HETA 86-073-1804
JUNE 1987
SOUTH CAMPBELL COUNTY MIDDLE SCHOOL
ALEXANDRIA, KENTUCKY

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I. SUMMARY

On November 25, 1985, the National Institute for Occupational Safety and Health (NIOSH) received a request from the Kentucky Labor Cabinet for technical assistance in their evaluation of indoor air quality at the South Campbell County Middle School (South), in Alexandria, Kentucky. Eleven teachers at the school had complained of respiratory symptoms related to their presence at the school. Areas of stagnant water, excessive mold growth, and imbalances in the ventilation system were also reported.

An initial survey was conducted at the school on December 6, 1985. Relative humidity levels on December 6, 1985, ranged from 28 to 32 percent, while carbon dioxide (CO_2) levels were 4-6 times higher than outdoor levels, up to 1500 parts per million (ppm).

Reports from construction engineers identified deficiencies in the building's construction and design, which may have allowed water seepage under the gymnasium floor and caused cracks in the interior and exterior walls. Ventilation contractors hired by the school board identified major deficiencies in the ventilation system, including improperly set controls, deficient maintenance, and improper design.

Because of these consultant reports, and because the School Board had begun to address the identified problems, NIOSH did not pursue extensive environmental evaluations. However, to better define the scope of the staff's respiratory complaints, a medical questionnaire survey was conducted.

During follow-up visits on December 16, 1985, and January 9, 1986, a cross-section questionnaire survey was conducted at South and at a control school, the Donald E. Cline Middle School (Cline), located in Cold Spring, Kentucky. Staff at both schools were similar in their demographic and prior medical history profiles. Staff at South were three times as likely to report respiratory symptoms as compared to staff working at Cline (relative risk, R.R.=2.96, P=.009).

Deficiencies in the ventilation system, pictures of mold growth on library books, and water deposits under the gymnasium floor, indicate that deficiencies in indoor air quality existed at the South Campbell County Middle School. These deficiencies could explain increased reports of respiratory irritation among staff of South, compared to the Cline Middle School. Recommendations aimed at improving indoor air quality at South are contained in Section VIII of the report.

KEYWORDS: SIC 8211, Indoor air quality, molds, allergy.

II. INTRODUCTION

On November 25, 1985, NIOSH received a request from the Kentucky Labor Cabinet for technical assistance in their evaluation of reported indoor air quality problems at the South Campbell County Middle School (South), Alexandria, Kentucky.

Eleven current and former employees at the school (two of the complaints were from former employees who had retired or transferred because of the symptoms they reported experiencing at the school) submitted written complaints to the Labor Cabinet of respiratory symptoms related to working at the school and of poor air quality. Imbalances in ventilation and heating, stagnant water under the gymnasium floor, cracks in exterior walls, and mold growth were also reported. Because private ventilation, construction and environmental consultant reports had previously identified many problems at the school, NIOSH confined its study to describing symptoms and evaluating reports that some teachers had developed asthma.

Following the initial walk-through survey and questionnaire data collection on December 6 and 16, 1985, and January 9, 1986, NIOSH distributed a letter describing this investigation on January 27, 1986. A second letter, distributed April 28, 1986, presented results of the questionnaire survey and recommended that controls, suggested by ventilation and construction consultants, be implemented.

III. BACKGROUND

The South Campbell County Middle School, located on the Southern edge of Alexandria, Kentucky, in Campbell County, opened in the fall of 1979. The two-story school building houses classrooms for approximately 500 students in grades seven, eight, and nine, and employs 45 staff, the majority of whom are teachers. South and Cline Middle School (Cline), are the two middle schools in Campbell County.

The school uses an open classroom architecture. Classrooms are not completely enclosed or separated, relying instead on partial walls as partitions. Carpeting is used to help reduce noise levels. The school is built on a level, low-lying area. It is set-back approximately 100 feet from the road by a 10-to-15 foot deep downward slope and a front driveway.
Shortly after the school opened, a number of construction-related problems were noted. Openings in the floor around pillars and close to the walls were reported. Cracks formed in the mortar, doors were out-of-plumb, water accumulated against the foundation, and water was later identified under the gymnasium floor. Mold was reported to have grown on different surfaces in a number of areas of the building, most notably in the library. (There are Pictures of mold-like growth on ceiling panels and library books.)

