A Survey of Asthma Prevalence in Elementary School Children

Environment & Human Health, Inc.

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A Survey of Asthma Prevalence in Elementary School Children

A Study of Asthma Rates Among Students enrolled in Kindergarten through Fifth Grade in Connecticut Schools

Executive Summary

Asthma is a chronic disease that affects growing numbers of children and adults in the United States. Little information is available as to the frequency with which it affects different communities. Preliminary work in some New England states suggests that school nurses are able to provide information at a community level to better characterize the distribution of asthma. Such information will enhance efforts to understand the causes of asthma and promote targeted interventions to prevent and treat the disease.

This study was designed to estimate the prevalence of asthma among children attending grades K-5 in Connecticut schools. A second goal was to obtain information regarding characteristics of school environments that may contribute to asthma or to asthma symptoms.

Summary of Findings

- Of 863 schools with grades K-5, 698 participated in this study, which represents 81 percent.
- Based on information from school nurses, 9.7 percent of K-5 students in Connecticut have asthma.
- Asthma affects more students in urban communities than in suburban and rural communities.
- While urban status appears dominant, socioeconomic status significantly affects asthma rates in communities. Children in poorer communities have higher rates of asthma than those in more affluent communities, even in rural areas of the state.
- School nurses have multiple sources of information about the health of students, can provide important information regarding asthma rates at a local level, and can play a role in developing a statewide and national asthma tracking system.
- While the causes of asthma are complex, involving multiple personal, home, and community factors, schools themselves may provide environments that can contain risk factors for asthma:
    - A majority of schools with grades K-5 in Connecticut have difficulties with water incursion into their buildings;
    - Over half of the schools renovate their buildings while students are present. Construction practices may increase asthma risk if guidelines for renovations during building occupancy are not implemented.
- The statewide rate of asthma estimated here, 9.7 percent, is higher than the rate estimated in a prior study conducted by Environment and Human Health, Inc. In 1999, the rate was estimated to be 7.8 percent among elementary school students. This change may reflect:
    - The fact that school nurses were surveyed later in the school year;
    - Increased recognition of asthma among students by physicians, parents, and school nurses; or
    - An increasing rate of asthma among elementary students in Connecticut.

Introduction and Background

Asthma is a growing problem in communities in the United States.

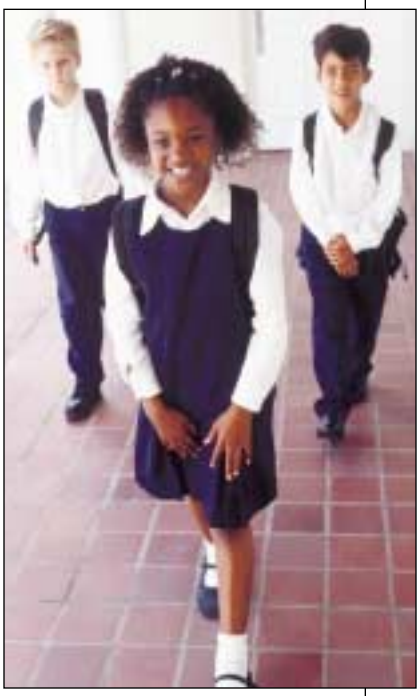
Asthma is an emerging problem in the United States. The prevalence rates of asthma have risen, as has the severity of the disease in affected individuals. The number of asthmatics in the United States doubled in the 15 years between 1980 and 1995. The prevalence rate of current asthma (symptoms present in the past 12 months) increased from 3.1 percent to 5.4 percent in that time.[1] Among children aged 5-14 years, current asthma increased from 4.5 percent to 7.0 percent between 1980 and 1996.[2] A recent report published by the Connecticut Department of Public Health estimates that 8.9 percent of children under the age of 18 in Connecticut had asthma in 2001.[3]

As the asthma prevalence rates have increased, so have the severity and mortality of the disease. Asthma mortality increased by 55 percent in the U.S. between 1979 and 1995. In Connecticut, asthma accounts for 50-60 deaths per year and contributes to another 75-100 deaths. The mortality rate is higher for blacks and Hispanics than for whites.[4]

How is asthma tracked in the United States?

