Carcinogenic Crops

Analyzing the Effect of Aflatoxin on Global Liver Cancer Rates

Tree nuts and groundnuts, along with maize and other grains, can harbor aflatoxins, naturally occurring fungal metabolites that have been identified as risk factors for developing liver cancer. This association has most often been seen in people infected with hepatitis B virus (HBV). A new study examines the aflatoxin/HBVrelationship to offer the first quantitative risk assessment of the number of liver cancer cases worldwide caused by aflatoxin [*EHP* **118:818–824; Liu and Wu**].

Although a relatively rare malignancy in developed countries, liver cancer is a common health threat in developing regions of the world including Southeast Asia, China, and sub-Saharan Africa. These same regions have higher prevalence of HBV infection as well as higher levels of aflatoxin contamination in food due to a lack of resources to control the fungi *Aspergillus flavus* and *Aspergillus parasiticus*, which infiltrate crops and produce aflatoxin. Research has shown that individuals with chronic HBV infection and aflatoxin exposure are up to 30 times more at risk for liver cancer than uninfected individuals exposed to aflatoxin.

Aspergillus flavus

In the current study, researchers analyzed information on food consumption patterns, aflatoxin biomarker levels in serum and urine, HBV prevalence, and population size in different world regions to quantify the subsequent risk of developing liver cancer. The investigators found that consumption of maize and groundnuts was higher overall in African and Asian countries than in wealthier, more developed nations, leading to increased aflatoxin exposure. However, risk of aflatoxin-induced liver cancer could vary widely within a given nation: urban populations with more diverse diets had lower aflatoxin exposures than their rural counterparts, and there also was a lower HBV prevalence in urban populations.

The authors concluded that uncontrolled exposure to aflatoxin may cause 4.6–28.2% of all liver cancer cases globally, with China, Southeast Asia, and sub-Saharan Africa bearing the brunt of the burden. This broad range reflects the uncertainty and variability of the available data on aflatoxin exposure and HBV prevalence. One thing does seem certain, they write: if more interventions to control aflatoxin and its health risks (for instance, improved storage protocols and vaccination for HBV) were administered in regions where they are most needed, liver cancer incidence could be significantly reduced worldwide.

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Stress and the City

Measuring Effects of Chronic Stress and Air Pollution

Scientists have begun to consider an association between chronic psychosocial stress and increased susceptibility to adverse physiologic effects from exposures to air pollution. Although epidemiologic evidence tends to support that hypothesis, it has proven difficult to untangle the complex web of exposure effects, stressors, and mechanisms behind the potential differences in susceptibility. A new laboratory study documents different responses to air pollution in stressed and nonstressed rats, supporting the epidemiologic evidence that chronic stress may alter respiratory responses to air pollution [*EHP* **118:769–775; Clougherty et al.**]. The protocol described in the study may provide a template for future controlled experiments to explore associations between psychosocial and environmental factors.

The authors randomly divided 24 rats into four groups—stress plus exposure to uniform doses of concentrated ambient particulates (CAPs), nonstress plus exposure to CAPs, stress plus exposure only to filtered air (FA) from which particles were removed, and nonstress plus exposure to FA. Each animal in the two stress groups was individually put into the cage of a dominant male rat for 20 minutes at a time, twice per week; the older male behaved territorially and aggressively toward the younger test rodents, which were able to protect themselves from scratches and bites by retreating into a Plexiglas tube in the cage. On the day following each stress exposure, animals were exposed to either CAPs or FA for 5 hours. All exposures occurred at the same time each day to account for normal diurnal variation in the animals' stress hormone and activity levels.

Respiratory responses were monitored continuously during the CAPs/FA exposure periods. Both CAPs-exposed groups had a significant response to the exposure, but the stress group exhibited greater breathing frequency, shorter inhalation and exhalation times, and lower expiratory flows and tidal volumes—that is, a rapid, shallow breathing pattern—compared with the nonstress group.

The researchers also observed changes in levels of several systemic inflammatory biomarkers associated with airway disease. Stress alone or CAPs exposure alone elevated some biomarkers, but only the group exposed to both stress and CAPs showed elevated levels of C-reactive protein and increased numbers of lymphocytes and monocytes, indicating the combination of exposures may have a different effect on inflammation than either exposure alone. This finding provides evidence that chronic stress may increase susceptibility to effects of air pollution on respiratory diseases.

As far as human exposures go, the authors note that social stressors (such as poverty and violence) and environmental exposures (such as traffic-related pollution) may be spatially correlated; "thus," they write, "the most pollution-exposed communities may also be the most susceptible." Although this study was small, it points wto important new ways to characterize the combined physiologic impact of those real-world phenomena.