Wipe samples for mold were collected by the Kentucky Department of Health, from four locations in the library. The wipe samples yielded common mold genera, Fusarium, Aspergillus, Penicillium and Alternaria. While these genera of fungi have been implicated in allergic disease, they are ubiquitous in indoor and outdoor environments, and their presence, by itself, does not constitute a health hazard.[1]

Informal interviews were conducted with 10 of the staff at South. Most of those reporting symptoms, reported upper respiratory irritation. However, one staff member at South, the librarian, reported symptoms suggestive of hypersensitivity pneumonitis–fevers of 101°F, chills, and muscle aches beginning late in the afternoon on Mondays and improving over the weekend. Serological tests for precipitating antibodies (IgG antibodies produced by the immune system) to antigens known to cause hypersensitivity pneumonitis were negative. Other tests for this disease were also negative (X ray and CBC during symptomatic stages). Skin tests for an allergic response to mold species were positive.

A mechanical service contractor, evaluated temperature controls, fresh air dampers and ventilation design specifications at South as well as another middle school, the Cline Middle School (Cline). A formal report on the South Campbell Middle School ventilation system was presented to the School Board, dated February 5, 1986.

The mechanical contractor's report detailed many deficiencies in air handling at South related to improper maintenance of the system (closed fresh air dampers, broken controls) and design problems (undersized fan and duct). Several zones of the HVAC system were reported to have no air flow, others had dampers propped open. There were shortfalls in air flow, up to 35% in one air handling zone, when compared to design specifications. Many filters were "extremely dirty," indicating that a number of problems were maintenance problems. A similar, though less extensive, review at Cline identified far fewer deficiencies. (Personal communication with John Loew, Kuempel service, February, 1986.)

IV. METHODS

A. Medical

To classify the health complaints, a symptom questionnaire was administered to the staff at South on December 16, 1986, and another on January 9, 1987. The students were not included in this survey because those reporting respiratory problems were allowed to transfer to other schools and because they spend less time in the school than the staff. (At the time of our initial survey, one student was on home-bound study with the diagnosis of anaphylactic angio-edema secondary to mold allergy. Six other students were transferred to another middle school at the request of their parents.)

Symptom questionnaires were distributed to staff at South and at Cline where no environmental problems had been reported. Both schools are middle schools employing a similar number of staff and teaching similar numbers of students in grades seven, eight and nine. Although Cline was built three years earlier in (1976), five miles to the north, and on higher level ground, it is otherwise similar to South in construction and design. One striking difference is the library design. At Cline, the library is not separated from the cafeteria and uses bookshelves as room dividers. At South, the library is separated from the cafeteria by floor to ceiling panels which completely enclose it, creating a separate room. These changes were made after the school was built to cut down on the noise and allow use of the library as a separate room.

The first questionnaire focused on lower respiratory symptoms; the second sought to describe the prevalence of upper respiratory symptoms. A case of lower respiratory illness was defined as one or more of the following symptoms: Coughing or difficulty breathing, wheezy or whistling breathing, shortness of breath, and chest tightness. A case of upper respiratory illness was defined as one or more

of the following symptoms: stuffy, runny nose; sinus pains or congestion; dry, tickling or scratchy throat; itchy, watery or burning eyes.

Staff at South with symptoms suggestive of lower respiratory illness temporally related to presence in the school building were asked to record peak expiratory flow rates, using a hand held peak flow meter, for the period December 18, 1985, to January 8, 1986. Five staff agreed to perform the tests and record readings. They were asked to record results every three hours, while awake, for a three-week period that included a ten day vacation. The variability, in percent, between the highest and lowest daily peak flow reading was analyzed for evidence of changes in lung function related to presence at the school. A reversible decrease in peak expiratory flow rate of greater than 20 percent in any one day was considered evidence of asthma.[2]

Finally, student absentee records for the last four years at both schools were reviewed.