In the United States we track the prevalence of asthma in several ways. The Behavioral Risk Factor Surveillance System (BRFSS) conducts a telephone survey of adults 18 years and older. In some states in some years, the survey asks questions regarding childhood asthma. In Connecticut, this survey estimated that 10.4 percent of children under the

age of 18 had asthma in 1998-1999. The rate varied by age, with 10.9 percent of children between the ages of 5 and 14 years estimated to have asthma and 14.4 percent of older children estimated to have asthma. In 2001, this survey estimated the asthma rate among children under 18 to be 8.9 percent.



The National Health and Nutrition Examination Survey (NHANES) periodically assesses the health status of a sample of the U.S. population in detail. Since 1980, the National Health Interview Survey (NHIS) used in the NHANES study has questioned one-sixth of the sample about asthma. In 1997, the survey began to inquire about childhood asthma.

Vital statistics provide another measure of asthma. Deaths from asthma increased 55 percent in the U.S. between 1979-80 and 1994-95. In Connecticut, asthma as a primary cause of death has not changed significantly between 1989 and 1998 but has increased as a contributing factor.[5]

Hospitalization rates for asthma show striking differences between urban and other populations in Connecticut. The Connecticut Department of Public Health reported that in 1995, the rate of hospitalization for asthma in Connecticut's five largest cities was more than twice the average for the state and higher than the national average. Whether this reflects higher asthma rates in the population or higher utilization of hospitals and emergency rooms for health care services is not known.

Occupational asthma is tracked in some states, including Connecticut. Work-related exposures may be responsible for nearly 30 percent of adult cases of asthma. However, surveillance systems depend upon interested physicians recognizing the conditions and reporting it to state public health agencies. Even in states with active surveillance systems, most cases are not recognized and reported.[6]

Existing information about asthma prevalence is inadequate.

Efforts to understand this rise in asthma have been stymied by the lack of good information as to how the frequency of asthma affects different groups of people in different regions.[7] International surveys demonstrate that asthma rates are rising worldwide, are higher in Westernized countries, and increase with urbanization.[8] Current surveillance systems in the United States provide information on a national basis and, more recently, on a statewide basis. Little information is available as to the occurrence of asthma at a community level.[9] To understand causes of and contributors to asthma we need to have a better measure of its occurrence in smaller populations. This will allow us to detect differences and to follow changes more meaningfully.

One place to evaluate the health of children at a community level is at school. School nurses provide direct care to children and are responsible for the administration of medications required during the school day. In 1999, Environment and Human Health, Inc. (EHHI) surveyed school nurses and determined that they could provide information regarding the number of asthmatics in the schools they serve.[10] Legislation passed in 2001 mandates that school nurses collect information about asthma among students and provide information to the local health department and the Connecticut Department of Public Health as to the number of students with asthma. The nurses are to use the information provided by physicians and parents on the Health Assessment Form. This system will begin to provide some ongoing information regarding asthma prevalence in the state in 2004.

There are many factors that contribute to the development of asthma. These include the genetic makeup of the individual, the home environment, childhood infections,

attendance at day care, access to health care, outdoor air quality, and nutrition. Home environmental factors include tobacco smoke, dust mites, moisture, mold, cockroaches, and pets. Whether pesticides play a role is uncertain.[11, 12] The causes of asthma are extremely complex. Early exposure to agents known to cause allergy later in life, for example, may be protective to infants. Obesity is now recognized as a strong contributor to asthma. The mechanisms and interactions among factors are poorly understood.

Schools also represent environments that may be important to the health of children.[13, 14, 15] In the past decade, there has been increasing concern that some schools may actually be contributing to the burden of asthma. The primary evidence for this comes from the rising number of occupational asthma cases among teachers.

