CLINICAL OLFACTORY TESTING IN A HEALTH SURVEY OF WORKERS IN AND RESIDENTS NEAR A SEWAGE PLANT

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The Environmental Health Program (EHP) of the New Jersey Department of Health received numerous calls regarding health problems reportedly around a sewage composting facility. Because of a suspected case of respiratory disease secondary to aspergillus and reports in the literature of allergic reactions to composting among sewage treatment workers, an investigation was conducted.

Several authors, particularly Clark et al. (1984), have reported adverse health effects among workers in sewage treatment facilities involving sludge composting. The reported health effects have included increased rates of: eye and skin irritation; nasal, ear and skin infections; Aspergillus colonization of the nose and throat; and elevated white blood cell and eosinophil counts, hemolytic complement levels, and levels of antibodies to compost-specific endotoxins. The work by Clark et al. indicates that, unlike other types of sewage treatment facilities, sludge composting operations result in clinical findings suggestive of low-grade inflammatory responses.

The most common cause of olfactory symptoms when they are the primary complaint appears to be nasal or sinus diseases, such as chronic rhinitis, chronic sinusitis and nasal polyposis (Goodspeed et al., 1985). One characteristic of these diseases is chronic inflammation of the nasal and sinus mucous membranes. The sense of smell is vulnerable to obstruction of airflow, such as that caused by swollen tissue, since the olfactory receptor area is a tiny patch of mucous membrane located just beyond the extremely narrow olfactory cleft. Obstruction of this airway can result in complete or partial loss of olfactory function. Since many people of this study group had been complaints of irritative symptoms suggesting

an inflammatory response in the nose, it seemed appropriate to include a test of olfactory function in the clinic evaluation.

The Sussex County Municipal Utility Authority (MUA) operates a regional sewage treatment facility in Hardyston Township, a rural community in Northwestern New Jersey. In June 1984, the MUA began to perform onsite sludge composting along with standard sewage treatment processes. Shortly thereafter, neighbors of the site complained to county health officials of chemical-type odors and burning throats and eyes. In August 1984, state authorities contacted the Executive Director of the MUA, who agreed to meet with the complainants and remedy the problem within 10 days.

Because the residents continued to complain of health problems, the MUA hired consultants to identify health problems related to composting and to conduct air monitoring at and near the plant. The consultant reported that low levels of volatile organics and Aspergillus fumigatus, a thermophilic fungus, were found both at the MUA and at a nearby home. Other fungi and bacteria were found at low levels, but were not of concern. There were no detectable levels of sulfides or ammonia. These findings, along with the tentative diagnosis of bronchopulmonary aspergillosis (ABPA) in one of the residents, led the county health officer to request the support of EHP on November 30.

On December 6, EHP staff collected air samples in three nearby residences and the regional high school, located about one-half mile from the plant. Samples were collected for hydrogen sulfide using the NIOSH method, carbon dioxide using Draeger tubes, and volatile organic hydrocarbons using DuPont P-4000 pumps and charcoal collection tubes.

Staff of EHP and the Sussex County Health Department also decided to arrange for medical evaluations of all MUA workers, nearby residents, and residents from a distant but similar township. The January 30, 1985, clinic evaluation included: personal interviews regarding demographic factors, medical history including chemosensory function, smoking history, and various home characteristics that related to indoor air quality; medical examinations including evaluations of mucous membrane and respiratory tract irritation, nasal fungal cultures, and blood tests for Aspergillus complement fixation and RAST tests and immunoglobulin E assays; allergy skin testing; and an olfactory function test based on that used by the University of Connecticut Taste and Smell Center. All testing, except the allergy testing, was conducted by New Jersey Department of Health personnel. Dr. Gent of the University of Connecticut trained the EHP staff to do the olfactory testing and assisted with it during the clinic session.

The environmental sampling conducted on December 6 showed that low levels of isopropanol, ethanol, and components of gasoline were detected at the MUA and inside nearby residences. Levels of carbon dioxide were slightly elevated in some homes. Only a trace level of isobutane was found in the regional high school. No detectable level of hydrogen sulfide was found.

The test of olfactory function administered to everyone 6 years of age or older was a multiple choice task of odor identification. Ten odorants were presented in jars, one at a time to one nostril at a time. Odorants included 7 that stimulated primarily the olfactory nerve and 3 that stimulated the trigeminal nerve as well. Subjects were asked to close their eyes, sniff, and identify each odorant. They could refer, as necessary, to a list containing the 10 test items interspersed with 10 distractors. Subjects were permitted to sniff an item several times

before giving a response and were given feedback after each response. Each item was repeated twice. The test score for each nostril was based on the number of correct responses to the 7 non-trigeminal stimuli. An overall olfactory function score was derived based on the average of the nostril test scores.