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Keeping an Eye on $PM_{2.5}$

Satellite Data Reveal Global Picture of Particulate Pollution

Scientists are using satellite observations to provide estimates of air quality with increasing reliability. For the first time researchers have now used satellite data to provide long-term air quality estimates of fine particulate matter ($PM_{2.5}$) that span the globe [*EHP* **118:847–855; van Donkelaar et al.**]. The study showed that many developing countries have high long-term levels of $PM_{2.5}$, which is produced by sources such as forest fires, coal-fired power plants, vehicles, and industrial facilities. These particles pose a health concern because of their ability to penetrate deep into the lungs.

The study used satellite data gathered over 6 years, remarkably providing some of the first long-term measurements of air quality for many regions where ground-level sampling stations are few or nonexistent. The scientists combined data gathered from two different NASA satellite instruments with different capabilities—MODIS (Moderate Resolution Imaging Spectroradiometer) and MISR (Multiangle Imaging Spectroradiometer)—to generate a more accurate estimate of $PM_{2.5}$. The satellite data yield a measurement called aerosol optical depth (AOD), which relates to the total amount of aerosol particles in the air between the ground and the satellite. The scientists combined AOD from the two satellites, then applied a chemical-transport model that integrated details about atmospheric structure and chemistry. The authors validated this approach by comparing their estimates to those taken from actual sampling performed at the ground level and found a statistically significant level of agreement.

The estimates showed that 80% of the global population lives in places where concentrations of $PM_{2.5}$ exceed the World Health Organization (WHO) air quality guideline of 10 μg/m^3. The WHO has set an interim target of 35 μg/m^3, which is exceeded over central and eastern Asia for 38% and 50% of the population, respectively. (The WHO guideline sets an ultimate goal for national air standards, whereas the interim target is proposed as an incremental reduction that could achieve significant, though not optimal, reductions in pollution-related health effects.) Eastern China showed a very high level of pollution—an estimated annual average of more than 80 μg/m^3.

The authors state that the methods described and validated by the study could be applied to studies of health effects from exposure to air pollution around the world. This is particularly true for areas where ground-based sampling is lacking, many of which are sites of rapid urbanization, where large populations are exposed to high levels of air pollution. They note that additional work is needed to address issues that may limit the accuracy of the satellite-based estimates, such as non-uniform satellite sampling and the satellites' inability to retrieve AOD under cloudy conditions.

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A Marked Disadvantage

Rapid Urbanization and Mortality of Young Children in Nigeria

Individual-level socioeconomic position has long been recognized as a factor in childhood mortality, with lower position carrying a higher risk of death before age 5. Recent research suggests that living in a socioeconomically disadvantaged area increases a child's risk even after adjusting for factors such as mother's education or income. A new study using data from Nigeria shows higher rates of under-5 mortality coincided with increased urbanization and uniquely accounts for the impact of disadvantaged neighborhoods on mortality in this age group [*EHP* **118:877–883; Antai and Moradi**].

The pace of urbanization in low- and middle-income countries, paired with inadequate economic performance and other constraints, can result in urban residents increasingly living in areas with overcrowded or deteriorating housing, few social amenities, poor environmental and sanitary conditions, and a lack of economic opportunities. Such conditions are associated with an increased risk of infectious disease and death, with under-5 mortality rates in particular reflecting the degree of socioeconomic development in specific geographic areas.

Nigeria has very rapidly shifted from a mostly rural nation to a heavily urbanized one. In 1970 only 16% of the population lived in an urban area compared with an estimated 40% or more today. The current study used cross-sectional data from the 2003 Nigeria Demographic and Health Survey to assess how urbanization related to under-5 mortality rates and to evaluate the influence of area-level socioeconomics. A subsample of 1,350 mothers and 2,118 of their children, representing 165 administratively defined communities, was selected from the data, which provided demographic and socioeconomic information as well as children's birth order and time intervals between siblings' births. Neighborhoods were ranked by "urban area disadvantage index" scores, calculated by the percentage of children living in households without piped water, flush toilets, electricity, or nonpolluting cooking fuel; whose mothers were unemployed or uneducated; and whose households were overcrowded or among the poorest 40%.

Analysis revealed that under-5 mortality increased in the periods 1979–1983 and 1999–2003. Additionally, after controlling for individual child and maternal factors, under-5 mortality rose with urban area disadvantage index score. The researchers concluded that living in a socioeconomically disadvantaged neighborhood independently increased mortality for children under 5 years old. Additionally, they confirmed other research showing that first-born status and short interval between births increased the risk of early childhood death. This study highlights a need for data to better define relationships between urban environments and health, a focus on reducing inequalities, and a promotion of longer birth intervals.

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Children play in the Lagos slum of Ajegunle, known locally as AJ City.

George Osodi/Panos Pictures