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## Do pesticide fumes pose a threat to golfers?

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Since the pesticides that managers apply to golf courses are designed to kill living organisms, it's reasonable to suspect they could harm golfers, too. But documenting the potential health hazards of golf course pesticides hasn't been easy to do through field research, leading two Cornell University engineers to use a modeling approach instead.



*Do the pesticides that help keep golf greens pristine pose a threat to golfers? Despite doing an exhaustive search of a large number of pesticides in all major climatic zones of the United States, researchers at Cornell University could find no evidence of health risk to golfers from inhaling pesticide vapors. Photo courtesy of VancityAllie.com.*

In the Nov.-Dec. 2013 issue of the *Journal of Environmental Quality*, Hywel Wong and Douglas

Haith describe a comprehensive modeling **study** of pesticide release to the air from U.S. golf courses and the risks golfers face from inhaling pesticide fumes. Although several pesticides in the analysis were volatile and produced relatively high levels of vapors, the Cornell researchers could identify no chronic health risks.

This result goes against certain field studies, in which scientists have found that golfers' exposure to inhaled chemicals during play can exceed reference doses associated with chronic diseases. The difficulty with such studies, say Wong and Haith, is that their high cost limits them to a small number of chemicals and a single location.

Meanwhile, golfers pursue their game in every region of the United States, where they're exposed to dozens of different pesticides under many possible weather conditions. Wong and Haith wanted to get a more complete picture of the risks posed by pesticide vapors. So they used a mathematical model to simulate the volatility levels and resulting air concentrations of 37 pesticides registered for use on greens, tees, or fairways. The study was also nationwide in scope, covering all major U.S. climatic regions.

The engineers tested the model by comparing its estimates of pesticide air concentrations with actual measurements from field experiments for eight pesticides taken at the University of Massachusetts Turfgrass Research Center. The comparison suggested that the model performed well—explaining more than 80% of the variation in actual air concentrations. From this and other performance features, Wong and Haith concluded it provided a credible basis for assessing the chronic health risks of pesticide exposure.

Next, the researchers applied the model to the 37 pesticides and nine climatic regions. Despite the large regional variations in volatility levels, air concentrations, and health risks uncovered by the model, it still found that only 14 of the chemicals volatilized more than 0.1% of their mass at any location. In other words, more than 60% of the commonly used pesticides in the study showed little volatility.

But several pesticides, notably benefin, clopyralid, pendimethalin, and trifluralin, did lose substantial amounts of their mass as vapors, with averages over all sites of 4.0, 3.2, 3.9, and 8.3% of applications. So from there Wong and Haith estimated the chronic health risks that might result from inhaling the fumes of these pesticides and others in the study.

They did this by determining the golfer “lifetime average daily dose” (LADD) of each pesticide, calculated from predicted air concentrations. Each value was then compared with a chronic reference dose—the daily exposure over a 70-year life span that produces no harmful health effects (cancer excluded). Since the chronic reference dose doesn’t take into account cancer, the researchers also measured the “incremental cancer risk” for golfers. Risks of more than a million to one are generally considered unacceptable.

Even though several of the pesticides produced relatively high amounts of vapors according to the model, the lifetime dose golfers were predicted to receive was far below the safe “reference dose.” In fact, reference doses exceeded estimated golfer lifetime doses by a factor of 10,000 for all chemicals and locations.

Similarly, cancer risks for 10 pesticides considered likely or possible carcinogens were determined to be less than one in a hundred million.

Thus, say Wong and Haith, despite conducting an especially thorough search involving a large number of chemicals, all major climatic zones in the United States, and a conservative fate and transport model for pesticides, they could find **no evidence of health risk to golfers from pesticide vapors**. This doesn't mean that golf courses should feel free to spray pesticides with abandon. But it does suggest that fumes resulting from the current levels of pesticide use don't pose a serious threat to golfers' health.

Summarized from: Hywel Wong and Douglas A. Haith. 2013. Volatilization of Pesticides from Golf Courses in the United States: Mass Fluxes and Inhalation Health Risks. [View abstract](#)

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