REPORT

A Health Survey of Residents Living Near and Workers Employed at the Sussex County Municipal Utilities Authority, Hardyston Township, New Jersey

Conducted by

Occupational and Environmental Health Services

New Jersey State Department Of Health

SUMMARY

The Sussex County Municipal Utilities Authority facility (MUA) in Hamburg, New Jersey, is a new facility that performs sewage treatment and composting of sewage sludge. Soon after composting began in June, 1984, residents living nearby began to complain of odors from the plant.

As odors continued, residents claimed health problems were caused by plant emissions; these included complaints of respiratory and mucous membrane irritation, allergy, and associated psychological stress. Initial attempts by the MUA to control odors were unsuccessful. In response to residents' organized efforts, the MUA hired a private laboratory to perform air testing on November 8, 1984. Results indicated that low levels of volatile organic chemicals and a moderate increase in spores of the fungus Aspergillus fumigatus were present at the plant and a nearby home. At this time, residents demanded that composting be stopped, and the County Health Department called the Environmental Health Program of the New Jersey State Department of Health (DOH) for assistance.

DOH performed air sampling on December 6, 1984, and met with residents and public officials on December 13, 1984. Air monitoring was performed for volatile organic chemicals (VOs), carbon dioxide (CO_2), and hydrogen sulfide (H_2S) at the MUA, inside three nearby homes, and at nearby Wallkill Valley Regional High School. On January 30, 1985, DOH invited employees working at the MUA, residents living nearby, and a comparison-group of residents living in nearby communities, for medical examinations.

Medical examinations were designed to differentiate among possible causes of the complaints: mucous membrane irritation by chemicals, allergy to fungi, and aspergillosis (colonization or infection with Aspergillus fungi). Of the 75 subjects, 43 were residents living near the MUA, 14 were MUA workers, and 18 lived in nearby communities (non-residents). The examinations included medical interviews, clinical olfactory (sense of smell) testing, physical examinations, allergy skin tests, blood tests, and nasal fungal cultures.

Results of air monitoring indicated low levels of VOs present at the MUA and in the homes, in total amounts under 1 part per million. At the high school, no VOs were found. CO_2 was elevated inside two of the homes, indicating inadequate ventilation. At all sites, H_2S was measured as none detected.

Subjects received their personal medical results several weeks after the examinations. The results were compiled, and the three groups--MUA workers, residents, and non-residents--were compared to each other. Results indicated that both workers and nearby residents had symptoms indicative of loss of sense of taste and smell, and of irritation of the mucous membranes and the respiratory tract. Most of the symptoms reportedly began after June, 1984; workers generally had higher rates of complaints. None of the symptoms were statistically increased.

On clinical olfactory testing, 26% of nearby residents, 11% of non-residents, and 29% of workers had decreased sensitivity. Physical examinations revealed individuals with nasal abnormalities, mostly redness and swelling, among both workers and residents. Subjects with such abnormalities had a higher rate of

subnormal results on olfactory testing. MUA workers had a slightly higher rate of abnormal allergy skin tests. Of the blood tests done, MUA workers had the highest mean eosinophil and white blood cell (WBC) counts, the highest mean IgE titer, and the highest percentage of mild-to-moderate abnormalities of WBC counts and IgE titers. The difference between workers' and non-resident's WBC counts was statistically significant. Residents had slightly higher mean WBC counts, eosinophil counts, and IgE titers than did non-residents. None of these results were statistically significant. MUA workers also had the highest percentage of individuals with positive skin tests indicating fungal allergy, and with fungi on nasal culture. Subjects with elevated IgE titers had a higher rate of positive nasal fungal cultures than did subjects without elevated titers; this difference was statistically significant. Because the number of subjects was small, the statistical power of the study was low.

There was no evidence of aspergillosis in any subject, and titers of antibodies to Aspergillus were not detected in any subject.

Based on these findings, DOH concludes that workers at the Sussex County MUA facility had an increased rate of abnormalities on blood testing, allergy skin tests, and nasal fungal cultures. These effects are probably related to working at the MUA. This result is consistent with results of other studies of sludge-compost workers, which indicate that exposure to compost products, such as endotoxins, may be the cause. Residents had symptoms indicating irritation of mucous membranes, and an increased rate of reported loss of sense of smell. The irritation probably was caused by persistent exposure to low levels of organic chemicals and odor-producing chemicals such as sulfides. Increased airborne fungal spores aggravate symptoms in those individuals with prior allergies. There was no evidence of this, however, on the laboratory testing. There was no evidence of other disease. The effects found in this study are not known to have longterm consequences.

DOH believes that the MUA can resume composting as this study does not show fungal related disease among residents. A DEP plan to fully enclose the facility and to disinfect emissions may solve odor problems. We encourage DEP and the MUA to implement such a plan if feasible.

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Report Prepared by:

Curtis E. Cummings, M.D.

Senior Public Health Physician

Office of the State Epidemiologist

New Jersey State Department of Health

Evaluation Conducted by:

Environmental Health Program

New Jersey State Department of Health

Rebecca T. Zagraniski, M.P.H., Ph.D., Chief

Sussex County Health Department

Frank Wilpert, Health Officer

Assistance with Evaluation:

Steve M. Miller, M.S.

Joseph E. Rizzo, B.A.

David Martin

Environmental Health Program

New Jersey State Department of Health

Assisted with Data Analysis

Janneane Gent, Ph. D.

University of Connecticut

Assisted with Chemosensory Testing

Julie Petix, B.S.

Angela Gilbert, B.S.

Environmental Health Program

New Jersey State Department of Health

Environmental Monitoring

I. INTRODUCTION

A. Initial Complaints and Evaluations

The Sussex County Municipal Utility Authority (MUA) facility is a new regional sewage treatment plant in Hardyston Township (postal address Hamburg, New Jersey). It accepts sewage from residents and industries in several municipalities, performing standard sewage treatment, and in June, 1984, began onsite composting of the sludge it produces. It is located on a flat plain in a valley, just off N.J. Route 94, with a neighborhood of homes overlooking it. The nearest homes are within 100 yards of the plant.

Soon after sludge composting began, residents living nearby began to complain of chemical-type odors and burning throats and eyes, which they related to the MUA. During July, 1984, individuals brought their complaints to the MUA and to the State Department of Environmental Protection, which is responsible for the facility's funding and its compliance to regulations. The complaints were attributed to the usual start-up difficulties encountered by sewage treatment plants.

The Environmental Health Program of the State Department of Health (DOH) was first called on August 14, 1984, with complaints of runny eyes, sore throat, poor digestion, rashes, aggravation of residents' pre-existing respiratory conditions, and noise from the MUA. During the ensuing week, DOH personnel contacted Mr. Peter Cerenzio, MUA Executive Director, and responsible officials at DEP. Mr. Cerenzio met with 3 households of complainants, and promised substantial reduction of the problem within 10

days. A memorandum from DEP's Compliance Monitoring Unit asserted that the MUA was "an extremely well-run facility with capable and conscientious personnel...."

Complaints continued throughout Autumn, 1984, however, and residents organized themselves into a civic association. They cited the medical literature which indicated that composted sludge can contain pathogenic bacteria and fungi, toxic chemicals, odors, and gases. They attributed to the composting their symptoms of respiratory and mucous membrane irritation, "allergy", nausea, and stress. Local physicians offered various opinions; some diagnosed MUA-related conditions. The MUA and its consultants researched the health effects of composting, found little evidence of adverse health effects, informed the County Freeholders and residents of efforts to control odors, and attempted to calm residents' fears.