B. Enviornmental

NIOSH conducted environmental sampling consisting of measuring relative humidity with a psychronometer and measuring carbon dioxide (CO_2) concentration with colorometric detector tubes. Viable air sampling was not performed by NIOSH because control measures were begun by the school board based on the conclusions of the various consultant reports.

V. EVALUATION CRITERIA AND METHODS

A. Air Contamination Evaluation Criteria

The primary sources of air contamination criteria generally consulted include: (1) NIOSH Criteria Documents and recommendations for occupational exposure, (2) the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLV's), (3) the U.S. Department of Labor (OSHA) federal occupational health standards, and (4) the indoor air quality standards developed by the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE). The first three sources provide environmental limits based on airborne concentrations of substances to which workers may be occupationally exposed in the workplace environment for 8 to 10 hours a day, 40 hours per week for a working lifetime without adverse health effects. The ASHRAE standards are general air quality standards for indoor environments, and are applicable for the general populations exposed for up to a 24-hour day of continuous exposure without known toxic effects.

1. Building-Related Illness Episodes

Building-related illness episodes have been reported more frequently in recent years as buildings have been made more air-tight in order to conserve energy and to reduce air conditioning expenses. Modern high-rise office buildings are constructed primarily of steel, glass, and concrete, with large windows that cannot be opened, thus making the building totally dependent on mechanical systems for air conditioning. Contaminants may be present in make-up air or may be introduced from indoor activities, furnishings, building materials, surface coatings, and air handling systems and treatments components. Symptoms often reported are eye, nose, and throat irritation, headache, fatigue, and sinus congestion. Occasionally, upper respiratory irritation and skin rashes are reported. In some cases, the cause of the symptoms has been ascribed to an airborne contaminant, such as formaldehyde, tobacco smoke, or insulation particles, but most commonly a single cause cannot be pinpointed.

Imbalance or malfunction of the air conditioning system is commonly identified, and in the absence of other theories of causation, illnesses are usually attributed to inadequate ventilation, heating/cooling, or humidification.[3]

2. Microorganisms

Microorganisms can be spread through ventilation systems in buildings where air filters become wet and moldy, where pools of stagnant water accumulate under air conditioning cooling coils, and where decaying organic matter is found near air conditioning intakes.

Increases in airborne microorganisms (protozoa, bacteria, and molds) can result in respiratory symptoms. Molds from many genera have been reported to induce allergic disease, including asthma.[4,5] However, because these organisms are ubiquitous, and display great weather-related and seasonal variations, it is difficult to implicate individual microorganisms without conducting extensive environmental and laboratory studies.

Less commonly, microbiological contamination of the indoor environment can result in a disease condition known as hypersensitivity pneumonitis (HP).[6] Hypersensitivity pneumonitis is a respiratory disease which can result from exposure to viable and nonviable organic proteins and certain chemicals, e.g., molds, animal dander, and isocyanates. Once sensitivity to an antigen has developed, re-exposure will result in redevelopment of the symptoms of chills, fever, and muscle aches. With chronic long term exposure serious non reversible disturbances in lung function can develop. The best method for preventing the reoccurrence of symptoms is to avoid exposure to the offending antigen, or the suspect environment if no antigen is identified.

Neither NIOSH, OSHA, or ASHRAE have developed standard evaluation criteria for indoor microbiological contamination because many variables determine whether illness will develop. Indoor microbiological levels are determined to a large extent by outdoor microbiological levels, which vary with season, time of day, and weather conditions. Individual susceptibility to microorganisms is also variable, reflecting individual genetic variability, prior history of exposure to the microorganisms, and underlying medical conditions.

3. Relative Humidity (R.H.)

Air that is too dry (R.H.<20%) can cause irritation of the eyes and upper respiratory tract. High humidity (R.H.>55%) can support the growth of various micro-organisms.

