Can Pesticide Exposures Impact Mental Health?

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I've been a licensed psychotherapist for more than 50 years and the Executive Director of the Maryland Pesticide Education Network (MPEN) since 1994. Given my dual professional history, the issue of how pesticide impact human mental health has long been of concern to me.

Early in my career as a therapist, I worked in a New York psychiatric hospital on a locked unit for patients diagnosed with some form of psychosis. During my 5 years on the unit, I and other unit staffers noticed times when it appeared all the patients on the unit would take a few steps backward, confusing the staff as to whether each of them was on the appropriate level of medication, and thereby, confusing their treatment plans. We sometimes thought there might be a full moon causing this unexplained general slip in our patients' well-being, yet rarely was there a full moon correlation. However, we did notice it sometimes happened when pesticides were applied, either indoors for pests or outdoor applications on our beautifully landscaped grounds. Still, it really didn't register then, that these were chemicals we and our patients were being exposed to, and how they may adversely interact with patient conditions and medications – potentially complicating diagnosis and treatment. Now we know pesticides can impact mental health.

Since the launch of MPEN's *IPM in Health Care Facility Project* in 2007, we work with Maryland health care facilities, including psychiatric facilities and facilities for children and adults with special needs. A growing body of research makes it clear that pesticides can impact mental, neurological and developmental health. They can also exacerbate existing mental, neurological, and developmental issues, and critically confuse diagnosis and treatment of related issues.

Increasingly, research links pesticide exposures to impacts beyond the well-known short- and long-term effects on physical health. This is a critical issue, especially for schools and health care facilities, including facilities that specialize in addressing psychiatric, developmental, and neurological issues. Pesticide exposures have been linked to causing and exacerbating depression, anxiety, bi-polar disorder, aggression, psychosis, dementia, ADHD, and more. And of course, pesticides may also impact providers caring for these vulnerable populations, who may also have pre-existing issues, such as depression and anxiety.

The article, Links between Pesticide Exposures and Mental Health, authored by the Mental Health and Environment Working Group of the Collaborative on Health and the Environment (CHE) provides a clinical and concerning overview regarding mental health impacts from pesticide exposure:

> *A growing body of research supports the association between pesticide exposure and adverse human health effects including depression, ADHD, anxiety, confusion, memory loss, lethargy, pervasive developmental disorders, unprovoked extreme agitation, anger, rage, and violence.*
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> *Epidemiological evidence suggests that mood changes after acute exposures can continue for many years and that repeated high exposures greatly increase the risk of mood disorders. Given that symptoms may not occur until after a period of repeated exposures, health care providers should consider both acute and chronic exposures when evaluating patients.*

The article cites 36 studies addressing this issue ranging from 1947–2009. Since this article was published, there has been significant research conducted that has added to an ever-growing body of research on the issue.

In 2021, after 20 years of research, the US Environmental Protection Agency (EPA) banned the use of the baby brain-harming pesticide chlorpyrifos on food crops after they found it to be harmful at any detectable level. Prior to this EPA decision, Maryland banned ALL uses of this pesticide in our state. Chlorpyrifos is linked to serious adverse long-term neuro-developmental impacts.

The federal Agricultural Health Study (funded by the National Cancer Institute and the National Institute of Environmental Health Sciences in collaboration with the United States Environmental Protection Agency), that addresses impacts of pesticides on farmer families' mental health found, for example, that pesticide applicators with greater exposure were more likely to experience depression and it also found links between depression and pesticide exposures in farm women.

Other studies conducted with communities living near agricultural fields – where residents have consistent exposures to pesticides – found higher rates of health and mental health issues.

Pesticides used in agriculture are also commonly used for land care and indoor/outdoor pests. In addition, certain widely used classes of endocrine-disrupting pesticides including synthetic pyrethroids which are often used for mosquito control, bed bugs, and more, can have an inverse reaction, whereby the

lower the dose the more adversely impactful, countering the long-held belief that the "dose makes the poison"! This ground-breaking research underscores how we need to be vigilant when a pest control company a facility contracts with reassures an institution manager (and the public) that they are using the lowest "safer" dose possible, when in fact lower dose does not always mean it's actually "safer."

Given what we already know regarding pesticides and mental illness, we need to consider how pesticide exposures in our facilities, schools, homes and elsewhere may potentially seriously complicate diagnosis and treatment of those with mental health issues.

Some additional studies of note are listed below.

Symptoms Related to Two Major Classes of Pesticides

Synthetic Pyrethroids (frequently used in mosquito control, and indoor applications):

- This review found that in 66.6% of the studies reviewed (8 of 12 studies), agricultural workers or their children occupationally exposed to pyrethroid pesticides have a higher risk of presenting difficulties in their neurocognitive, neuromotor, or neurobehavioral performance, mainly associated with attention, processing speed (linked to hand-eye coordination), and motor coordination.
- This study correlates exposure to geriatric depression.
- This regional study identified higher rates of Autism Spectrum Disorder (ASD)/Developmental Delay (DD) diagnoses in an area with aerial pesticides application. Zip codes with aerial pyrethroid exposure were 37% more likely to have higher rates of ASD/DD (adjusted RR = 1.37, 95% CI = 1.06-1.78, p = 0.02).

Organophosphates and Carbamate Pesticides: "Exposure to agricultural pesticides puts farmers at six times greater risk of exhibiting depressive symptoms, including chronic anxiety, irritability, restlessness, and sadness. Pesticide exposure from farms or commercially-managed fields threaten residential (non-occupational) populations living nearby, who are more likely to have high depressive symptoms."

Pesticides Linked to Behavioral and Neurological Impacts including ADHD, Impulsivity, and Autism

- Study confirms pesticide exposure is associated with elevated risk of depressive symptoms in the general population
- A pest to mental health? Exploring the link between exposure to agrichemicals and mental health
- Developmental delays (DD) and autism spectrum disorders (ASD)
- Prenatal and infant exposure to ambient pesticides and autism spectrum disorder in children
- Association of maternal insecticide levels with autism in offspring from a national birth cohort
- Prenatal organophosphate insecticide exposure and infant sensory function
- The relationship between pesticide exposure during critical neurodevelopment and autism spectrum disorder

Depression and Anxiety in Adolescents:

- Associations of acetylcholinesterase inhibition between pesticide spray seasons with depression and anxiety symptoms in adolescents, and the role of sex and adrenal hormones on gender moderation
- Chemical threats: Researchers are discovering potential links between chemicals in common household items and damage to developing brains
- Biomarker of pesticide exposure tied to depressive symptoms among teens

Pesticides and ADHD:

- Association of pyrethroid pesticide exposure with attention-deficit/hyperactivity disorder in a nationally representative sample of U.S. children
- Pesticide exposure and child neurodevelopment
- An anthropological approach to the evaluation of preschool children exposed to pesticides in Mexico
- Occupational pesticide exposure and symptoms of attention deficit hyperactivity disorder in adolescent pesticide applicators

Pesticides, Violence and Aggression:

- Case control study of impulsivity, aggression, pesticide exposure and suicide attempts using pesticides
- Pesticides lead to brain damage, mass dhootings, violence, and hatred

"The widespread use of pesticides may be the biggest threat to mental health and humanity that we face at this time and for generations to come. If it is not addressed, it may dramatically alter the course of the human race and reshape the fabric of society itself forever."