However, telephone calls and personal complaints continued. In response, the MUA hired J.T.C. Environmental Consultants, a private laboratory from Bethesda, Maryland, to perform air monitoring at and near the MUA on November 8, 1984. Results reported on November 30 indicated that low levels of volatile organic chemicals, under 1 part per million (ppm), and moderate counts of spores of the thermophilic fungus Aspergillus fumigatus, were present both at the MUA and at a nearby home. Both chemicals and spores were increased over background levels (Table 1). Other thermophilic fungi and low levels of aerobic bacteria also were present at both the MUA and nearby. Sulfides and ammonia were not detected. The J.T.C. report stated that the elevated bacterial counts were not at levels which would normally be considered "of health significance", but that the

levels of volatile organics and the Aspergillus counts indicated "that a problem of elevated levels exists."

A local physician tentatively diagnosed a case of bronchopulmonary aspergillosis (ABPA), using the J.T.C. report. At this point, residents were convinced that their health complaints were related to volatile organics and Aspergillus, and demanded various actions, among them closure of the MUA. The MUA placed air purifiers in the three homes closest to the facility. The Sussex County Health Officer, Frank Wilpert, called DOH on November 30, for assistance.

B. DOH Response

During the first week of December, 1984, DOH gathered information from the MUA, DEP, residents, and Mr. Wilpert. DOH performed air sampling on December 6 at the MUA, at the three nearest residences on Route 94, and at the Wallkill Valley Regional High School, one-half mile from the MUA. On December 13, Dr. Curtis Cummings, representing DOH, met with residents, the MUA board of directors, DEP, and other public officials in a public meeting; interpreted the J.T.C testing results and the complaints DOH had received to that date; and addressed public questions.

Following the public meeting, DOH and the County Health Department arranged medical examinations for January 30, 1985, at Borough Hall in nearby Hamburg. The content of interviews and tests were designed to differentiate among possible causes of resident complaints: mucous membrane and respiratory irritation from low-level chemicals or from odors,

fungal allergies, and colonization or infection with fungi. To assess these possibilities, the examinations included medical interviews, physical examinations, allergy skin testing, nasal fungal cultures, a recently developed clinical olfactory (sense of smell) testing protocol, and blood tests -- including blood counts, Aspergillus tests, and immunoglobulin assays.

II. MATERIALS AND METHODS

A. Study Population

The study was designed to include all current fulltime workers at the MUA (the group with the most exposure to the composting process), all current residents in the neighborhood adjacent to the MUA, and residents of a nearby community chosen to be compared to the first two groups (henceforth called "non-residents"). Most of the non-residents were from Franklin, a borough similar to Hardyston in age, sex, racial distribution, and socio-economic status. A total of 75 individuals were examined. These included 43 (86%) of approximately 50 invited residents, 14 (77%) of 18 invited MUA workers, and 18 (24%) of the approximately 75 invited non-residents.

B. Environmental Assessment

Air sampling was performed at the MUA at two sites, inside three homes on Route 94, and inside and outside the Wallkill Valley Regional High School. Samples were collected for hydrogen sulfide (H_2S) (using the NIOSH method), carbon dioxide (CO_2) (with Drager tubes), and volatile organic hydrocarbons (VOs) (with DuPont P-4000 pumps). The samples were analyzed by the New Jersey State Department of Health Laboratory.

C. Medical Examinations

Appendix A shows the consent form and standardized examination forms. Interviews, examinations, and tests were performed by DOH

personnel. Contractors assisted with blood tests; Dr. Janneane Gent of the University of Connecticut developed and supervised olfactory testing.

Using a standard interview form (Appendix A), all subjects underwent interviews that included the following histories: demographic background, smoking, home environment, chemosensory (smell and taste) status, and medical history, including questions about symptoms of irritation and allergy. All subjects also underwent physical examinations and nasal fungal cultures by DOH physicians. Fungal cultures were obtained by swab from the nasal antrum. Individuals above age 6 were offered clinical olfactory testing and blood tests. Olfactory testing was a multiple choice task of odor identification. Blood tests included complete blood counts (CBCs) with eosinophil counts to measure allergy, anemias, and elevated white blood cell (WBC) counts; immunoglobulin E (I_gE) titers to measure allergic response; and Aspergillus radioallergosorbent test (RAST) and complement fixation (CF), to measure systemic antibodies to Aspergillus and thereby to indicate allergy or infection (1,5,8). Blood specimens were sent to Metpath Laboratories, Teterboro, N.J. Intradermal (skin) allergy tests for four common allergenic fungi (Aspergillus, Penicillium, Hormodendrum, Alternaria) were offered to all subjects above age 6. These were performed over several days' time in January, 1985, by Dr. Joseph Salerno, a private allergist.

Rates were calculated for positive responses for all factors recorded in interviews, for findings on physical examinations, for allergy testing, and for values obtained on blood and clinical olfactory testing. Allergic broncho-

pulmonary aspergillosis was defined as a patient with pre-existing asthma, with eosinophilia, positive skin test, and positive Aspergillus antibodies, with confirmation by chest x-ray, if medically indicated.

Subjects received their personal medical results several weeks after the examinations. Tables of results were compiled; those presenting relevant data or indicating differences between groups are presented in this report.

III. RESULTS

A. Air Sampling

Of the several hundred VOs detectable by VO sampling, low levels of isopropanol, ethanol, and gasoline or components of gasoline were detected at the MUA and inside nearby homes (Table 2). Total levels of VOs all were under 1 ppm. CO_2 levels were mildly elevated inside homes (indicating poor ventilation). CO_2 levels were normal both inside and outside the Wallkill Valley High School; VOs were not detected, except for traces of isobutane (a component of natural gas) inside. H_2S was not detected in any sample.

B. Medical Examinations

1. Demographic Factors

In Table 3, sex and age-group data reported by each subject are presented. MUA workers mostly were male; the resident group was 19 percent children, there were no children in the other groups. All subjects were white. There were no significant differences between groups in educational status or employment status (except for the presence of resident children). Non-residents had a non-significant increase in the percentage of managers/professionals.

2. Smoking Histories

Residents reported the lowest rate of smoking, and workers the highest rate of smoking and passive smoking (Table 4).

3. Home Heating, Cooking, Space Heating

Among factors that may produce indoor air pollution other than smoking , MUA workers reported a higher rate of wood-stove heating, (Table 5). Gas cooking, which is more polluting than electric-cooking, was most prevalent among non-residents. Residents were least likely to use kerosene space-heating (the most polluting), and the most likely to use electric heaters. The primary heating source for all groups was oil.

4. Reported loss of taste and smell

Both residents (27.9%) and workers (28.6%) reported more reduced or absent sense of smell compared to nonresidents (16.7%) (Table 6). Of those reporting smell loss, 75% of the residents, 50% of the workers, and 33% of the non-residents said that it began within one year. Almost 21% of residents reported that a family member had smell loss. Most workers and non-residents reported the smell loss as caused by known nasal disease, but residents attributed the loss to other causes, including the MUA.

