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Biomonitoring of Exposure to Organophosphate Pesticides in New York City

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In a recent publication, McKelvey et al. (2013) reported higher levels of some urinary metabolites of organophosphate (OP) and pyrethroid insecticides in a cohort from New York City (NYC) compared with a national cohort. However, the authors concluded that

> Estimates of exposure to pyrethroids and dimethyl organophosphates were higher in NYC than in the United States overall, underscoring the importance of considering pest and pesticide burdens in cities when formulating pesticide regulations. (McKelvey et al. 2013)

Although urinary excretion levels of dialkylphosphates (DAPs)—which are metabolites and environmental degradates of OP insecticides—are useful as quantitative indicators of exposure to OPs in agricultural workers, they are not as useful for the general population. For agricultural workers, the source of the OP and time of exposure are typically known, and there is substantial exposure above background, thus allowing an unambiguous estimation of exposure levels (Chen et al. 2013). In contrast, urinary excretion levels of DAPs in the general population represent an integrated measurement of intakes of both pesticide and pesticide metabolites 1 or 2 days prior to sampling (Chen et al. 2012). Half-lives of OPs and their metabolites in the body range from a few hours to < 1 day (Chen et al. 2013; Timchalk et al. 2007). Evidence indicates that urinary DAPs in the general population primarily result from exposures to nonneurotoxic OP metabolites that are in food (Krieger et al. 2012).

McKelvey et al. (2013) stated that

> Diazinon and chlorpyrifos were detected in all indoor air samples collected from a sample of NYC homes (Whyatt et al. 2007) and from the majority of floor-wipe samples in a national study of U.S. homes (Stout et al. 2009) several years after these compounds were phased out for indoor use.

Measureable human exposure to chlorpyrifos applied indoors declines to background levels within weeks of an application (Krieger et al. 2001), so although measureable residues may remain indoors, those residues do not contribute appreciably to the urinary DAPs from chronic low-level exposure to OP metabolites in food. Likewise, ambient inhalation exposures, even in high-use agricultural areas, contribute negligibly to OP exposure (McKone et al. 2007). The inescapable conclusion is that if OP use in NYC were driving elevated urinary excretion levels, a sizeable percentage of NYC residents would have been exposed to recent indoor uses of dimethyl OPs. Yet, at the time of the sampling, use of these OPs was almost completely phased out. Moreover, although diethyl OPs, such as chlorpyrifos and diazinon, had been used extensively indoors until 2001, the dimethyl OPs—and especially dimethylthio OPs—were never used as extensively indoors, as evidenced by the results reported by Stout et al. (2009).

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Biomonitoring of Exposure to Organophosphate Pesticides: McKelvey et al. Respond

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In their letter, Ross and Ginevan criticize the conclusion of our recent article on pesticide biomonitoring in New York City (NYC), in which we stated that

> Estimates of exposure to pyrethroids and dimethyl organophosphates were higher in NYC than in the United States overall, underscoring the importance of considering pest and pesticide burdens in cities when formulating pesticide regulations. (McKelvey et al. 2013)

However, in our article, we raised similar concerns as Ross and Ginevan—namely, the possibility that the exposures we measured could have been exposures to the metabolites themselves or to compounds that originated in food (either as the parent compound or the metabolite). We discussed the reduced likelihood that the dimethyl metabolites originated from structural pest control, based on limited use of these products for indoor pest control in NYC at the time. We also noted the possibility of exposure through use of flea and tick control products on pets or for outdoor garden care. Tetrachlorvinphos is a common ingredient in flea and tick products and a credible source of exposure in New York City, where pets tend to stay indoors and living spaces are smaller. We call attention to recent concern over indoor use of dichlorvos, a dimethyl organophoshate ingredient of insecticidal pest strips, which could have also been a source of exposure (Tsai et al. 2014). Our interpretation of elevated levels of urinary dimethyl phosphates in NYC adults was consistent with the recommendation of Krieger et al. (2012), cited by Ross and Ginevan in their letter, that use of dialkylphosphate compounds as biomarkers of exposure to organophosphates be limited to identifying potentially exposed groups or changing use patterns. We followed this recommendation in reporting evidence for increased exposure to dimethyl organophosphate products at the high end of the distribution in the general NYC adult population.

More importantly, pyrethroids are now the largest share of structural pesticide applications in NYC (New York City Department of Health and Mental Hygiene 2014). The 95th percentiles of urinary pyrethroid metabolites we measured in NYC adults were higher than those in the general U.S. population. Exposure may be greater in NYC because of more applications, drift between housing units in multiunit dwellings, or other factors related to the built environment. The registration and regulation of pesticides do not adequately account for such phenomena. More regulatory oversight

of pesticide use in densely populated areas such as NYC is a logical response.

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

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