In Connecticut, teaching is the most common occupation associated with the development of work-related asthma.[16] Among the four states (Massachusetts, New Jersey, Michigan, and California) with occupational asthma surveillance through the National Institute for Occupational Safety and Health (NIOSH), indoor air pollutants are in the top two causes of work-related asthma, accounting for one-fifth of the cases in Massachusetts. Educational services account for from 4 to 14 percent of reported work-related asthma cases in these states and rank second or third in three of the four states.[17] Efforts to understand the causes of asthma in teachers have led to concerns regarding chronic water incursion and microbial growth in schools. In 1995, the U.S. General Accounting Office reported that one in five schools in the U.S. has problems with indoor air quality.[18] There are no systematic inventories of schools in New England regarding building characteristics or maintenance practices to provide information about the frequency of possible risk factors for asthma.

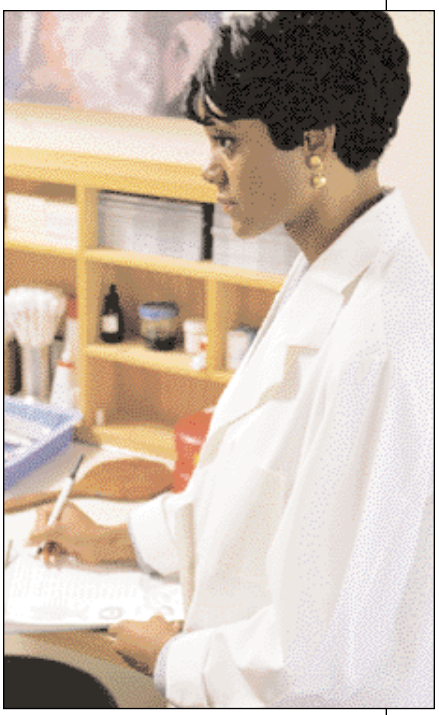
Previous study of school nurse data by Environment and Human Health, Inc. (EHHI)

In 1999, Environment and Human Health, Inc. conducted a study of asthma prevalence rates among all kindergarten through twelfth graders who attended Connecticut public schools and certain private, nonprofit schools that were provided health services through the public school districts. In order to gather information on students diagnosed with asthma, school nurses were surveyed. The data provided by school nurses regarding the number of students in each school with the diagnosis of asthma were aggregated, evaluated and reported by school district.[19]

In that study, it was found that 7.8 percent of elementary school children had asthma. The number of students known to have asthma increased slightly from fall to winter. Data regarding asthma were less variable from schools with elementary students than from schools with middle and high school students. The asthma rate for school districts ranged from a low of just over 3 percent to a high of just under 14 percent. Asthma prevalence rates for elementary school children were consistent among urban, suburban, and rural districts with no appreciable difference. Asthma prevalence rates among Connecticut elementary school children in districts grouped by socioeconomic status (SES) were significantly different. Based on a classification used by the Connecticut Department of Education to place school districts into socioeconomic groupings, called Education Reference Groups (ERGs), asthma prevalence rates rose from the highest SES grouping with the lowest prevalence rate of 5.5 percent, to the lowest SES grouping with the highest prevalence rate of 9 percent. Asthma prevalence rates among Connecticut elementary school children in districts grouped by county were also significantly different.

While significant differences among urban, suburban, and rural schools were not found in the 1999 study, the fact that the unit of analysis was the school district, rather than individual schools, may have influenced this finding. The number of students attending school in one district may vary by thousands from the number of students attending school in another.