4. Carbon Dioxide

Carbon Dioxide (CO_2) is rarely considered a potentially hazardous contaminant in schools or office buildings because it is highly unlikely that hazardous concentrations (>5000 ppm) of CO_2 could occur is such environments. However, CO_2 measurements can provide a useful tool for quickly assessing certain elements of a building's ventilation system. For examples, the quantity of fresh air that is being supplied to a building can be calculated by comparing the indoor CO_2 concentrations with the outdoor CO_2 level (250-350 ppm in most areas). Generally, if the average indoor CO_2 level is more than two to three the outdoor CO_2 level, then it is likely that the ASHRAE guideline of 15 cfm of fresh air per person is not being met.

B. Ventilation Evaluation Criteria

Neither NIOSH nor OSHA has developed ventilation criteria for general offices. Criteria often used by design engineers are the guidelines published by ASHRAE.

Until recently, the ASHRAE Ventilation Standard 62-73 (1973) was utilized, but recommendations were based on studies performed before the more modern, air-tight office buildings became common. These older buildings permitted more air infiltration through leaks in cracks and interstices, around windows and doors, and through floors and walls. Modern office buildings are usually much more airtight and permit less air infiltration. Due to the reduced infiltration, ASHRAE questioned whether the 1973 minimum ventilation values assure adequate outdoor air supply in modern, air-tight buildings.

Subsequently, ASHRAE revised its standard and published standard, ASHRAE 62-1981, "Ventilation for Acceptable Indoor Air Quality." The standard is based on an occupant density of 7 persons per 1000 ft^2 of floor area, and recommends higher ventilation rates for areas where smoking is permitted. The ASHRAE standard stated that indoor air quality for "General Offices" shall be considered acceptable if the supply of outdoor air is sufficient to reduce carbon dioxide to less than 2500 ppm and to control contaminants, such as various gases, vapors, microoganisms, smoke, and other particulate matter, so that concentrations known to impair health or cause discomfort to occupants are not exceeded. However, the threshold levels for health effect from these exposures are poorly documented. For "General Offices" where smoking is not permitted,

the recommended rate was 5 cfm of outdoor air per person. On July 15, 1986, ASHRAE submitted a proposed revised standard (ANSI/ASHRAE 62-1981R) for public review. In this draft standard ASHRAE recommends raising the minimum ventilation rate to 15 cfm of outdoor air per person in order to control odors. Higher ventilation rates are recommended for spaces where smoking is permitted because tobacco smoke is one of the most difficult contaminants to control at the source. When smoking is allowed, the amount of outdoor air provided should be 20 cfm per person.[7]

The ASHRAE Standard 62-1981 also provides ventilation requirement guidelines for a wide variety of commercial, institutional, residential, and industrial facilities and should be consulted for application to the specific situation under evaluation.

Several recent studies have suggested that in occupied spaces, a level of CO_2 in excess of 1000 ppm is an indicator of inadequate outdoor air supply.[8,9] These researchers suggest that levels under 600 ppm indicate adequate fresh air in the building. Between 600 to 1000 ppm, the prevalence of irritative complaints are likely to increase. Over 1000 ppm of CO_2, symptoms of irritation or allergy are likely to be more common.

VI. RESULTS

A. MEDICAL

1. Questionnaire Results

Completed questionnaires were obtained from 40 (88%) of 45 staff at South. Three staff members on sick leave; one with respiratory problems (allergic rhinitis, sinusitis, and asthma) diagnosed in October 1984, were not included in the study. At Cline, 37 (93%) of 40 available staff completed the questionnaire. Two staff members on non-respiratory-related sick leave were not included in the study.

Staff at South and Cline had similar distributions of age, sex, race, education, job classification, medical history, and prior diagnosis of respiratory illnesses (Table 5). Only the number of years working at the school was different–on average, Cline staff worked two years longer than South staff (6 vs 3.8 years, t=3.01, P=.006).

Table 1 lists the prevalence of work-related symptoms by school. Figure 1 portrays these results graphically. The most common symptoms reported were throat irritation, headache, eye irritation, wheezing, and nose irritation.
Sixteen (40%) of 40 South participants, and five (14%) of 37 Cline participants had symptoms that met the case definition of either uppper or lower respiratory illness (Relative Risk, RR =2.96, P=.009). Survey participants working at South were three times as likely to report respiratory symptoms as compared to staff working at Cline.