Reported loss of sense of taste also was most common among residents (21.9%) (Table 7). Of those reporting lost sense of taste, 8 of 9 (88.9%) residents and 2 of 2 workers (100%) reported a duration of one year or less, and the same individuals reported that the loss affected appetite. Because the number of subjects in the study was small, the few reports of altered sense of the four basic components of taste (salt, sweet, sour, bitter) could not be evaluated.

The differences between groups in these attributes were not statistically significant. Reported losses of smell and taste were associated with each other to a statistically significant degree in residents and of borderline significance in workers, but not in non-residents (Table 8).

5. Self-reported medical history and symptoms

There were no significant differences between groups in rate of the following self-reported factors of medical history: nasal disease or surgery, dental surgery, hypertension, diabetes, epilepsy, heart disease, and chemical exposures.

The interviewer-administered questionnaire data on symptoms are presented on Table 9. When the three groups were compared, residents and workers had higher rates for a number of reported symptoms.

Symptoms reported more commonly among both workers and residents than among non-residents included the following: phlegm

production increased since June, 1984; headaches in overall frequency, beginning in 1984, and worse since June, 1984; stuffy noses in overall frequency and beginning in 1984; post-nasal drip in overall frequency and beginning in 1984; sore throats, all of which reportedly began in 1984; and eye irritation, nearly all of which reportedly began in 1984. No statistically significant differences were found.

Workers reported higher rates of frequent cough, dry cough almost daily, and headache occurring at work. Residents reported the following most frequently: headache occurring at home; dry cough beginning in 1984; earaches, all of which began in 1984, were worse since June, 1984, and occurred at home; skin rashes beginning in 1984; and odors in the home.

Non-residents did not exceed residents or workers in rates of any complaints. There were no significant differences between groups among other aspects of medical background, including all aspects of allergies, physician-diagnosed ear infections, allergies or asthma in family members, chest tightness, and other reported symptoms shown in Table 9. Specific individuals with known pre-existing allergies or asthma did report that symptoms were worse since June, 1984. Also, two workers and four residents anecdotally reported nausea, and one worker reported diarrhea, in association with days when odors were reportedly strong.

6. Physical Examinations

DOH physicians' findings were reviewed after the examinations for those that may have been related to chemicals or fungi. Nasal abnormalities were found more frequently in residents (34%) and workers (29%) than in non-residents (17%) (Table 10). Mostly, DOH physicians noticed swollen, red nasal passages; several subjects in each group had viral colds. There were no significant differences between groups found on examination of the following areas: eyes, mouth, chest, skin, or abnormal blood pressure. There was one evident external ear infection on the physical examinations, in a resident, a few slightly irritated ear canals, and one old ear abnormality, in an MUA worker. There was a high rate of hypertension overall.

7. Laboratory Tests

Laboratory test results are listed in Table 11. Both workers and residents had higher rates of abnormal results than did non-residents for a number of tests. Workers had the highest mean eosinophil and WBC counts, the highest mean IgE titers, and the highest rates of abnormal WBC counts and IgE levels. These abnormalities were of a mild-to-moderate degree. The difference between worker and non-resident WBC counts was statistically significant. Residents had a slightly higher rate of abnormal eosinophil counts. Workers had a slightly higher rate of positive nasal fungal cultures than did the other two groups. The difference between groups was not statistically significant for any test other than WBC count. Titers of antibodies to

Aspergillus were not detected in the RAST or CF tests in any subject; there were no cases of allergic bronchopulmonary aspergillosis. No notable differences was found on other factors on the complete blood counts.

WBC and IgE were analyzed according to presence or absence of the symptoms listed in Table 9, of positive nasal fungal cultures, and of abnomalities of physical examination of the eyes or nose. IgE correlated to positive nasal fungal culture; there were no other correlations.

8. Intradermal Allergy Tests

Workers had a slightly higher rate of abnormal intradermal allergy tests for four fungi; the difference between workers and nonresidents was of borderline statistical significance (Table 11).

9. Clinical Olfactory Testing

On clinical olfactory testing, 25.6% of residents, 11.1% of non-residents, and 28.6% of workers had decreased sensitivity (Table 12). The differences were not statistically significant. Olfactory test results were analyzed according to presence or absence of abnormal nasal physical examination; the correlation was present and statistically significant.

IV. DISCUSSION

A. Background

The health effects of sludge composting upon sewage treatment workers has been reported by several authors (2, 3, 6), most recently and most extensively by C.S. Clark at the University of Cincinnati. Studies are lacking on the health effects in residents living near composting facilities, and it is not known how chemical and biological factors may interact around such facilities.

In evaluating 121 workers at several sludge composting facilities, Clark reported increased rates of the following health effects: complaints of burning eyes and skin irritation; nasal, ear, and skin infections on physical examination; evidence of past exposure to Legionella bacteria (the agent that causes Legionnaire's disease); colonization of the nose and throat with Aspergillus; and elevated white blood cell and eosinophil counts, hemolytic complement levels, and levels of antibodies to compost-specific endotoxin (a product of gram-negative compost bacteria that produces inflammation) (3). There was no evidence of allergic bronchopulmonary aspergillosis or other forms of aspergillosis. Other reports by Clark and others have yielded similar results (2,4) or have been more limited in scope (6). Clark wrote that fungal infections were thus uncommon in the workers studied in spite of fungal exposure, and that the findings in the blood suggested a low-grade inflammatory response. Clark and Lundholm (6) have suggested that these findings

can be attributed to exposure to endotoxin. These findings were not reported in studies of wastewater sewage treatment workers not exposed to sludge or compost material.

DOH has evaluated neighborhoods and workplaces where residents or workers have had eye and respiratory tract (mucosal) complaints which were temporally related to low-level chemical exposures, but where such exposures were below published standards (if standards existed) and where there were few objective findings. In such cases, the complaints appear to indicate mucosal irritation caused by a mixture of irritant chemicals in low levels.

In Hardyston Township, it was evident that there were mucosal irritant complaints among nearby residents. The study was designed to determine the nature of the problem in Hardyston and to differentiate among the following potential causes: chemical exposure, fungal allergy, aspergillosis, and exposure to compost material such as endotoxins. DOH also used the new modality of chemosensory testing to measure any decrements in sense of smell. Because of small numbers of subjects, the statistical power of this study was low, and findings should be interpreted cautiously.

B. Environmental Factors

Both chemical and biological agents were present in Hardyston, and should be considered as possible causes of the symptoms and objective findings in this study. Environmental monitoring in this study was revealing, despite limitations.

Both J.T.C. Environmental Consultants and DOH found low levels of airborne volatile organic hydrocarbons both at the MUA and in nearby homes (Tables 1 and 12). All were well below occupational standards. There are no published standards for community exposures to VOs. The source of the VOs probably is the release of chemicals that come from consumer products used in homes and from small industries, through sewer lines during primary sewage treatment at the MUA. Composting does not produce VOs. J.T.C. and DOH found different chemical patterns in their testing, probably as a result of specific chemicals in sewers on the day of sampling. The health effects should be the same in either case -- mild mucosal irritation -- and symptoms found in this study may have been caused in part by these exposures.

