

Impacts of Industrial Swine Operations on the Health and Well-Being of People Living Nearby

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Introduction

The Interdisciplinary Environmental Clinic at the Washington University School of Law has asked for my opinions regarding impacts of industrial swine operations on the health and well-being of people living nearby. My approach to this subject is based upon my experience as an epidemiologist in a school of public health. My primary research area is environmental epidemiology. I have conducted research into impacts of industrial swine operations on the health and quality of life of neighbors since 1996.

Background

Industrial swine operations are facilities that raise pigs inside buildings and collect the animals' waste in pits or open-air lagoons. The nutrient-rich waste is generally applied to nearby agricultural lands. Air quality around these operations is influenced by gasses and dusts that come from confinement buildings, cesspools, and fields where the waste is applied.¹ Industrial swine operations require a large quantity of water which becomes contaminated with pathogens, antibiotics, and other chemicals. The waste water affects surface and ground water quality.^{2,3}

Pollutants from industrial swine operations impact the global, regional and local environment. At a global scale, methane and ammonia contribute to global greenhouse gasses. Nutrient imbalance from excess nitrogen and phosphorus affect regional ecology and eutrophication of surface waters. Dust particles, ammonia, hydrogen sulfide, and other odorant gasses affect local air quality, and liquid waste can impact local ground water.¹

Methods

I considered research pertaining to impacts of industrial swine operations on the health and quality of life of neighbors. I used the definition of health given in the Preamble to the Constitution of the World Health Organization (WHO): "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity."⁴ This definition is useful as a statement of the positive dimensions of health that should be considered in relation to quality of life, and contrasts with much of medical practice that is focused on diagnosis and treatment of specific diseases rather than on health.

Findings

Cole et al. reviewed literature, citing 251 reports, on occupational and community health effects of industrial swine operations.⁵ This review identified numerous hazardous chemical and biological agents present in swine confinements, found clear evidence of impacts of occupational

exposures on respiratory function and respiratory diseases among workers, and found that several studies of neighbors of swine operations reported elevated levels of symptoms similar to those shown by workers. A study of 155 rural residents in eastern North Carolina found that neighbors of a swine confinement reported more frequent headaches, upper respiratory and gastrointestinal symptoms and more mucous membrane irritation than residents of matched communities. Swine operation neighbors reported more frequent occasions when they could not open their windows or go outside even in nice weather more often than the other rural residents, and they also reported many more problems with livestock odor.⁶

Industrial swine operations are well-known for their obnoxious odors. RW Bottcher of the NC State University Department of Biological and Agricultural Engineering describes the complex mixture of chemical compounds emitted from these facilities as “uniquely offensive.”⁷ Bottcher notes that environmental odors are, in part, a consequence of the need to ventilate confinement buildings sufficiently to maintain the well-being of the livestock. He observes, “The production and transport of odorants from swine farming operations have a significant impact on the well-being of farm neighbors and the viability of swine operations.”⁷

Bottcher notes that dust plays a role in transport of odorant chemicals from swine operations. Respirable dust particles, known as PM₁₀ (particulate matter less than 10 microns in aerodynamic diameter), are well-known to have negative cardiopulmonary effects and have been associated with “hospital admissions and emergency room visits, school absences, work loss days, restricted activity days, effects on lung function and symptoms, morphological changes, and altered host defense mechanisms.”⁸ These effects are associated with PM per se, not odors. However, to the extent that PM₁₀ plays a role in transport of odorant chemicals, increased levels of PM₁₀ can contribute to reduced health and quality of life among swine operation neighbors. This is an example of one of the classic mechanisms connecting odor and health in which the observation of a health consequence of odor is due to the presence of non-odorant substance that itself is responsible for the health effect.⁹⁻¹¹

Organic dusts that contain bacteria, fungi, endotoxins and antibiotics may play a role in health effects that have been associated with swine operations. In a study of 6,937 residents of a livestock producing area of Lower Saxony, Radon et al. (2007) report that wheezing without a cold and physician-diagnosed asthma increased with reported levels of livestock odor annoyance.¹² Mirabelli et al. found that adolescents who attended schools where staff reported livestock odor inside the school twice or more per month had a 24% higher prevalence of wheezing symptoms than children who attended schools where no odor was reported. Merchant et al. (2005) found an excess of asthma outcomes among Iowa children living on swine operations that add antibiotics to feed; these operations also had larger numbers of livestock.