While sixty six percent (8/12) of lower respiratory cases were upper respiratory cases and 47 percent (8/17) of upper respiratory cases were lower respiratory cases, this correlation was not statistically significant (X^2=1.23, P=0.26, McNemar's matched pair analysis). Staff at South were more likely to have both upper (76% vs. 23%, RR=3.01, P=.02) and lower (83% vs. 17%, RR=4.63, P=.018) respiratory symptoms when compared to staff at Cline.

Since prior medical history can influence susceptibility to airborne allergens, the proportion of staff reporting medical problems was compared by school. This proportion did not vary significantly between South and Cline, Table 5. Cases were then examined for a prior history of specific respiratory conditions such as, allergy, sinusitis, or asthma. A larger proportion of all respiratory cases reported a history of allergy (R.R. 2.2, P=.071) and hay fever (R.R.=2.4, P=.054) when compared to non-cases, Table 2. The relationship between case status and medical history was also evident for upper-respiratory (hay

fever) and lower respiratory (sinusitis, allergy) cases, Tables 3 and 4. Only two staff reported a prior diagnosis of asthma, one at South and one at Cline.

Teachers were more likely than others to have a case of respiratory illness (R.R.=2.9, P=.04) When the data were stratified by school, teachers at South were five times more likely to be a lower respiratory case (R.R.=5.4, Fishers exact test P=.059) than nonteachers. No significant difference in teacher illness was noted for teachers at Cline (R.R.=1.48, Fishers exact test P=1.00).

The gymnasium and the library were two areas where mold and/or moisture were reported to have been a problem. No association was identified between case status and moderate exposure (more than five hours per week) to the library, gymnasium, first or second floor. When exposure was defined as spending one or more hours per week in the area (any exposure), respiratory cases were twice as likely (R.R.=2.17, P=.04) to report exposure to either the South or Cline library compared to non-cases. (Moderate exposure was used to define library exposure in the April 1986, report.) Cases at South were more likely to report any exposure to their library compared to cases at Cline (R.R.=2.1 vs. 1.3). Fifty eight percent (10/17) of those reporting any exposure to the library at South were cases compared to 16 percent (2/12) of those reporting any exposure to the library at Cline.

2. Peak-Flow Meter Results

Four of the five eligible South staff who agreed to use the peak-flow meters recorded data on their peak expiratory flow rate. (One staff member did not take readings because of personal reasons.) No evidence of decrement in lung function (daily variability greater than 20 percent) related to presence at the school was identified in any of the four workers; and none recorded any symptoms suggestive of asthma during the monotoring period. As well, no patterns of differences in daily variability between vacation and work periods were seen.

3. Absentee Records

Although South had a higher student absentee rate from September to October 1985, the difference was less than one percent. A review of previous years did not show a consistent trend of increased absenteeism at one school when compared to the other. Unfortunately data on the symptoms or cause of the absences are not recorded unless potentially serious or contagious illnesses are suspect.

B. Environmental

Relative humidity readings ranged from 28 to 32%. Indoor CO_2 levels, 1000-1500 ppm, were four to six times higher than the level measured outdoor (250 ppm).

VII. CONCLUSION

The questionnaire survey was conducted to categorize the symptoms reported at South and to compare the frequency of symptoms with those at a control school, the Cline Middle School. The availability of a cohort exposed to the same aged children and working in a similarly designed building provided a good opportunity for a comparative study.

The medical questionnaire results support the hypothesis that working at the South Campbell County Middle School was associated with respiratory illness. Staff at South were three times as likely to report work-related respiratory symptoms as compared to staff at Cline. Respiratory symptoms were also related to a history of allergy or hayfever and to being a teacher. Still, the prevalence of illness was higher among teachers at South than among teachers at Cline and higher among staff at South with a prior respiratory medical problem than among staff at Cline with a prior respiratory medical problem.