In addition to the VOs, it is likely that hydrogen sulfide and organic sulfides were present but not measured (Table 1). Sulfides are known to be produced by sewage treatment and are quite pungent, but sampling is difficult. The limits of detection in the sampling by J.T.C. (1 ppm) and DOH (0.45 ppm) are near the sulfide levels known to be irritating, and well above sulfide odor thresholds (as low as several parts per billion). Therefore, workers and residents' mucosal symptoms may also have been caused in part by exposure to sulfides.

The elevated CO_2 levels inside homes indicate poor ventilation, unrelated to the MUA. With poor ventilation, homes tend to retain pollutants, trap pollutants which enter from the outside, have poor indoor air quality because of consumer products and combustion indoors, and have occupants with irritant symptoms. During winter, tightly sealed homes may

have this problem, and with a sewage plant nearby, residents may experience mucosal irritation. DOH did not measure other indoor pollutants, such as those produced by cigarettes or space heaters.

The levels of airborne fungal spores measured by J.T.C. may affect workers and residents who were already allergic to fungi, or possibly those who were atopic (tending to be allergic) but not yet aware of fungal allergies. Median airborne fungal spore levels in rural areas may range from 0 to several thousand/m^3 of air during the winter mold season, and Aspergillus spore levels have been measured at 0 to 71 (5). The levels measured at the MUA were within this range for total spores, although Aspergillus spores were higher. Allergy sufferers may develop respiratory symptoms with such air levels, while non-allergic individuals have no symptoms. Because sampling was limited to one day, the levels may or may not have represented the MUA and the nearby Community accurately.

The factors that produce aspergillosis are not all known (2,3), but air levels of spores have not been correlated with disease. DOH did not measure airborne endotoxin, since methodology is not available, nor airborne bacteria, which are not known to have health effects at levels measured by J.T.C.

C. Health Effects

Both workers and residents had an excess of a number of findings when compared to non-residents, who served as a control group.

Workers and residents reported increased rates of loss of taste and smell since the beginning of composting at the MUA, and reported headaches and eye, ear, nose, throat, and chest symptoms, with onset or exacerbation in 1984. These symptoms appear to be related to the beginning of composting, and are similar to Clark's findings (4,6) and to complaints of environmental irritation found in other DOH studies. The MUA workers generally had higher rates of complaints even though working populations tend to be healthier than the general population, and even though MUA workers included a few clerical staff who worked indoors. The anecdotal reports of nausea and diarrhea have been reported at sludge-treatment facilities. Earache, stuffy nose, sore throat, and eye irritation were reported by residents and workers at greater rates than in non-residents, and the differences were statistically significant.

Nasal irritation also was evident on physical examination among workers and residents. No definite conclusions can be drawn from this as the number of subjects was small and some had viral colds. Ear and skin infections were not found in this study. The hypertension found at these one-time examinations may have been caused by the stress of examination. It is usual medical practice to repeat blood pressures one or two additional times under more relaxed conditions before diagnosing an individual as having hypertension.

Clark's findings on blood testing also were confirmed on blood tests in Hardyston. Workers had higher mean WBC and eosinophil counts and IgE levels and had excess rates of abnormal total WBC counts and total IgE levels. This indicates an immune or inflammatory response to some aspect of composting. Residents did not have the same increases in laboratory testing as the workers despite similiar symptoms. As previously noted, concerned

residents and their physicians had attributed the mucosal symptoms and a possible case of aspergillosis to the MUA. However, because DOH found no positive Aspergillus RAST or CF titers or any cases of aspergillosis (including allergic bronchopulmonary aspergillosis), the symptoms seen in residents in this study were not caused by fungal colonization or infection of the lungs.

Workers had slightly increased rates of positive nasal fungal cultures and positive allergy skin tests to common fungi. Residents and nonresidents both had low rates of both findings, although the differences between groups were not statistically significant. The meaning of positive cultures is not established. In this study, it did not predict an increase in symptoms, or in positive skin tests, since correlations were not found. The skin testing results and IgE titers, however, may indicate an allergic component to the symptoms in workers. In other studies, skin test results predict symptoms in allergic individuals, and elevated serum IgE and eosinophil counts are associated with nasal allergy. In this study, the findings may have been caused by any combination of chemical and gas irritation, reaction to endotoxin, and various types of allergy; it was not possible to clearly differentiate among these.

D. Conclusions

DOH concludes that workers at the Sussex County MUA appeared to be experiencing measurable effects related to the MUA sewage sludge composting process, although the number of subjects in this study was small and its statistical power was low. Compared to nearby residents, and to more distant non-residents, workers had increased rates of the following: symptoms of lost taste of smell, irritation of mucous membranes, and

accompanying headaches; higher mean total WBC and eosinophil counts and IgE titers, and higher numbers of elevated total WBC counts and IgE titers; a slightly increased rate of positive nasal fungal cultures; and an increased rate of positive results on allergy skin testing to common fungi.

Residents alone had symptoms similar to those reported by MUA workers, but at lesser rates, increased abnormal results on the olfactory testing and slightly elevated IgE titers. Residents did not have positive skin tests, nasal cultures, or significantly elevated blood test results. Because the study was not statistically powerful, the absence of elevated test results in residents needs to be interpreted cautiously.

Several components of the composting process may have caused the effects, including compost products such as endotoxin and fungal spores, and volatile organic chemicals and sulfides. MUA workers had irritation of mucosal surfaces and elevated blood test results, probably from direct compost exposure, perhaps aggravated by the chemicals. Allergies may be revealed or aggravated as well in these workers, with potentially increased symptoms. Residents' symptoms probably were mainly caused by the low level VOs and odors; some allergic individuals' symptoms might be aggravated by fungal spores but there was no evidence of this.

The correlation between elevated IgE titers and positive nasal fungal cultures found in this study may indicate that individuals with fungal colonization are the ones with demonstrated allergic responses. This study did not demonstrate, however, that these individuals are the ones with symptoms.

Clinical olfactory testing suggested loss of sense of smell among workers and residents. Test results correlated with abnormal findings on nasal examinations.

The concerns of residents and local physicians about aspergillosis were not verified by DOH medical examinations.

Based on these findings, DOH believes that the MUA can resume the composting operation. Workers with symptoms should be provided with NIOSH-approved protective masks on the job. To reduce odor complaints, a proposed DEP plan to enclose the composting and to disinfect emissions should be evaluated and carried out if feasible. The irritative effects found in this study are not known to have longterm consequences.

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TABLE 1

Summary, Results of Air Sampling By J.T.C. Environmental Consultants

A. Volatile Organic Hydrocarbons (VOs)

	Concentration (ppb)		
Chemical	Near Private Home	MUA, onsite During Screening	Control Site
Benzene	34	11	ND
Ethylbenzene	10	3	ND
Methylene chloride	28	16	ND
Toluene	60	21	ND
Xylenes	48	16	ND

ppb = parts per billion
ND = not detected (limit of detection VOs = 2 ppb)
Reported as not detected, all three sites:
acrolein, acrylonitrile, BCME, bromoform, carbon tetrachloride, chloroethanes, chloroethylenes, chlorovinylether, chloroform, chloropropanes, methyl bromide, methyl chloride, vinyl chloride

B. Odor Components

	Concentration		
Chemical	Near Private Homes (2 sites)	MUA (3 sites)	Control Site
Hydrogen sulfide	ND	ND	ND
Methyl/ethyl sulfides	ND	ND	ND
Methyl/ethyl mercaptan	ND	ND	ND
Carbonyl sulfide	ND	ND	ND

ND = not detected (limit of detection, 1 part per million)

TABLE 1 (Continued)

C. Microbial Aerosols

Site	Total Concentration (cfu/m^3) Aerobic Bacteria	Total Thermophilic fungi	Aspergillus fumigatus
Near compost screening			
during screening	12,000	1,451	919
not screening	3,471	659	281
Near active pile			
during screening	2,867	746	314
not screening	619	762	413
Near private home			
during screening	470	6	3
not screening	597	66	20
Private home			
during screening	4,226	354	221
not screening	297	49	22
Control (nearby lake)	323	39	16

Notes:

1) Results of sampling for fecal coliforms and strep all very low.

