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Insecticide-induced changes in amphibian brains: How sublethal concentrations of chlorpyrifos directly affect neurodevelopment

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Abstract

Widespread use of pesticides often contaminates natural habitats, exposing nontarget organisms to pesticides that were designed to control pest populations. Even low levels of pesticides can affect aquatic communities both directly and indirectly. Previous work has shown that trace amounts of the pesticide chlorpyrifos altered tadpole morphology and neurodevelopment in artificial ponds (mesocosms). To determine whether effects resulted from direct chlorpyrifos exposure or from disruption of the food web due to a pesticide-induced decline in zooplankton, we examined the impacts of chlorpyrifos on amphibian development in the presence of chlorpyrifos-resistant zooplankton, a key component of the aquatic trophic community. Northern leopard frog (Lithobates pipiens) tadpoles were reared through metamorphosis in mesocosms containing either 0 or 1 µg/L chlorpyrifos and either chlorpyrifos-resistant or chlorpyrifos-sensitive Daphnia pulex zooplankton. Developmental exposure to chlorpyrifos resulted in metamorphs with a relatively wider optic tectum, medulla, and diencephalon compared with controls, and this result was found regardless of the zooplankton population within the mesocosm. Thus, chlorpyrifos directly impacted brain development, independent of the effects on the trophic community. With respect to body shape, chlorpyrifos had no effect on body shape of metamorphs reared in mesocosms with chlorpyrifos-sensitive zooplankton, but body shape was sensitive to zooplankton population in the absence of chlorpyrifos. To conclude, low, ecologically relevant doses of organophosphorous pesticides can directly impact neurodevelopment in a vertebrate model. Environ Toxicol Chem 2018;37:2692-2698. © 2018 SETAC.

Keywords: Acetylcholinesterase inhibitors; Gape width; Insecticide; Neurology; Organophosphate; Rana pipiens.

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