A significant association was identified between any exposure (one or more hours per week) to the library in South or Cline and respiratory case status. An association between a library environment and allergic illness is plausible because libraries and other book collections are thought to increase exposure to antigens--dust, glue, mold, or arthropods--associated with the books.[10] A humid environment containing books and carpeting could provide a good substrate for mold growth increasing the allergenicity of this environment. Subsequently, when books are opened or the carpeting is walked upon, aerosols to mold and other allergens may be generated. Significantly more cases reported exposure to the library at South (58%) than to the library at Cline (16%). However, staff at South were more likely to report exposure to their library compared to staff at Cline (48%, 17/35 vs 33%, 12/36). The library at South is a separate room, and mold growth was reported on library books: Therefore, staff at South, especially those with respiratory problems, may have been more aware of time they spent in the library than staff at Cline. No dose-response relationship could be identified between hours spent in the library at South and respiratory symptoms, most likely because the sample size was small and because few staff reported spending more than 3 hours per week in the library.

Expiratory peak-flow readings were recorded from four workers with suspected lower respiratory illnesses to attempt to correlate their symptoms with changes in airway function and with exposure to the environment at South. Correlation of daily variability with exposure to a specific process or work environment can implicate the process or work environment as a cause of the respiratory illness. Unfortunately, incomplete data recording, history of respiratory disease, and medication regimes can obscure associations. The negative results do not refute workers complaints of respiratory symptoms, but indicate that no asthmatic symptoms were detected during the monitored period. Upper respiratory symptoms, as well as medically controlled asthma would not likely result in a decrease in peak-flow readings. Furthermore, the comparability of air quality at South during the NIOSH study with the air quality during previous years, when problems were reported to be more serious, can not be determined.

Awareness by staff at South of reports of respiratory illness and of mold growth could have introduced a response bias increasing the number of workers likely to report illness when compared to staff at Cline. Nonetheless, anecdotal, environmental, questionnaire, and engineering data are available to

suggest that the combination of ventilation, maintenance, and design deficiencies, may have decreased the indoor air quality and led to staff's respiratory complaints.

VIII. RECOMMENDATIONS

The following recommendations should assist the school board in more quickly identifying and resolving problems related to deficiencies in indoor air quality.

1. The role of carpeting as a reservoir for bioallergens must be considered. In areas where carpeting is not essential for noise reduction and where it is likely to be chronically exposed to stagnant water, it should be removed. Damp carpet fibers can be colonized by molds and bacteria, which can become aerosolized as students and staff walk across the area, or as the carpet is vacuumed.

2. Carpet shampooing practices should be altered to insure that carpets do not remain damp over vacations and other absences from school when lights will be off and temperatures not controlled.

3. Caution must be employed when applying any chemicals to carpeting to suppress mold growth. Although reports of symptoms associated with these chemicals have been rare, and generally with unusually susceptible individuals or misapplication, NIOSH can not endorse the use of any chemical as a long-term primary control measure, especially in a school environment. Outbreaks of respiratory irritation have also been reported from exposure to chemicals in carpet shampoos.[11] Now that recommended improvements have been made in the building, routine use of any chemicals to suppress mold growth should be discontinued.

4. Maintenance personnel at all schools should follow approved maintenance procedures.

5. Of all the school's microenvironments, the library has the greatest potential for producing dusts and organic aerosols. Because the library at South was partitioned after the school was built, much effort should be employed to ensure the library's temperature, humidity, and ventilation are properly maintained.

IX. REFERENCES

1. Howard, WA. "Incidence and Clinical Characteristics of Mold Allergy," Mold Allergy pp. 147-156. (Lea & Febinger, Philadelphia, 1984) Al-Doory, Yousef; Domson, Joanne; ed.

2. Burge, S.P. "Could you be overlooking Occupational Asthma?" Journal of Respiratory Diseases 3:97-112;1982.

3. Melius, J; Wallingford, K; Keenlyside, R; Carpenter, J. "Indoor Air Quality–The NIOSH Experience." Ann. Am. Conf. Gov. Ind. Hyg., 10:3-7;1984.