The individuals evaluated at the clinic included 75 persons: 86% of the 50 nearby residents; 78% of the 18 MUA workers; and 24% of the 75 non-residents invited to participate. The comparison community was selected based on its similarity to Hardyston in age, sex, racial, and socioeconomic status distribution, and was about 5 miles from the MUA facility. While all study participants were white and the workers were predominantly male, the residential groups differed only in that there were no persons under age 17 in the non-resident group. The individuals invited to the clinic were notified by letter and were also contacted by telephone to obtain the greatest possible response rate. Despite these efforts, the response rate for the non-resident group was surprisingly low for this type of study in New Jersey.

Seventy-eight percent of the non-residents, 64% of the workers and 30% of the residents reported that they had ever smoked tobacco. The workers were more likely than residents or non-residents to smoke heavily and to have passive smoking exposures. Gas heating and cooking were least common among the residents' group.

The self-reported medical data indicated that workers and residents commonly complained of increased phlegm production, headaches, stuffy noses, post-nasal drip, sore throats and eye irritation since June 1984. Workers reported the highest rates of frequent cough, dry cough, and headaches at work. Residents had the highest rates of cough since June, headaches at home, earaches, skin rashes,

and offensive odors at home. Non-residents did not exceed workers or residents on any health complaint. The clinical evaluations showed that 34% of the residents, 29% of the workers, and 17% of the non-residents had nasal abnormalities, including swollen and red nasal passages, and common colds. There were no differences between the groups on ear problems or on chemical or fungal-related abnormalities of the eyes, mouth, chest, skin, or blood pressure. There were no significant differences between study groups on allergy test results. Workers had the highest rates of abnormal white blood cell counts and IgE levels, while residents had a slightly higher rate of abnormal eosinophil counts. Although these differences were not statistically different, 29 percent of the workers and 28% of the residents complained of olfactory deficits, as compared to 17% of the non-residents. Seventy-five percent of the residents stated that the onset of their loss was less than one year in duration, and most attributed the problem to the MUA. Non-residents and workers stated nasal disease as the primary cause of the olfactory deficits. Upon clinical olfactory testing, 29% of the workers, 26% of the residents and 11% of the non-residents were found to have a loss in olfactory ability. The differences between groups were not statistically significant. Olfactory losses have been associated with abnormal eosinophil levels and IgE levels (Goodspeed et al., 1984), but neither of these associations were confirmed by this study. An odds ratio of 9.6 (p 0.01) was found for olfactory loss and clinical evidence of nasal disease.

The environmental contaminants found by both the MUA's consultant and the EHP are probable causes of the mucosal and respiratory irritation and the olfactory deficits found among the workers and residents. The volatile organics detected were not the same in the two sampling sessions, but this may have been due to variations in the many possible sources and environmental conditions. The sources

of the volatile organics are probably common household and industrial products, and not the composting procedure itself. While sulfides were not detected, the limit of detection here was 450 parts per billion which is far above the level for olfactory detectability and is close to the levels known to be irritative. The elevated carbon dioxide levels found in some homes indicate poor ventilation and thus indoor air quality which could also exacerbate irritative symptoms. Although the fungal spore levels were generally low, they could be sufficient to generate health responses in allergic or otherwise sensitive individuals. This study does not indicate, however, that Aspergillus was responsible for the health findings.

The clinical findings here corroborate those of Clark et al. (1984), despite the small number of workers in this study. The workers' and residents' subjective complaints of irritation and olfactory deficit were largely verified by the clinical examination and olfactory tests. The elevated rates of abnormal total white blood cell counts, eosinophil counts, and total IgE levels among workers and residents suggest that immune or inflammatory responses are related to sludge composting.

The conclusions of this study should be interpreted cautiously because of the small sample size and the poor response rate among non-residents. It is interesting to note, however, that olfactory function loss was greatest for the group with the highest exposure and least for the group with the lowest exposure, suggesting that olfactory deficits may indeed be associated with low levels of exposure to common irritants and environmental contaminants.

The clinical testing of olfactory function used for this study was both well-received by participants and easy to use in the field. As more is learned

about the health significance of olfactory deficits in worker and community populations, such an inexpensive, relatively quick, objective evaluation of olfactory complaints would appear to be a useful addition to any field test battery where inflammatory responses can be expected.