Environment and Human Health, Inc.'s current study of asthma rates among Connecticut school children in grades K-5



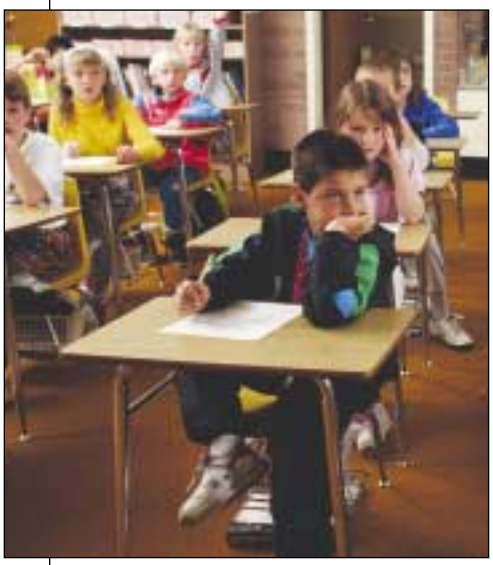
This study surveyed all school nurses who provide health services to kindergarten through fifth grade students in Connecticut public schools and in Connecticut private, nonprofit schools that receive health services through the public schools. The goals of this study were to evaluate rates of asthma within districts and across regions to see if there were patterns of potential importance. In addition, the survey asked school nurses to provide information on characteristics of school buildings, maintenance, and pesticide use that may have an impact on asthma.

Methods

Design of Survey Instrument

Based on experience with the previous EHHI study, the investigators developed a survey instrument to ascertain the number of asthmatic students in kindergarten through grade five (K-5) in Connecticut schools (Appendix 1). Questions were added to the survey instrument to assess characteristics of school buildings and activities that have been identified as potential contributors to risk factors for water incursion or exposure to asthma triggers. Questions were limited to those that the investigators thought could be answered readily by school nurses.

The survey instrument was specifically designed to elicit data from each participating school regarding the following:



- number of students in Grades K-5;
- number of K-5 students known to have a diagnosis of asthma;
- number of K-5 asthmatic students with inhalant or nebulizer medication in school;
- school's geographic setting and roof type;
- history of water incursion;
- presence of carpets;
- use of pesticides;
- presence of pests;
- recent construction or renovation activities; and
- presence of idling school buses on school property.

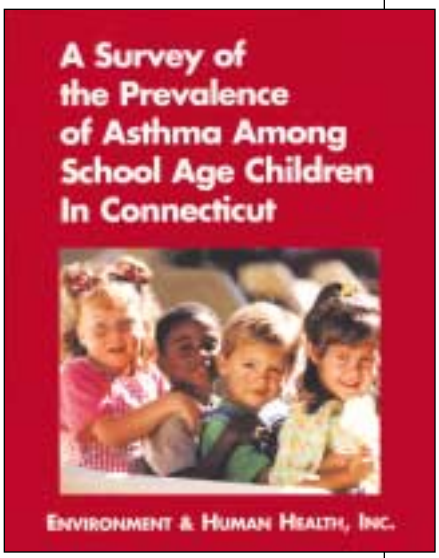
To ensure a high response rate, the study investigators understood that the survey questions needed to be clear and the information requested had to be limited to data that:

- were readily available to school nurses in their offices, by observation, or by quick consultation with another school official;
- would not require school nurses to conduct time-intensive record reviews;
- could be provided on two sides of one page;
- were in aggregate form and not personally identifiable; and
- would not be used to identify individual schools, school nurses, or school districts.

The issue of anonymity was clearly addressed in the cover letter (Appendix 2). Disclosure of individually identifiable student information without express consent was never an issue since such disclosure is unethical and prohibited by state and federal law. Additionally, anonymity for the respondents was protected, as investigators believed, from consultation with school nurse supervisors and other education leaders, that school nurse supervisors and individual school nurses would be less likely to participate in the study if the identity of individual schools, nurses and districts could not be protected.

Data Collection: Survey Sample

The survey sample included all K-5 students in Connecticut who, during the 2002-03 school year, attended either a public school or a private, non-public school that received health services through public school district programs.