Malodor can impact health and quality of life due to psychophysiological mechanisms.⁹⁻¹¹ It has long been known that environmental sensory stimuli influence physiological functioning; a classic case is the fight/flight response in which neuroendocrine arousal occurs in response to perceived threat. Odors can clearly induce physiological response. For example, people commonly salivate in response to the odor of food. Physiological response to malodor is receiving increased attention, and research is beginning to address the hypothesis that malodor is a stressor with biological consequences. In a study of 15 swine operation neighbors who

recorded swine odors and collected saliva twice daily for two weeks, Avery et al. found that secretory immunoglobulin A (IgA) concentrations and secretion rates were lower during periods of high swine odor.¹³ In a study of college student volunteers exposed to swine odor in an experimental chamber, Schiffman et al. observed effects of air from a swine confinement building on symptoms but not on secretory IgA.¹⁴ However, malodor does not have the same meaning to experimental subjects for whom the exposure is temporary. In contrast, swine operation neighbors are exposed in and around their homes to unpredictable and uncontrollable “uniquely offensive” odors that may affect their physical health, activities of daily living, use of their property, and the value of their homes. In another German study of 3112 residents, Radon et al. (2004) found that reported levels of livestock odor annoyance were strongly associated with negative physical and emotional health.¹⁵

Conclusions

Environmental malodor can adversely affect health and quality of life. Industrial swine operations are one source of particularly obnoxious environmental malodors. Furthermore, malodorous air pollution from industrial swine operations may be transported and accompanied by respirable dust which is regulated by the US-EPA due to its recognized health effects. Findings of a 2004 workshop, “Environmental Health Impacts of Concentrated Animal Feeding Operations: Anticipating Hazards—Searching for Solutions,” included the recommendation that, “sufficient research supports actions to protect rural residents from the negative impacts of CAFOs on community health.”¹⁶ A growing body of scientific literature supports the conclusion that emissions from industrial swine operations have a negative impact on the health and quality of life of neighboring residents.

References

1. National Academy of Sciences. Air Emissions from Animal Feeding Operations: Current Knowledge, Future Needs. Washington, DC: National Academy Press; 2003.
2. Mallin M. Impacts of industrial animal production on rivers and estuaries. *American Scientist* 2000;88:26-37.
3. Centers for Disease Control and Prevention NCFEH. Proceedings from the Confinement Animal Feeding Workshop. In: *The Confinement Animal Feeding Workshop*; 1998; Washington, D.C.; 1998.
4. WHO. Constitution of the World Health Organization. *Bulletin of the World Health Organization* 2002;80(12):983-4.
5. Cole D, Todd L, Wing S. Concentrated Swine Feeding Operations and Public Health: A Review of Occupational and Community Health Effects. *Environmental Health Perspectives* 2000;108:685-99.
6. Wing S, Wolf S. Intensive Livestock Operations, Health, and Quality of Life among Eastern North Carolina Residents. *Environmental Health Perspectives* 2000;108(3):233-38.
7. Bottcher R. An environmental nuisance: Odor concentrated and transported by dust. *Chemical Senses* 2001;26:327-31.
8. USEPA. Review of National Air Quality Standards for Particulate Matter: Policy Assessment of Scientific and Technical Information. Research Triangle Park, NC: United States

Environmental Protection Agency Office of Air Quality Planning and Standards; 2005
December, 2005.

9. Schiffman S. Livestock Odors: Implications for Human Health and Well-Being. *Journal of Animal Science* 1998;76:1343-55.
10. Schiffman S, Walker J, Dalton P, et al. Potential Health Effects of Odor From Animal Operations, Wastewater Treatment, and Recycling of Byproducts. *Journal of Agromedicine* 2000;7(1):7-81.
11. Shusterman D. Critical Review: The Health Significance of Environmental Odor Pollution. *Archives of Environmental Health* 1992;47(1):76-87.
12. Radon K, Schultze A, Ehrenstein V, van Strein R, Praml G, Nowak D. Environmental exposure to confined animal feeding operations and respiratory health of neighboring residents. *Epidemiology* 2007;18:300-8.
13. Avery R, Wing S, Marshall S, Schiffman S. Perceived odor from industrial hog operations and suppression of mucosal immune function in nearby residents. *Archives of Environmental Health* 2004;59:101-8.
14. Schiffman SS, Studwell CE, Landerman LR, Berman K, Sundry JS. Symptomatic effects of exposure to diluted air sampled from a swine confinement atmosphere on healthy human subjects. *Environ Health Perspect* 2005;113(5):567-76.
15. Radon K, Peters A, Praml G, et al. Livestock odours and quality of life of neighbouring residents. *Ann Agric Environ Med* 2004;11:59-62.
16. Donham K, Wing S, Osterberg D, et al. Community health and socioeconomic issues surrounding confined animal feeding operations. *Environmental Health Perspectives* 2007;115:317-20.



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