4. Gravesen, S. "Fungi As a Cause of Allergic Disease" Allergy 34:135-154; 1979.

5. Salvaggio, J.; Aukrust, L. "Mold Induced Asthma" J. Allergy Cline. Immunol. 68:327-346;1981.

6. Rylander, R. "Organic Dusts and Lung Reactions–Exposure Characteristics and Mechanisms for Disease." Scan. J. Work Environ. Health 11:199-296;1985.

7. American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. ASHRAE standard 62-1981, Ventilation for Acceptable Indoor Air Quality. Atlanta, Georgia: ASHRAE 1981.

8. Rajhans, G.S., Occupational Health in Ontario. 4:160-167;1983.

9. Bell, S.J., Khati, B., Occupational Health in Ontario. 4:103-108;1983.

10. Burge, H.P.; Boise, J.R.; Solomon, W.R.; Bandera, E. "Fungi in Libraries: An Aerometric Survey." Mycopathologia 64:67-72;1978.

11. Kreiss, K. "Respiratory Irritation due to Carpet Shampoo: Two Outbreaks," Environment International 8:337-341;1982.

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XI. DISTRIBUTION AND AVAILABILITY OF REPORT

Copies of this report are currently available upon request from NIOSH, Division of Standards Development and Technology Transfer, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days, the report will be available through the National Technical Information Service (NTIS), 5285 Port Royal, Springfield, Virginia 22161. Information regarding its availability through NTIS can be obtained from NIOSH Publications Office at the Cincinnati address. Copies of this report have been sent to:

1. South Campbell County Middle School, Alexandria, Kentucky
2. Kentucky Labor Cabinet
3. NIOSH, Region IV
4. OSHA, Region IV

For the purpose of informing affected employees, copies of this report shall be posted by the employer in a prominent place accessible to the employees for a period of 30 calendar days.

Table 1
Occupationally-Related Symptoms Reported by School
South Campbell County Middle Schools
Alexandria, Kentucky
HETA 86-073
December 1985

SYMPTOMS (Reported regularly at work, but not at home.)	SOUTH	CLINE	Case Definition
Nausea or vomiting	2/36	0/34	
Stuffy, runny nose	4/36	1/34	*
Sinus pains or congestion	3/36	0/35	*
Dry, Tickling or scratchy throat	7/36	4/35	*
Headache	7/35	3/35	
Itchy, watery or burning eyes	7/36	2/35	*
Coughing or difficulty breathing	3/35	0/35	**
Fever, chills or muscle aches	2/36	1/35	
SYMPTOMS (Symptoms reported at work, but not at all at home, or not at all during vacation.)			
Wheezy or whistling breathing	5/37	1/36	**
Shortness of breath	1/37	1/35	**
Chest tightness	3/37	2/35	**

Case Definitions:

at least one of...

* or ** = Respiratory case

* = Upper respiratory case

** = Lower respiratory case

Table 2

Respiratory Case Status by Demographic and Exposure Variables

South Campbell County Middle School
Alexandria, Kentucky
HETA 86-073
December 16, 1985

Variable	Cases With Variable	Cases Without Variable	X^2	P	RR
School (South)	16/40	5/37	6.80	.009	2.96
Sex (Males)	9/25	12/47	.87	.35	1.41
Years in Building ≥2	16/53	5/15	.19	.662	1.21
Teacher	18/52	3/25	4.35	.037	2.88
Teach more than 3 hrs/day	4/23	10/25	2.96	.085	0.43
First floor >25% of day	14/50	7/21	.20	.65	0.84
Second floor >25% of day	9/27	7/22	.01	.91	1.05
Gym, any exposure	7/19	14/53	.74	.39	1.39
Library, any exposure	12/29	8/42	4.23	.040	2.17
Pets	12/38	9/34	.23	.634	1.19
Hobbies with glue or solvents	5/12	16/61	1.17	.308*	1.59
Allergy	6/11	15/60	3.90	.071*	2.18
Sinusitis	13/34	8/38	2.56	.109	1.82
Hay fever	6/10	15/61	5.17	.054*	2.44
Asthma	1/2	20/69	.41	.495*	1.73
Library - South, any exposure	10/17	5/18	3.44	.064	2.12
Library - Cline, any exposure	2/12	3/24	.12	1.00*	1.33
Current Smoker	3/13	18/60	.25	.744	0.77