As in the earlier study conducted by Environment and Human Health, Inc. (EHHI), the survey designers relied on certain characteristics of school nurse staffing in Connecticut for access to statewide data regarding K-5 students with asthma. Each school district is required to have at least one qualified school nurse or school nurse practitioner. While there is no mandate regarding additional staffing, Connecticut has an approximate ratio of one school nurse to 500 students,[20] ensuring the availability of professional nurse responders, rather than unlicensed assistants or other non-healthcare personnel. Another important characteristic is that the majority of large school districts, urban districts and resource-rich districts have school nurse supervisors who understand the significance of this survey initiative. While many smaller school districts do not have school nurse managers, alternate contact persons (usually a school nurse in the district or the administrator responsible for overseeing the school health services program) are identified on an annual basis by the State Department of Education. These contact persons are accustomed to receiving communications about school health and nursing services from both the Connecticut State Departments of Education and Public Health, and were generally expected to support the survey by passing it on to their school nursing staff. For the remainder of this report, the term “school nurse supervisors” will include both supervisors and contact persons.

Another important characteristic of school health services in Connecticut is that public school districts are required by Connecticut General Statutes, Section 10-217a, to

provide "like" health services to private, nonprofit schools located in their district. Through this mechanism, nearly all parochial schools and some other private, nonprofit schools in Connecticut receive nursing services as part of the public school districts' health services programs. Although certain restrictions apply to this mandate, school nurses and their supervisors in public school districts are generally responsible for providing services in private, nonprofit schools located within their communities. Therefore, these schools were accessible through the same school nurse supervisors, simplifying both survey distribution and data collection. The combination of both public and nonprofit schools provided a potential database of almost all K-5 students attending Connecticut schools during the 2002-03 academic year.

Data Collection: Pilot Study

During October of 2002, the draft survey tool and a draft cover letter with instructions were piloted in seven school districts, with school nurses in 26 schools from those districts asked to respond to the questionnaire. The seven pilot school districts were chosen according to willingness of the nursing supervisor to participate, along with consideration of county and urban-rural-suburban location. Depending on the size of the school district, each participating school nurse supervisor was asked to distribute the pilot survey to between two and five schools in the district. The supervisor was also asked to choose schools that varied in terms of the school nurse's expertise and expected response to the form. The completed forms were returned in November.

In December, 2002, and January, 2003, a study investigator visited eight of the 26 respondent schools (3 urban, including 1 parochial; 3 suburban; 2 rural) to assess quality

characteristics of the data provided on the respondents' survey forms. The investigator ascertained that the school nurses found the questionnaire easy to manage. In two schools including grades beyond K-5, the number of asthmatics provided included those in grades 6-8. The visit prompted a correction of these numbers. The school nurses interviewed in the pilot phase noted that the data regarding the number of asthmatic children were easier to access in the winter than when the pilot questionnaire was first distributed in the fall. All eight school nurses used multiple sources of information to determine whether a child had asthma. Four school nurses collected specific health information on an annual basis as children returned to school. In general, any past or current diagnosis of asthma was included, although some school nurses removed children from the list of active asthma cases if they had required no treatment for several years. Four school nurses identified more asthmatic children in the winter (1-4 additional children per school) and five had more inhalers in the nursing office (2-9 additional inhalers) in the winter than in the fall. The pilot-phase finding that more students with asthma are identified in school as the fall months turn to winter is consistent with findings in the prior EHHI study.[21] It provided the rationale for waiting until winter to conduct the statewide study.