2) Sampling of microbials done using 8um Anderson samplers; results of microbials from samples of aerosols 8um and _ 8um in size are combined.

TABLE 2

Summary Results of DOH Air Sampling

Location	Contaminant	Concentration (ppm)
MUA		
Interior (near dewatering system)	Isopropanol	0.043
	Ethanol	0.199
	Gasoline	0.203*
	CO_2	600
	H_2S	ND
Exterior (retaining wall)	VO Scan	ND
	CO_2	500
	H_2S	ND
Wallkill Valley Regional H.S.		
Cafeteria	Isobutane	0.020
	H_2S	ND
	CO_2	400-500
Exterior	VO Scan	ND
	H_2S	ND
	CO_2	400-500
Residence #1		
Bedroom	Isopropanol	0.151
	Ethanol	0.345
	Gasoline	0.432*
	CO_2	1500
	H_2S	ND
Residence #2		
Bedroom	Isopropanol	0.042
	Ethanol	0.186
	Isobutane	0.039
	2,2,5-trimethylhexane	0.020[a]
	2,3,4-trimethylpentane	0.014[a]
	CO_2	700
	H_2S	ND
Residence #3		
Den	Isopropanol	0.071
	Gasoline	0.559*
	CO_2	1000
	H_2S	ND

*Approximate concentration based on Molecular Weight of 72.5 for gasoline
[a]Component of gasoline
ND = None Detected (detection limits - VOs = about 5 ppb, H_2S=0.4 ppm, CO_2=100 ppm)
Note: All other volatile organics (over 100 chemicals) reported as ND.

TABLE 3

A. Demographic Factors

Characteristic	Residents (%) n = 43	Non-residents (%) n = 18	Workers (%) n = 14
Sex			
Male	20 (46.5)	10 (55.6)	10 (71.4)
Female	23 (53.5)	8 (44.4)	4 (28.6)
Age			
≤16	8 (18.6)	0 (0)	0 (0)
17 - 29	7 (16.2)	1 (5.6)	4 (28.6)
30 - 49	14 (32.6)	10 (55.5)	7 (50.0)
≥50	14 (32.6)	7 (38.9)	3 (21.4)

B. Occupation*

	Residents (%) n = 35	Non-residents (%) n = 18	Workers (%) n = 14
Classification			
managerial/professional	9 (25.7)	8 (44.4)	3 (21.4)
sales/clerical/service	8 (22.9)	1 (5.6)	5 (35.7)
crafts/operators/laborers	7 (20.0)	4 (22.2)	6 (42.9)
homemaker or retired	9 (25.7)	5 (27.8)	—
unknown	2 (5.7)	—	—

*excludes those 16 or younger

TABLE 4

Smoking Characteristics of Subjects

A. Smoking Status

	Residents (%) n = 43	Non-residents (%) n = 18	Workers (%) n = 14
Current Smoker	5 (11.6)	7 (38.9)	7 (50.0)
Former Smoker	8 (18.6)	7 (38.9)	2 (14.3)
Never Smoker	30 (69.8)	4 (22.2)	5 (35.7)

B. Passive Smoking*

	Residents (%) n = 43	Non-residents (%) n = 18	Workers (%) n = 14
Exposed	15 (34.9)	6 (33.3)	9 (64.3)
Unknown	1 (2.3)	—	—
Unexposed	27 (62.8)	12 (66.7)	5 (35.7)

*frequency of others smoking in subject's household

TABLE 5

Home Heating and Cooking Fuels

Space Heating Source	Residents (%) n = 43	Non-residents (%) n = 18	Workers (%) n = 14
Wood	13 (30.2)	4 (22.2)	7 (50.0)
Kerosene	2 (4.7)	5 (27.8)	2 (14.3)
Electric, other or none	26 (60.4)	8 (44.4)	5 (35.7)
Two or more of above sources	2 (4.7)	1 (5.6)	—
Cooking Source			
Gas	10 (23.3)	7 (38.9)	3 (21.4)
Electric	31 (72.0)	11 (61.1)	11 (78.6)
Other	2 (4.7)	—	—
Heating Source			
Oil	42 (97.7)	16 (88.9)	10 (71.4)
All other	1 (2.3)	2 (11.1)	4 (28.6)

TABLE 6

Characteristics of Self-Reported Smell Loss by Group

	Residents (%) n = 43	Non-residents (%) n = 18	Workers (%) n = 14
Reported Sense of Smell			
Normal	31 (72.1)	15 (83.3)	10 (71.4)
Reduced or absent	12 (27.9)	3 (16.7)	4 (28.6)
Family Member with Smell Loss			
Yes	9 (20.9)	1 (5.6)	—
Of These Reporting Reduction	n = 12	n = 3	n = 4
Date of Onset of Smell Loss			
During or after 1984	9 (75.0)	1 (33.3)	2 (50.0)
Prior to 1984	3 (25.0)	2 (66.7)	2 (50.0)
Self-Evaluated Cause of Smell Loss			
Nasal disease	4 (33.3)	3 (100.0)	3 (75.0)
All other explanations	8 (66.7)	—	1 (25.0)
Restoration of Sense of Smell			
Yes	7 (58.3)	2 (66.7)	3 (75.0)
Reported Effects of Smell Loss on Appetite			
Affected	5 (41.7)	—	—
Not Affected	7 (58.3)	3 (100.0)	4 (100.0)

TABLE 7

Characteristics of Self-Reported Taste Loss by Group

	Residents (%) n = 43	Non-residents (%) n = 18	Workers (%) n = 14
Reported Sense of Taste			
Normal	34 (79.1)	16 (88.9)	12 (85.7)
Reduced	9 (20.9)	2 (11.1)	2 (14.3)
Of Those Reporting Reduction	n = 9	n = 2	n = 2
Date of Onset of Taste Reduction			
During or after 1984	8 (88.9)	—	2 (100.0)
Prior to 1984	1 (11.1)	2 (100.0)	—
Self-evaluated Cause of Taste Reduction			
Disease	2 (22.2)	—	2 (100.0)
All other explanations	7 (77.8)	2 (100.0)	—
Detectable Effects of Taste Loss on Appetite			
Affected	8 (88.9)	—	2 (100.0)
Not Affected	1 (11.1)	2 (100.0)	—

TABLE 8

Association of Self-Reported Attributes - Smell Loss and Taste Loss

	Residents (%) n = 43	Non-residents (%) n = 18	Workers (%) n = 14
Taste Normal			
Smell normal	27 (62.8)	13 (72.2)	10 (71.4)
Smell decreased	7 (16.3)	3 (16.7)	2 (14.3)
Taste Decreased			
Smell normal	4 (9.3)	2 (11.1)	—
Smell decreased	5 (11.6)	—	2 (14.3)
p of Fisher's Exact Test for each group	p = 0.05	p = 0.68	p = 0.06