* = Fischer's Exact Test, 2-tailed P-value

Table 3

Upper Respiratory Case Status by Demographic and Exposure Variables

South Campbell County Middle School
Alexandria, Kentucky
HETA 86-073
December 16, 1985

Variable	Cases With Variable	Cases Without Variable	X^2	P	RR
School (South)	13/40	4/37	5.26	.022	3.01
Sex (Males)	7/24	10/39	0.69	.406	1.43
Years in Building $\geq$2	13/40	4/16	0.17	.766*	1.23
Teacher	14/52	3/22	2.18	.139	2.24
Teach more than 3 hrs/day	4/23	8/25	1.36	.24	0.54
First floor >25% of day	11/50	6/15	0.35	.553	0.77
Second floor >25% of day	8/27	5/22	0.30	.586	1.30
Library, any exposure	8/29	8/42	0.72	0.40	1.45
Pets	10/38	7/34	0.33	.567	1.28
Hobbies with glue or solvents	3/12	14/61	0.02	1.00*	1.09
Allergy	5/11	12/60	3.31	.118*	2.27
Sinusitis	10/34	7/38	1.20	.273	1.60
Hay fever	5/10	12/61	4.34	.052	2.54
Asthma	0/ 2	17/67	0.67	.521	0.0
Current smoker	2/13	15/60	0.55	.719	0.62

* = Fischer's Exact Test, 2-tailed P-value

Table 4

Lower Respiratory Case Status by Demographic and Exposure Variables

South Campbell County Middle School
Alexandria, Kentucky
HETA 86-073
December 16, 1985

Variable	Cases With Variable	Cases Without Variable	X^2	P	RR
School (South)	10/40	2/37	5.61**	.018	4.63
Years in Building $\geq$ 2	9/53	3/20	0.04	1.00	1.13
Teacher	11/52	1/25	3.78	.090*	5.29
Teach more than 3 hrs/day	1/23	6/25	3.71	.099*	0.18
First floor >25%	9/50	3/21	0.15	1.00*	1.26
Second floor >25%	4/27	3/22	0.01	1.00*	1.09
Gym, any exposure	3/19	9/53	0.01	1.00*	0.93
Library, any exposure	7/29	5/42	1.83	.209*	2.03
Pets	7/38	5/34	0.18	0.673	1.25
Hobbies with glue or solvents	5/12	7/61	6.65	.022	3.63
Allergy	4/11	8/60	3.51	.082*	2.73
Sinusitis	9/34	3/38	4.46	.035	3.35
Hay fever	3/10	9/61	1.42	3.56*	2.03
Asthma	1/ 2	11/58	1.61	.20	3.14
Current smoker	3/10	9/60	0.51	0.437	1.54

* = Fischer's Exact Test, 2-tailed P-value

Table 5

Medical History and Exposure Variables by School

South Campbell County Middle School
Alexandria, Kentucky
HETA 86-073
December 16, 1985

Variable	South	Cline	X^2	P
Teacher	25/40	27/37	0.96	0.326
Gym, any exposure	7/36	12/36	1.79	0.181
Library, any exposure	17/35	12/36	1.71	0.191
Pets	18/36	20/36	0.22	0.636
Hobbies with glue or solvents	8/37	4/36	1.47	0.226
Allergy	5/37	6/35	0.144	0.708
Sinusitis	19/37	15/35	0.521	0.475
Hay fever	6/37	4/34	0.290	0.737*
Asthma	1/39	1/34	0.004	1.000*
Current smoker	5/37	8/37	0.84	0.359

* = Fischer's Exact Test, 2-tailed P-value

SOUTH CAMPBELL COUNTY MIDDLE SCHOOL
Alexandria, Kentucky
HETA 86-073

FIGURE 1. PREVALENCE (Percent) OF SYMPTOMS EXPERIENCED AT WORK, BUT NOT AT HOME by SCHOOL (December 1985 - January 1986)