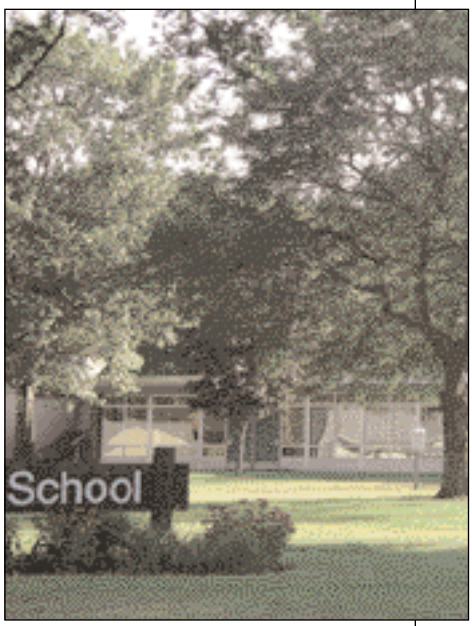
With regard to questions about the characteristics of the school building and its recent environmental history, school nurses were able to provide information fairly easily and accurately. Seven of the eight school nurses interviewed in the pilot phase consulted the custodian to complete the questionnaire. Four walked around the building to provide certain requested information. One called the town's Parks and Recreation department to find out about pesticide application at the school. On inspection by the investigator, information regarding location, land, and roof type was accurate.

Data Collection: Statewide Study

Review of the pilot survey responses led to improvements in clarity of the individual questions and format, but no substantive change, except that "personal use of pesticides" was deleted as a question. Investigators also made minor changes to the cover letter to improve clarity of the instructions, especially limitation of data collection to K-5 students, and assurance of anonymity. Investigators prepared packets for the school nurse supervisors of all 158 school districts with one or more schools that had at least one grade in the K-5 group. Each packet contained the following: a cover letter; a survey form for each school in the district known to have at least one grade in the K-5 group, already filled in with school name and district identification code; one extra form with district code, but blank name, in case the district served a new school eligible to participate; and a pre-stamped, pre-addressed, return envelope (size 8 x 11). (See Appendices 1 & 2 for the final survey form and the cover letter.) As in the initial EHHI study, an investigator who was both knowledgeable about the operations of the school health services programs and well known to school nurse supervisors across the state wrote the cover letter and made the follow-up contacts. With concerns regarding protection and disclosure of individual school and district data, investigators assumed that if participation was requested and anonymity offered by an established and trusted colleague, the response rate would be much higher than if participation was requested by investigators not well known to the schools and school nurses.

On January 3, 2003, investigators mailed packets to 158 school nurse supervisors that included surveys for approximately 860 schools known to have students in one or more

K-5 grades, plus one extra per district. School nurse supervisors were asked to return the completed surveys by January 31, 2003. Although the initial response rate was well over 60 percent, it was anticipated that follow-up would yield additional cooperation and responses. Investigators sent a reminder letter on February 14 to school nurse supervisors in districts that had yet not responded, and initiated telephone contact with non-responding supervisors starting in March. Some participating districts returned a portion of, but not all, surveys from their eligible schools. This occurred when individual nurses in the district had forgotten or opted not to respond.



By April 5, 80 percent of the schools and 85 percent of the districts had responded. In situations in which districts returned some, but not all, of the surveys for their K-5 schools, further telephone contact was made directly with the school nurses who had not completed a survey. Additional forms were faxed as necessary to facilitate school nurse cooperation. In most instances, surveys had not been completed due to competing priorities; in some instances, a school district official had directed the school nurse(s) not to participate due to current or prior environmental issues in the district.

Investigators also made follow-up phone calls to school nurses and supervisors between April and June to request clarification of responses provided or to obtain essential data elements that, on review of the surveys, were identified as missing or likely to be in error. During this entire process, the listing of public and private, nonprofit schools with one or more grades in the K-5 group was amended, though minimally, according to changes documented by the school nurse supervisors. For example, a new elementary school opened in a district, or a private, nonprofit school closed or changed its grade configuration.