Note: Mantel-Haenszel Chi-Square for association among all three groups = 4.5, p = 0.10 (not statistically significant)

TABLE 9

Self-Reported Symptoms, By Group

A. Allergies	Residents (%) n = 43	Non-residents (%) n = 18	Workers (%) n = 14
1. Seasonal/respiratory allergies			
Yes	7 (16.3)	2 (11.1)	4 (28.6)
No	36 (83.4)	16 (88.8)	10 (71.4)
Date of onset of seasonal/ respiratory allergies	n = 7	n = 2	n = 4
During or after 1984	1 (14.3)	—	2 (66.7)
Prior to 1984	4 (57.1)	2 (100.0)	1 (33.3)
Unknown	2 (28.6)	—	1 (33.3)
Site of maximum of allergic symptoms			
Home	4 (57.1)	1 (50.0)	2 (50.0)
Work	—	—	1 (25.0)
Other	2 (28.6)	1 (50.0)	—
Unknown	1 (14.3)	—	1 (25.0)
2. Other allergies (excluding food, skin and drug allergies)			
Yes	4 (9.3)	4 (22.2)	2 (14.3)
No	39 (90.7)	14 (77.8)	12 (85.7)

TABLE 9 (Continued)

	Residents (%) n = 43	Non-residents (%) n = 18	Workers (%) n = 14
Date of onset of other allergies	n = 4	n = 4	n = 2
During or after 1984	2 (50.0)	—	—
Prior to 1984	2 (50.0)	4 (100.0)	2 (100.0)
Symptoms aggravated since 1984			
Yes	3 (75.0)	1 (25.0)	—
No	1 (25.0)	3 (75.0)	2 (100.0)
B. Cough			
1. Frequent cough			
Yes	10 (23.3)	4 (22.2)	6 (42.9)
No	33 (76.7)	14 (77.8)	8 (57.1)
2. Dry cough almost daily			
Yes	7 (16.3)	3 (16.7)	3 (21.4)
No	36 (83.7)	15 (83.3)	11 (78.6)
Date of onset	n=7	n=3	n=3
During or after 1984	5 (28.6)	1 (33.3)	1 (33.3)
Prior to 1984	2 (71.4)	2 (66.7)	2 (66.7)

TABLE 9 (continued)

	Residents (%) n = 43	Non-residents (%) n = 18	Workers (%) n = 14
C. Headache			
Frequent headache			
Yes	17 (39.5)	5 (27.8)	6 (42.9)
No	26 (60.5)	13 (72.2)	8 (57.1)
Date of onset	n = 17	n = 5	n = 6
During or after 1984	15 (88.2)	—	5 (83.3)
Prior to 1984	2 (11.8)	5 (100.0)	1 (16.7)
Worse since 1984			
Yes	12 (70.6)	1 (20.0)	4 (66.7)
No	4 (23.5)	4 (80.8)	2 (33.3)
Unknown	1 (5.9)	—	—
Site of most frequent headache			
Home	16 (94.1)	2 (40.0)	—
Work	—	—	3 (50.0)
Other	—	2 (40.0)	1 (16.7)
Unknown or not applicable	1 (5.9)	1 (20.0)	2 (33.3)

TABLE 9 (continued)

	Residents (%) n = 43	Non-residents (%) n = 18	Workers (%) n = 14
3. Phlegm production			
Yes	4 (9.3)	2 (11.1)	4 (28.6)
No	39 (90.7)	16 (88.9)	10 (71.4)
Date of onset	n = 4	n = 2	n = 4
During or after 1984	1 (25.0)	1 (50.0)	2 (50.0)
Prior to 1984	2 (50.0)	—	2 (50.0)
Unknown	1 (25.0)	1 (50.0)	—
Increased since 1984			
Yes	4 (100.0)	1 (50.0)	4 (100.0)

TABLE 9 (continued)

	Residents (%) n = 43	Non-residents (%) n = 18	Workers (%) n = 14
D. Earache			
Frequent earaches			
Yes	11 (25.6)	—	2 (14.3)
No	32 (74.4)	18 (100.0)	12 (85.7)
Date of onset of frequent earaches	n = 11	n = 0	n = 2
During or after 1984	11 (100.0)	—	2 (100.0)
Prior to 1984	—	—	—
Symptoms aggravated since 1984			
Yes	11 (100.0)	—	2 (100.0)
No	—	—	—
Site of most frequent earache			
Home	11 (100.0)	—	—
Work	—	—	1 (50.0)
Other	—	—	1 (50.0)
E. Skin Rash			
1. Frequent skin rash			
Yes	7 (16.3)	3 (16.7)	1 (7.1)
No	36 (83.7)	15 (83.3)	13 (92.9)

TABLE 9 (continued)

	Residents (%) n = 43	Non-residents (%) n = 18	Workers (%) n = 14
Date of onset of rash	n = 7	n = 3	n = 1
During or after 1984	6 (85.7)	2 (66.7)	—
Prior to 1984	1 (14.3)	1 (33.3)	1 (100.0)
Worse since 1984			
Yes	4 (57.1)	2 (66.7)	1 (100.0)
No	3 (42.9)	1 (33.3)	—
Site of most frequent rash			
Home	7 (100.0)	1 (33.3)	1 (100.0)
Work	—	1 (33.3)	—
Other	—	1 (33.3)	—
F. Stuffy Nose			
Frequent stuffy nose			
Yes	25 (58.1)	4 (22.2)	6 (42.9)
No	18 (41.9)	14 (77.8)	8 (57.1)
Date of onset	n = 25	n = 4	n = 6
During or after 1984	21 (84.0)	2 (50.0)	4 (33.3)
Prior to 1984	4 (16.0)	2 (50.0)	2 (66.7)

TABLE 9 (continued)

	Residents (%) n = 43	Non-residents (%) n = 18	Workers (%) n = 14
G. Post-Nasal Drip			
Frequent post-nasal drip	n = 43	n = 18	n = 14
Yes	12 (27.9)	3 (16.7)	5 (35.7)
No	31 (72.1)	15 (83.3)	9 (64.3)
	n = 12	n = 3	n = 5
Date of onset			
During or after 1984	5 (41.7)	2 (66.7)	2 (40.0)
Prior to 1984	7 (58.3)	1 (33.3)	3 (60.0)
H. Sore Throat			
Frequent sore throat			
Yes	12 (27.9)	—	4 (28.6)
No	31 (72.1)	18 (100.0)	10 (71.4)
	n = 12	n = 0	n = 4
Date of onset			
During or after 1984	12 (100.0)	—	4 (100.0)
Prior to 1984	—	—	

TABLE 9 (continued)

	Residents (%) n = 43	Non-residents (%) n = 18	Workers (%) n = 14
I. Eye Irritation			
Frequent eye irritation			
Yes	17 (39.5)	2 (11.1)	7 (50.0)
No	26 (60.5)	16 (88.9)	7 (50.0)
Date of onset	n = 17	n = 2	n = 7
During or after 1984	17 (100.0)	1 (50.0)	6 (85.7)
Prior to 1984	—	1 (50.0)	1 (14.3)

TABLE 10

Abnormalities on Physical Examination

	Residents (%) n = 43	Non-residents (%) n = 18	Workers (%) n = 14
Nose			
Normal	27 (62.8)	15 (83.3)	10 (71.4)
Irritation-related findings	16 (37.2)	3 (16.7)	4 (28.6)
Ears			
Normal	40 (93.0)	18 (100.0)	13 (92.9)
Irritation-related findings	3 (7.0)	—	1 (7.1)
Blood Pressure			
140/90 or more	5 (11.7)	1 (5.5)	2 (14.3)
under 140/90	(67.4)	29 (66.7)	12 (78.6)
Not taken	9 (20.9)	5 (27.8)	1 (7.1)

Note: Of all other systems examined on physical examinations, only isolated abnormalities were observed. The above differences between groups were not statistically significant.

