Children's Environmental Health Network

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Title

Decreased Lung Function in 7-year Old Children With Early-life Organophosphate Exposure

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Abstract

Background

Organophosphate pesticides (OPs) are widely used in agriculture, and have been linked to adverse respiratory health effects in occupational settings. Additional studies have linked OP exposure to a variety of detrimental health outcomes that specifically affect children, including higher susceptibility to certain childhood cancers, altered functioning of the immune system, and adverse effects on the nervous system. Children living in agricultural communities where OPs are applied can be exposed as the airborne pesticides drift from the site of application to residences and schools. Few studies have investigated children's chronic health effects associated with this type of OP exposure, and of those that have, few have employed direct measurements of exposure or investigated associations with objective health outcomes.

Objective

To evaluate associations between early-life OP exposure and lung function of children living in agricultural communities.

Methods

Participants were mother and child pairs from the Center for the Health Assessment of Mothers and Children of Salinas (CHAMACOS) longitudinal birth cohort. The children's OP exposures were determined by the levels of diethyl (DE) and dimethyl (DM) dialkylphosphate (DAP) metabolites (byproducts of the metabolism of OPs) in their mothers' urine, measured twice during pregnancy, and also in their own urine after birth, which was measured five times during childhood (6–60 months). Spirometry, a battery of simple breathing tests used to determine basic respiratory functioning, was performed at age 7 years. The researchers controlled for potential confounding variables, including: maternal smoking during pregnancy; season of birth; particulate matter concentrations during first 3 months of life; breast feeding duration; mold and pets at home; distance of home from a highway; food insecurity; maternal education; the season during which spirometry was administered; sex; height; and technician.

Results

Average DAP urinary concentrations in mothers during pregnancy were not significantly associated with children's lung function measurements at age 7. Higher childhood DE, DM and total DAP concentrations were associated with decreases in lung function at age 7. Specifically, the highest FEV1 (the volume of air that can forcibly be blown out in one second, after full inhalation) measured from children was significantly associated with total DAPs.

Conclusion

Early-life OP exposure as assessed by DAP concentrations is associated with decreased pulmonary function among school-age children living in an agricultural community in California.

Policy Implications

In recent years, due to mounting evidence of the toxicity of OPs on human and especially children's health, regulations on OPs and other pesticides have become increasingly tight. The U.S. Environmental Protection Agency (EPA) phased out a number of OP residential and commercial uses over the past 15 years, and thus, use has been on the decline, as indicated by an EPA-released 2007 report on pesticides sales and usage. The report shows that the amount of OPs used has declined more than 60% since 1990, from an estimated 85 million pounds in 1990 to 33 million pounds in 2007. As substantial a drop as this may seem, the overall use of OPs in agriculture is still exceptionally high.

A chief concern of OP use is the potential for pesticide off-target drift, which occurs when pesticides used for agricultural purposes are dispersed and carried by wind to surrounding areas. In 2012 EPA established "no-spray" buffer zones around public spaces and homes, but these may not provide adequate protection. In October 2014, EPA launched a voluntary program (the Pesticide Drift Reduction Technology program) to combat pesticide drift by incentivizing manufactures and users to improve the technology associated with dispersing pesticides. However, voluntary programs cannot provide the level of protection necessary to safeguard children's health.

One heavily used agricultural OP, chlorpyrifos, has been under intense scrutiny over the past few years. In October 2015 EPA proposed a measure that would revoke all food residue tolerances of chlorpyrifos. While risk from food exposure to chlorpyrifos is minimal, when those exposures are combined with exposures from drinking water, particularly in watersheds where chlorpyrifos is heavily used, the aggregate exposures for people residing in those areas may be unsafe. EPA is completing its refined drinking water chlorpyrifos analysis for the entire country and has updated its human health risk assessment of the OP. The agency anticipates releasing the final food residue-revoking rule in December 2016, after public commenting periods on the revised risk assessment and drinking water analysis.

This study's findings support and extend the results of previous studies of OP exposure and respiratory symptoms and function, and contribute even more evidence that OPs pose numerous risks to human health, especially that of children. It is crucial that aggregate exposures of the most vulnerable populations, including from off-target drift, drinking water, food, and other potential inhalation and dermal exposures, are considered, along with biomonitoring and epidemiological data, in assessing OPs' risks to children's health, in order to establish true child-protective regulations.

Reference

Article available in Thorax.

Keyword(s)

Chlorpyrifos, Pesticides