthalates, alkylphenols, and pesticides, are toxicologically important chemicals that are widespread in indoor environments, making them priorities for future research and regulatory evaluation. They also provide tools for the study of hormonally mediated health outcomes, including breast cancer. Application of these methods to a larger number of homes, with analysis of the relationship between indoor air and dust measures and urine measurements for selected analytes, is underway.