Advancing Industrial Livestock Production

Health Effects Research and Sustainability

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In this issue of Epidemiology, Schinasi et al. make an important addition to the growing literature regarding adverse health effects of community exposures to emissions from animal feeding operations. Several controlled epidemiologic studies have reported increased respiratory and other symptoms among residents living close to animal feeding operations, but this is the first study to measure symptomatic and functional responses to specific, well-recognized environmental exposures arising from the industrial production of swine. Even with a relatively small study population of 101, qualitative but repeated measures of odor, H2S (a characteristic emission that comes from animal feeding operations and no other common rural source), PM10, PM2.5, and endotoxin were related to eye and nasal irritation, respiratory symptoms, difficulty breathing, wheezing, chest tightness, nausea, and declines in forced expiratory volume (FEV1). These findings are highly consistent with well-documented adverse health effects among those who were occupationally exposed to animal feeding operations, as well as with the community-based studies cited above.

This research team from the University of North Carolina joined with the Concerned Citizens of Tillery to conduct a community-driven, participatory, and longitudinal study. Their methodological approach is worthy of replication for a number of reasons. The authors have previously documented the reliability and objectivity of this research project in a population of predominantly black, eastern North Carolina residents in 16 communities and living within 2 miles of 1–16 animal feeding operations. Ironically, the poverty and lack of political capital that ties environmentally exposed populations such as these to their homes and communities not only motivates the exposed population to participate in research, but also limits the outward migration of those with exposure-associated health effects (such as asthma), which has been observed in more prosperous rural communities with animal feeding operations. This tends to reduce the selection bias typically observed in populations exposed to airway irritants.

The longitudinal study design, with repeated (hundreds) of well-selected measures of biologically relevant acute responses over a 2-week period, provided robust health outcome data. A common misconception is that clinical diseases are the only valid health outcomes, but clinical endpoints such as doctor-diagnosed asthma or chronic changes in lung function are late manifestations of environmental exposures. Furthermore, these endpoints are highly susceptible to selection bias in dose-response studies of airway irritants. It is instructive to note that the US Supreme Court upheld the Department of Labor Cotton Dust Standard which concluded that “grade 1/2 byssinosis (occasional Monday chest tightness) and associated pulmonary function decrements are significant health effects in themselves and should be prevented in so far as possible.” Episodic dose-related respiratory symptoms and declines in expiratory flow are clearly valid measures in setting public policy.
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Schinasi et al\(^1\) also collected thousands of measures of exposures relevant to animal feeding operations, paired with repeated measures of acute responses. This approach overcame some study limitations. One was the study’s focus on a single exposure site in each community, which would be expected to misclassify individual home exposures but would tend to bias exposure estimates toward the null. Another limitation addressed by this design is the even smaller number of available lung-function measurements (limited by PM and endotoxin measurements in 12 communities); nevertheless, declines in FEV\(_1\) were found to be associated with unit increases in PM\(_{2.5}\). A third exposure-related limitation was the presence of the study’s highly visible air-monitoring equipment. The presence of such equipment may well have limited usual waste-management practices (such as spraying of hog waste) during the study period, thereby limiting higher exposures that would likely cause more prevalent acute responses. Nonetheless, substantially significant health effects were observed.

Finally, unlike occupationally exposed populations (who are relatively healthy), community residents typically include more susceptible members of society—children, the elderly, and those with chronic diseases. So as to not bias their study with community residents who may be more susceptible to the effects of swine emissions, the authors chose to study only adult nonsmokers who had a low prevalence of prior respiratory diseases and few exposures to passive smoking. In sum, these investigators avoided common pitfalls of many community-based environmental health studies. In doing so, they have provided both important new dose-response data and a very useful methodological approach to the study of community residents exposed to livestock and other environmental air emissions.

This study has important policy implications. It is not necessarily generalizable to all communities exposed to swine emissions, but it is a broadly-based study of 16 communities in a region of North Carolina that is densely populated with animal feeding operations. These dose-response estimates are therefore a solid starting point for models of exposures and health outcomes, using air-dispersion models now being developed for industrial-livestock exposures. It will be necessary to validate such models with paired health outcome and exposures from various animal feeding operations before more generalizable exposure-based conclusions can be drawn.

While the paper by Schinasi et al\(^1\) focuses only on reports of odor, irritant-related symptoms, and changes in lung function, the environmental and societal effects of industrial livestock production are much broader. Streams and estuaries are polluted by pathogenic organisms, pharmaceuticals, and hormones; antimicrobial resistance is promoted by the use of antibiotics; industrial livestock production contributes to greenhouse gases, (especially methane) and to regional increases in ammonia-related PM\(_{2.5}\); animal abuse occurs through a variety of confine-
exposures. Such an approach would both advance industry-wide sustainability and protect the health of their employees, their communities, and their customers.

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REFERENCES