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## **LONG-TERM PESTICIDE EXPOSURE MAY INCREASE RISK OF DIABETES**

Licensed pesticide applicators who used chlorinated pesticides on more than 100 days in their lifetime were at greater risk of diabetes, according to researchers from the National Institutes of Health (NIH). The associations between specific pesticides and incident diabetes ranged from a 20 percent to a 200 percent increase in risk, said the scientists with the NIH's National Institute of Environmental Health Sciences (NIEHS) and the National Cancer Institute (NCI).

"The results suggest that pesticides may be a contributing factor for diabetes along with known risk factors such as obesity, lack of exercise and having a family history of diabetes," said Dale Sandler, Ph.D., chief of the Epidemiology Branch at the NIEHS and co-author on the paper. "Although the amount of diabetes explained by pesticides is small, these new findings may extend beyond the pesticide applicators in the study," Sandler said. Some of the pesticides used by these workers are used by the general population, though the strength and formulation may vary. Other insecticides in this study are no longer available on the market, however, these chemicals persist in the environment and measurable levels may still be detectable in the general population and in food products. For example, chlordane, which was used to treat homes for termites, has not been used since 1988, but can remain in treated homes for many decades. More than half of those studied in the National Health and Nutrition Examination Survey in 1999-2002 had measurable evidence of chlordane exposure. "This is not cause for alarm," added Sandler "since there is no evidence of health effects at such very low levels of exposure."

Overall, pesticide applicators in the highest category of lifetime days of use of any pesticide had a small increase in risk for diabetes (17 percent) compared with those in the lowest pesticide use category (0-64 lifetime days). New cases of diabetes were reported by 3.4 percent of those in the lowest pesticide use category compared with 4.6 percent of those in the highest category. Risks were greater when users of specific pesticides were compared with applicators who never applied that chemical. For example, the strongest relationship was found for a chemical called trichlorfon, with an 85 percent increase in risk for frequent and infrequent users and nearly a 250 percent increase for those who used it more than 10 times. In this group, 8.5 percent reported a new diagnosis of diabetes compared with 3.4 percent of those who never used this chemical. Trichlorfon is an organophosphate insecticide classified as a general-use pesticide that is moderately toxic. Previously used to control cockroaches, crickets, bedbugs, fleas, flies and ticks, it is currently used mostly in turf applications, such as maintaining golf courses.

"This is one of the largest studies looking at the potential effects of pesticides on diabetes incidence in adults," said Freya Kamel, Ph.D., a researcher in the intramural program at NIEHS and co-author in the paper appearing in the May issue of the "American Journal of Epidemiology." "It clearly shows that cumulative lifetime exposure is important and not just recent exposure," said Kamel. Previous cross-sectional studies have used serum samples to show an association between diabetes and some pesticides.

Diabetes occurs when the body fails to produce enough insulin to regulate blood sugar levels or when tissues stop responding to insulin. Nearly 21 million Americans have diabetes. The cause of diabetes continues to be a mystery, although genetics and environmental factors such as obesity and lack of exercise appear to play roles.

To conduct the study, the researchers analyzed data from more than 30,000 licensed pesticide applicators participating in the Agricultural Health Study, a prospective study following the health history of thousands of pesticide applicators and their spouses in North Carolina and Iowa. The 31,787 applicators in this study included those who completed an enrollment survey about lifetime exposure levels, were free of diabetes at enrollment, and updated their medical records during a five-year follow-up phone interview. Among these, 1,171 reported a diagnosis of diabetes in the follow-up interview. The majority of the study participants were non-Hispanic white men.

Researchers compared the pesticide use and other potential risk factors reported by the 1,171 applicators who developed diabetes since enrolling in the study to those who did not develop diabetes. Among the 50 different pesticides the researchers looked at, they found seven specific pesticides -- aldrin, chlordane, heptachlor, dichlorvos, trichlorfon, alachlor and cynazine -- that increased the likelihood of diabetes among study participants who had ever been exposed to any of these pesticides, and an even greater risk as cumulative days of lifetime exposure increased.

All seven pesticides are chlorinated compounds, including two herbicides, three organochlorine insecticides and two organophosphate pesticides.

"The fact that all seven of these pesticides are chlorinated provides us with an important clue for further research," said Kamel. Previous studies found that organochlorine insecticides such as chlordane were associated with diabetes or insulin levels. The new study shows that other types of chlorinated pesticides, including some organophosphate insecticides and herbicides, are also associated with diabetes. The researchers also found that study participants who reported mixing herbicides in the military had increased odds of diabetes compared to non-military participants.

The Agricultural Health Study (AHS) <<http://aghealth.nci.nih.gov/>> is a prospective study of licensed pesticide applicators from North Carolina and Iowa recruited in 1993-1997 at the time of license renewal. The cohort includes 4,916 commercial applicators from Iowa and 52,395 private applicators, mostly farmers, from both states. More than 75 percent or 32,347 spouses of married private applicators also enrolled in the cohort. The study is a collaboration of the National Institute of Environmental Health Sciences (NIEHS), the National Cancer Institute (NCI), the Environmental Protection Agency (EPA) and the National Institute for Occupational Safety and Health (NIOSH).

For more information about cancer, please visit the NCI Web site at <<http://www.cancer.gov/>>, or call NCI's Cancer Information Service at 1-800-4-CANCER (1-800-422-6237).

The primary mission of the National Institute of Environmental Health Sciences <<http://www.niehs.nih.gov/>> (NIEHS), one of 27 Institutes and Centers at the National Institutes of Health, is to reduce the burden of human illness and disability by understanding how the environment influences the development and progression of human disease. For additional information, visit the NIEHS Web site at <<http://www.niehs.nih.gov/>>.

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#### REFERENCE:

Montgomery MP, Kamel F, Saldana TM, Alavanja MCR, Sandler DP. Incident diabetes and pesticide exposure among licensed pesticide applicators: Agricultural Health Study 1993 - 2003, "Amer J Epidemiol," 2008;167:1235-46.