Science Spotlight

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Pesticides and Neurobehavioral Effects Among Thai Children

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Assessing pesticide exposure and resulting health effects is becoming more and more important in Thailand, which has experienced a four-fold increase in the use of pesticides for crop production since 2000. A new study found that children living on rice farms in Thailand experienced higher exposures to organophosphate (OP) and pyrethroid pesticides compared with U.S. farm children of similar age. However, the high exposures did not predict adverse outcomes in neurobehavioral tests.

Organophosphates and pyrethroids are the major pesticide classes used for crop protection in Thailand. (Photo courtesy in Mark Robson)

Led by Nancy Fiedler, Ph.D., a professor of environmental and occupational medicine at Rutgers University School of Public Health, the study investigated exposure to pesticides and the corresponding health effects among children. The study, performed in collaboration with Chulalongkorn University in Bangkok, Thailand, evaluated neurobehavioral effects among 6- to 8-year-old children living in the central farming region of Thailand.

“To our knowledge, this is the first study to evaluate neurobehavioral health effects among Thai children who are routinely exposed to higher concentrations of organophosphate and pyrethroid insecticides than in the developed world,” said Fiedler.

Organophosphates and pyrethroids are common pesticides known to disrupt neurodevelopment. Several birth cohort studies have shown an association between prenatal or early-life organophosphate exposure and poorer measures of intelligence around age 7, such as lower mental and motor development scores, and reductions in perceptual reasoning and working memory. Other studies have found that children living in farm areas are more highly exposed to certain pesticides, such as organophosphates. According to the authors, limited resources have prevented adequate characterization of the health consequences of these exposures, especially for children.

Examining Exposures and Health Effects

For the new study, the researchers recruited 54 children in regions outside of Bangkok, Thailand. They compared children from a rice farming community, where pesticides are applied on rice crops, to children

from a shrimp aquaculture farming community, which requires little to no use of pesticides. In both groups, pyrethroid pesticides were used by households for mosquito control.

Each participant completed a set of neurobehavioral tests six months apart during high and low pesticide use seasons, based on the rice farming schedule. On the morning of each neurobehavioral appointment, urine samples were collected to measure pesticide metabolites, a way to estimate pesticide exposure.

Assessing the Differences

Compared to the children living on aquaculture farms, rice farm participants had significantly greater organophosphate and pyrethroid metabolite concentrations indicative of exposure. For most of the metabolites, there were no significant differences between high and low use time periods. One pyrethroid metabolite, DCCA, was higher in rice participants only in the high use season. There were several high values for both groups of participants during the low use season, which are likely from pyrethroid use in households to control mosquitos.

Despite significantly greater metabolite concentrations as compared with the aqua farm participants, rice farm participants didn't show significantly worse neurobehavioral performance during high or low pesticide use seasons. Previous studies have also shown that concurrent OP exposures are not associated with reduced mental development and that prenatal exposure may be more predictive of adverse neurological effects.

Although differences were not significant, the authors add that small differences in the results suggest that they cannot rule out small to modest adverse effects on some neurobehavioral tests in the children from the rice farming community. They posit that a larger sample size and better markers of prenatal and early childhood exposure are needed to adequately assess the health impacts.

A Thai research assistant (right) is conducting a computerized neurobehavioral test known as the Behavioral Assessment Research System with a child in the study. A significant part of this project also involved building capacity among the Thai faculty and graduate students at Chulalongkorn University to conduct these human studies. (Photo courtesy of Nancy Fiedler)

"Although it was assumed that exposure would decline during seasons when OP pesticides are not applied as frequently in the rice fields, this was not reflected in the biomarkers measured in this study, implying that these children are consistently exposed throughout the year," said Fiedler. "This study also highlights the importance of developing and collecting measures of chronic exposure

particularly among those most vulnerable to potential health effects, such as children in developing countries."

Source: Fiedler N, Rohitrattana J, Siriwong W, Suttiwan P, Ohman Strickland P, Ryan PB, Rohlman DS, Panuwet P, Barr DB, Robson MG. 2015. Neurobehavioral effects of exposure to organophosphates and pyrethroid pesticides among Thai children. Neurotoxicology 48:90-99. doi: 10.1016/j.neuro.2015.02.003.