TABLE 11

A. Laboratory and Skin Tests

	Residents (%) n = 43	Non-residents (%) n = 18	Workers (%) n = 14
White Blood Cell Count*			
Mean	7980	7550	9720
Normal	39 (90.7)	17 (94.4)	10 (71.4)
Elevated (men-over 11,300) women-over 11,600	4 (9.3)	1 (5.6)	4 (28.6)
Immunoglobulin E			
Mean	111	61	115
Normal	36 (83.7)	16 (88.9)	10 (71.4)
Elevated (over 150)	7 (16.3)	2 (11.1)	4 (28.6)
Eosinophil Count			
Mean	176	161	185
Normal	38 (88.4)	17 (94.4)	13 (92.9)
Elevated (over 423)	5 (11.6)	1 (5.6)	1 (7.1)
Fungal Cultures			
Aspergillus	1 (2.3)	1 (5.6)	1 (7.1)
Other non-aspergillic	4 (9.3)	2 (11.1)	4 (28.6)
None	38 (88.4)	15 (83.3)	9 (64.3)

*p of t-test = 0.004

TABLE 11 (continued)

	Residents (%) n = 43	Non-residents (%) n = 18	Workers (%) n = 14
Intradermal Allergy Mold Testing**			
Aspergillus	2 (4.6)	—	3 (21.4)
None	38 (88.4)	18 (100.0)	10 (71.4)
Not taken	3 (7.0)	—	1 (7.1)

**p of t-test = 0.06 (border line statistical significance) comparing workers and nonresidents

Note: Other tests did not attain statistical significance at p = 0.05 level; these included t-tests for differences between means and Fisher's exact tests when comparing percentages abnormal.

B. Correlation Between IgE and Nasal Fungal Culture***

	Nasal Fungal Culture	
	Possitive for any Fungi n = 11	Negative n = 62
IgE over 150	5	8
IgE 150 or less	6	54

*** p = 0.02 by Fisher's exact test

Note: Other correlations did not attain statistical significance at p = 0.05 level for Fisher's exact tests. These included correlation of IgE with abnormal physical examination of eyes or nose and with all symptoms listed in Table 9; and correlation of WBC with nasal fungal culture, with abnormal physical examination of eyes or nose and with all symptoms listed in Table 9.

TABLE 12

Anosmia (Loss of Smell) by Chemosensory Test

A. Comparisons of Groups

	Residents (%) n = 43	Non-residents (%) n = 18	Workers (%) n = 14
Test score			
Normal (80 or more points)	32 (74.4)	16 (88.9)	10 (71.4)
Subnormal (under 80 points)	11 (25.6)	2 (11.1)	4 (28.6)

(p of Fisher's exact all non-significant)

B. Correlation of Chemosensory Test with Nasal Physical Examination

	Nasal Physical Examination	
	Normal n = 52	Abnormal n = 22
Test Score		
Normal (n = 58) (80 or more points)	46	12
Subnormal (n = 16) (under 80 points)	6	10

$p = 0.003$ by X^2, Odds ratio = 6.4

APPENDIX

SUSSEX COUNTY HEALTH STUDY
January, 1985

Interviewer's Initials_____ I.D. Code__ __ __ __ (1-4)

Background

1. Sex (by observation): Male 1
Female 2 (5)

2. Race (by observation): White 1
Black 2
Other (Specify_____) 3 (6)

3. How old were you on your last birthday? _____years (7-8)

4. What is your date of birth? _____ / _____ / _____ (9-14)
(mo. / day / yr.)

5. What is the highest level of education that you have completed? (Circle one only.) ___ ___ (15-16)

Grade: 1 2 3 4 5 6 7 8 9 10 11 12

College (years): 1 2 3 4 5+

Graduate (years): 1 2 3 4 5 6+

6. Are you currently employed? Yes (go to Q.8) 1
No (go to Q.7) 2 (17)

7. Are you a homemaker, 1
student, 2
laid off, looking for work, 3
or retired? (go to Q. 11) 4 (18)

8. Are you employed fulltime 1
or part time? 2 (19)

9. What is the primary function of your employer? (business, dentistry, food service, etc.)
_____ ___ ___ ___ (20-22)

10. What is your current job title?_____ ___ ___ ___ (23-25)

11. Other than yourself, who else lives (at least 9 months a year) in your home? (Circle all that apply.)

No one	1	
Spouse	2	
Children over 18 (no.=)	3	
Children under 18 (no.=)	4	
Other relatives	5	
Friends (not related by birth or marriage)	6	(26)

Smoking

12. Have you ever smoked or used tobacco on a regular basis for at least 3 months?.

Yes (go to Q.13)	1	
No (go to Q.18)	2	(27)

13. How old were you when you started smoking regularly?
____ (years old) (28-29)

14. Do you smoke or use tobacco now?

Yes (go to Q.16)	1	
No (go to Q.15)	2	(30)

15. How old were you when you quit? (____ years old) (31-32)

16. During the last year that you smoked or used tobacco, did you regularly use: (circle all that apply)

cigarettes,	1	
cigars,	2	
pipes,	3	
chewing tobacco or snuff?	4	(33)

17. How much did you smoke (or use)?

(if cigarettes)	_____packs/day	(34-35)
(if cigars)	_____no./day	(36-37)
(if pipes)	_____ pipeful/day	(38-39)
(if other)	_____ounces/day	(40-41)

18. Does anyone (else) smoke tobacco in your home?

Yes	1	
No	2	(42)

Home Environment

19. Do you cook with a gas stove,

an electric stove,	1	
or other (specify _____)	2	
	3	(43)

20. What type of fuel do you primarily use to heat your home?

Oil	1	
Natural gas	2	
Electricity	3	
Other (specify_____)	4	(44)

21. Do you use a wood stove 1
kerosene heater, 2
or other space heater? (specify_____) 3
(none) 4 (45)

22. Do you humidify your home? Yes 1 (46)
No 2

23. Do you air condition your home? Yes 1
No 2 (47)

24. Do you have an air purifyer in your home? Yes 1
(specify)_____
No 2 (48)

Exposure History

25. Have you ever had prolonged or serious exposure to any of the following: (Circle all that apply)

Metal dusts	1	
Acid fumes	2	
Industrial solvents	3	
Cleaning products	4	
Herbicides or pesticides	5	
Other (specify_____)	6	(49)

