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CAFOs

Concentrated Animal Feeding Operations

PUBLIC HEALTH

CAFOs and Public Health:
Emissions and the Respiratory Health of Neighbors

EXPERT REVIEWED

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Introduction

As animal agriculture increases in Indiana, so does the prevalence of concentrated animal feeding operations (CAFOs). CAFOs are facilities that hold and feed large numbers of animals in a confined area for 45 days or more out of the year (see "What is a CAFO?" for more information). These facilities have recently drawn attention from some Indiana citizens concerned about the impact that CAFOs may have on the public health of the surrounding communities. Among these concerns are CAFO emissions, namely hydrogen sulfide, ammonia, and organic dust, and the effects that these compounds may have on the pulmonary health of neighbors.

What follows is a brief summary of recent research examining CAFO emissions focusing on the possible interactions between CAFO emissions and respiratory illnesses in neighboring residents.

CAFO Emissions

There are three main compounds of concern in CAFO emissions: hydrogen sulfide, ammonia, and organic dust. Hydrogen sulfide (H_2S) is a colorless, flammable gas with a noxious odor. It is produced from the bacterial breakdown of organic material in animal wastes. Extremely high concentrations are fatal with exposure to low levels causing sore throat, coughing, shortness of breath, and fluid in the lungs.

Ammonia (NH_3) is a colorless gas with a distinct odor. It is naturally produced by microorganisms in manure and is also used as fertilizer for agricultural crops. As with H_2S, persons in close range to farms could receive more exposure to ammonia than others. Exposure to high levels of ammonia can cause irritation to the nose, throat, and lungs resulting in coughing, burning sensations, and other discomfort. Asthmatics are usually more sensitive to ammonia than others.

Organic dust typically comes from grain, straw, and livestock and can consist of bacteria, pesticides, and animal particles (dander, etc.). Organic dust can be high in endotoxin, a bacterial cell wall component that is highly allergenic in humans. Long-term exposure to organic dust can cause

coughing, wheezing, and congestion. An extreme sensitivity to organic dust can prohibit working in confinement buildings (see reference 1 for more information on specific emissions).

Emission Concentrations at Residences Close to CAFOs

CAFO emissions are usually much lower at residences in the vicinity of the operation than within the confinement buildings themselves. In terms of actual concentrations, a group in Iowa compared emission levels at residences near large swine CAFOs with homes near smaller hoop structure (low-density, solid manure) swine farms as well as homes in areas devoid of livestock. The researchers found that the concentration of hydrogen sulfide (8.42ppb) was highest in homes located near large confinement operations. The concentrations of both carbon dioxide (449.6ppm) and ammonia (12.78ppb), however, were highest in homes located near the smaller, less confined operations[2]. Other studies have found concentrations of emissions to be low (less than 1ppm for ammonia, less than 1ppb for hydrogen sulfide) at property lines adjacent to swine CAFOs.[3]

A more recent study by another group in Iowa measured the levels of ammonia and hydrogen sulfide both inside and outside of residences located near a large swine CAFO. Ammonia concentrations outside the homes ranged from 12 to 55ppb. Ammonia concentrations were significantly higher inside the homes ranging from 29 to 95ppb.

The researchers concluded that sources such as pets and household cleaners contributed to the higher ammonia concentrations inside the houses. Hydrogen sulfide concentrations outside the homes (ranging from 0.4 to 2.4ppb) were statistically no different from concentrations recorded inside the homes (0.7 to 2.5ppb). The group noted that "as a frame of reference, the State of Iowa [uses] a Health Effects Value (HEV) for H_2S of 30ppb at a residence located at or beyond the regulated separation distance, not to be exceeded more than seven one-hour averages per year".[4]

CAFO Emissions and Respiratory Ailments in Neighbors

It has been documented that CAFO emissions can sometimes negatively impact the pulmonary health of those who work inside confinement buildings with poor ventilation for an extended period of time without respiratory protection.

It is problematic, however, to infer that similar effects can be found in neighboring residents as emission concentrations are usually very dilute by the time they reach nearby homes, and to date there are only a few studies available that specifically address CAFO emissions and respiratory illnesses in neighboring residents. A study at Duke University exposed healthy volunteers to air samples collected at a local swine CAFO. The samples were diluted to mimic concentrations that might be found at residences close to the CAFO (e.g., hydrogen sulfide, 24ppb; ammonia, 817ppb; odor 57 times above odor threshold).

Volunteers were exposed to the diluted air samples for one hour and researchers recorded objective health parameters such as blood pressure, temperature, heart rate, respiratory rate, lung function, nasal inflammation, mood, attention, and memory. The researchers also recorded perceived, or self-reported health symptoms.

There were no differences in the objective health measures between the group that was exposed to CAFO air versus the group that was not. Volunteers exposed to CAFO air did, however, have higher incidences of self-reported health symptoms such as headaches, nausea and eye irritation.[5]

There are a handful of studies that have examined CAFO emissions and their possible effects on the pulmonary health of neighbors in more real-life settings. One study that took place in Germany found no correlations between the frequency of odor annoyance and the prevalence of clinical asthma symptoms (non-self-reported), such as certain blood parameters and lung capacity. Increases in self-reported symptoms of asthma, however, (e.g., wheezing without an accompanying cold) correlated with increases in self-reported odor annoyance. That is, the more often the study participants complained of CAFO odors, the more often they reported experiencing asthma symptoms. The study did not examine specific emissions nor did it quantify their concentrations at participants' homes.[6]

Another study in North Carolina focused specifically on CAFO emissions and childhood asthma. It found that the prevalence of wheezing was slightly higher in children who attended schools close to swine confinement

buildings and highest in children attending schools where livestock odor was noticeable at least twice per month.[7]

Another group comparing asthma in children in two different Iowa public schools found an increase in the prevalence of physician-diagnosed asthma in children attending a school located only one-half mile from a CAFO. There were no differences in the severity of asthma between the two groups and the authors cautioned that the differences in the number of physician-diagnosed asthmatics could be due to different sets of physicians in the two areas and physician bias.[8]

Conclusions

Determining the effect of emissions on the pulmonary health of neighbors is difficult because of the lack of published research in this area and conflicting results in the available studies. It is certain that CAFO emissions including hydrogen sulfide, ammonia, and organic dust can have a detrimental effect on the respiratory health of those who work inside the confinement buildings when they are exposed to high levels for long durations. Whether those same symptoms appear in neighbors where emissions are diluted, is unclear. Data from a handful of studies suggest that CAFO emissions can cause an increase in self-reported respiratory symptoms such as wheezing, headache, etc. To date, however, emissions have not been associated with increases in objectively measurable respiratory illnesses.

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