Chemosensory

26. Would you characterize your sense of smell now as:

normal. (go to Q.31)	1	
decreased but not absent. (go to Q.27)	2	
completely absent. (go to Q. 27)	3	
(Don't know) (go to Q.31)	8	
(No answer) (Go to Q.31)	9	(50)

27. For how many years have you had this smell loss? (51-52)
____ Years

28. In what year did the loss begin? 19_____ (53-54)

29. Does your sense of smell ever return under special conditions? (such as, exercise or medication)

Yes (specify_____)	1	
No	2	
Don't know	8	(55)

30. Does this loss affect your appetite?

Yes	1	
No	2	(56)

31. Has anyone (else) in your family experienced a loss in their sense of smell?

Yes (specify_____)	1	
No	2	
(Don't know/can't remember)	8	
(No answer)	9	(57)

32. Would you characterize your sense of taste now as:

normal. (go to Q.39)	1	
decreased but not absent. (go to Q.33)	2	
completely absent. (go to Q.33)	3	
better than it has been. (go to Q.33)	4	
(Don't know) (go to Q.39)	8	
(No answer) (go to Q.39)	9	(58)

33. For how many years have you had this loss? ____ years (59-60)

35. In what year did the loss begin? 19___ (61-62)

36. What do you feel caused this loss?

Disease (specify_____)	1	
Accident (specify_____)	2	
Exposure (specify_____)	3	
Surgery (specify_____)	4	
Other (specify_____)	5	
(Don't know)	8	(63)

37. Does this loss affect your appetite?

Yes	1	
No	2	(64)

38. Compared to the way things tasted before your loss began, how do each of the following taste now; stronger, no change, weaker or not at all? (cirlce one no. for each substance)

	Stronger	No Change	Weaker	Not at all	
Salt	1	2	3	4	(65)
Sweet (sugar)	1	2	3	4	(66)
Sour (vinegar)	1	2	3	4	(67)
Bitter (coffee)	1	2	3	4	(68)

39. Has anyone (else) in your family experienced a loss in their sense of taste?

Yes (specify_____)	1	
No	2	
(Don't know/can't remember)	8	
(No answer)	9	(69)

Medical Background

40. Do you have a good appetite? Yes 1 (70)
No 2

41. How much do you weigh now? _____ pounds (71-73)

42. How tall are you? _____ft.____ins. (74-76)

43. Have you ever had any serious nasal disease or surgery?
Yes (go to Q.44)
No (go to Q.45) (77)

44. Have you had any of the following: (circle all)

Sinus infection or surgery	1	
Nasal polyps or polypectomy	2	
Deviated septum or surgical repair	3	
Frequent nosebleeds (more than 1/mo.)	4	
Other (specify_____)	5	(78)

45. Have you ever had gum or other dental diseases? Yes 1
No 2 (79)

46. Have you ever had dental surgery? Yes 1
(tooth extractions, jaw repair, etc.) No 2 (80)

47. Have you ever had any head or facial injury? (such as loss of consciousness or trauma from a car or sport accident)
Yes (specify_____) 1
No 2 (81)

48. Have you had any nasal, dental or head surgery that has not yet been mentioned?
Yes (specify_____) 1
No 2 (82)

49. Have you ever had any of the following conditons: (circle all that apply)

High blood pressure (onset year_____)	1	(83-84)
Diabetes (onset year_____)	2	(85-86)
Epileptic Seizures (onset year_____)	3	(87-88)
Heart disease (onset year_____)	4	(89-90)

50. Have you ever had allergies?

Yes (go to Q.51)	1	
No (go to Q.56)	2	(91)

If yes, ask:	First Date of onset (mo/yr)	Worse Since June 1984? Yes	No	Where do you have the problem most often? Home	work	other	DK	NA	
51. Seasonal/respiratory	(__ __/__ __)	1	2	1	2	3	8	9	(92-97)
52. Food allergies	(__ __/__ __)	1	2	1	2	3	8	9	(98-103)
53. Skin allergies	(__ __/__ __)	1	2	1	2	3	8	9	(104-109)
54. Allergies to medicines (specify_____)	(__ __/__ __)	1	2	1	2	3	8	9	(110-115)
55. Other (specify)	(__ __/__ __)	1	2	1	2	3	8	9	(116-121)

56. Do you have a frequent cough?

Yes (go to Q.57)	1	
No (go to Q.60)	2	(122)

If yes, ask:	First Date of onset (mo/yr)	Worse Since June 1984? Yes	No	Where do you have the problem most often? Home	Work	Other	DK	NA	
57. Do you cough first thing in the morning or on getting up on most days at least 3 months per year? (Exclude single cough)	(__ __/__ __)	1	2	1	2	3	8	9	(123-128)
58. Do you have a dry cough on most days? (Exclude single cough)	(__ __/__ __)	1	2	1	2	3	8	9	(129-134)
59. Do you bring up phlegm from your chest, first thing in the morning on most days, at least 3 months per year?	(__ __/__ __)	1	2	1	2	3	8	9	(135-140)

60. Do you frequently wheeze (noise in your chest when breathing)?

Yes (go to Q.61)	1	(141)
No (go to Q.64)	2	(142)

61. Do you get this apart from episodes of colds or flu?

Yes (go to Q.62)	1	
No (go to Q.64)	2	(143)

	If yes, ask:	First Date of Onset (mo/yr.)	Worse since June 1984? Yes	No	Where do you have the problem most often? Home	Work	Other	DK	NA	
62.	Do you get this when resting? (__ __/__ __)		1	2	1	2	3	8	9	(144-149)
63.	Has a doctor told you that you have asthma? (__ __/__ __)		1	2	1	2	3	8	9	(150-155)

64. Have you had any of the following: frequent headache, frequent earaches or skin rashes, frequent colds (over 4 year), frequent stuffy nose or postnasal drip, frequent sore throat, or frequent eye irritation?

Yes (go to Q.65)	1	
No (go to Q.66)	2	(156)

	If yes, ask:	First Date of Onset (mo/yr.)	Worse since June 1984? Yes	No	Where do you have the problem most often? Home	Work	Other	DK	NA	
65.	Headaches? (__ __/__ __)		1	2	1	2	3	8	9	(157-162)
	Earaches? (__ __/__ __)		1	2	1	2	3	8	9	(163-168)
	Skin rashes? (__ __/__ __)		1	2	1	2	3	8	9	(169-174)
	Colds? (__ __/__ __)		1	2	1	2	3	8	9	(175-180)
	Stuffy nose? (__ __/__ __)		1	2	1	2	3	8	9	(181-186)
	Post-nasal drip? (__ __/__ __)		1	2	1	2	3	8	9	(187-192)
	Sore throat? (__ __/__ __)		1	2	1	2	3	8	9	(193-198)
	Eye irritation? (__ __/__ __)		1	2	1	2	3	8	9	(199-204)

66. Are you bothered by odors in your home?

Yes (specify_____)	1	
No	2	(205)

67. Does a member of your family have asthma or allergies?

Yes	1	
No	2	(206)

68. How many times has a doctor diagnosed you with ear infections?_____ When (mo/yr.)_____ (207)

69. Do you have any other comments relating to this survey:

Yes (specify)_____	1	
No	2	(208)

Physical Examination

1. Eyes _____

2. Ears _____

3. Nose _____

4. Mouth/throat _____

_____

5. Chest _____

_____

6. Skin _____

_____

Physician's Initials _____