Methods

Data Analysis

Completed questionnaires were received in hard copy. Data were coded and entered into an Excel (Microsoft) spreadsheet, then imported into Data Desk 6.0 (Data Description Inc., Ithaca, NY). Descriptive statistics were performed for every variable to identify missing data and outlying values. The original hard copies were reviewed to first resolve discrepancies; if necessary the school nurse was called to provide missing data or verify unusual values. Schools were assigned a designation of rural, suburban, or urban, based on the size of the town in which the school is located (rural: population of less than 5000; suburban: 5000-49,999; urban: 50,000 or more [1990 U.S. Census]). Out of the urban group, the three largest cities in Connecticut were separated into another category, "large city." The rest of the urban group was referred to as "small urban." Classification by Education Reference Group (ERG) was taken from the Connecticut Department of Education. ERGs group public school districts based on socioeconomic status and need. Factors include income of families with children in public school, education and occupation of parents, poverty, family structure, home language, and enrollment. Private, nonprofit schools were assigned an ERG based on location in a district. Appendix 3 provides a listing of districts by ERG. Identified by letter, socioeconomic status declines and need rises as one progresses from A through I.

Rates of asthma were calculated for all participating schools, and the distribution by school, school district, and social and geographic characteristics was summarized. Since

the rates were distributed normally, analysis of variance (ANOVA) was performed to determine co-variation with each major demographic factor: urbanization, county, ERG. ANOVA models were explored incorporating each of these factors since each was correlated, partially, with the others.

Next, the relationship between rates of asthma and school characteristics identified on the questionnaires was investigated. An analysis of variance was used to assess the relationships between asthma rates and: indices of water incursion into the school building; carpet use; presence of rodents or cockroaches; pesticide use inside and outside the school; school renovations; and school bus idling.

To explore the possibility that one or more of the environmental factors might increase the severity of asthma, an "inhaler" rate was calculated for each school as the proportion of asthmatic children using inhalers. This rate was evaluated in identical fashion to the asthma rate, adjusting for covariates as above.

Finally, to explore the possibility an environmental effect might be of particular importance in schools with the highest rates of asthma, a nested case control study was conducted. The 10 percent (N=70) of schools with the highest rates of asthma were selected. Each school was matched against a randomly selected school from the same district that did not have such a high asthma rate. If no school was available for comparison, the control was selected from another district of the same size (i.e., large city, small urban, suburban or rural) in the same county and in the same ERG. Schools could not also be matched by public/private status. Contingency tables were constructed for each environmental variable and composite. The prevalence of school characteristics among cases and controls was compared, using the chi-square statistic to determine if differences in rates were statistically significant.

Results

Participating schools

Of 863 schools in Connecticut with any grade K-5, including 685 public schools and 178 private, nonprofit schools receiving health services from the public schools, 700 (81 percent) completed the survey. Of these, 698 had sufficient information for inclusion in the analysis. Of these 698 schools, 565 (81 percent) were public schools and 133 (19 percent) were private, nonprofit schools. Over half of the participating schools (53 percent) are in suburban districts, 8 percent are rural, 25 percent are small urban, and 14 percent are large city. Table 1 provides the distribution of public and private schools participating. Table 2 shows the distribution of schools by ERG and urbanicity. Of the 158 school districts included in the study, 134 returned all or some surveys from their K-5 schools. Based on a district's participation with all or some surveys, the response rate of school districts with K-5 schools was 85 percent.

Table 1: Participation of Grades K-5 in Connecticut Public Schools and Private Nonprofit Schools that Receive Health Services from the Public School Programs

	Connecticut Number	Participating Schools Number (%)
Districts	158	134 (85%)
Schools	863	698 (81%)
Public	685	562 (82%)
Private	178	132 (74%)
Children*	290,412	236,471 (81%)

** Estimate based on grades K-5 during the 2002-2003 school year*

Asthma among school children

School nurses reported 22,829 cases of asthma out of a population of 236,471 students in grades K-5. This represents a statewide rate of asthma among children in these grades of 9.7 percent.

Table 2 shows asthma rates for all participating schools. Higher rates are reported in cities and in districts with ERGs of lower socioeconomic status.

Table 2. Asthma prevalence of schools according to urbanicity and socioeconomic status

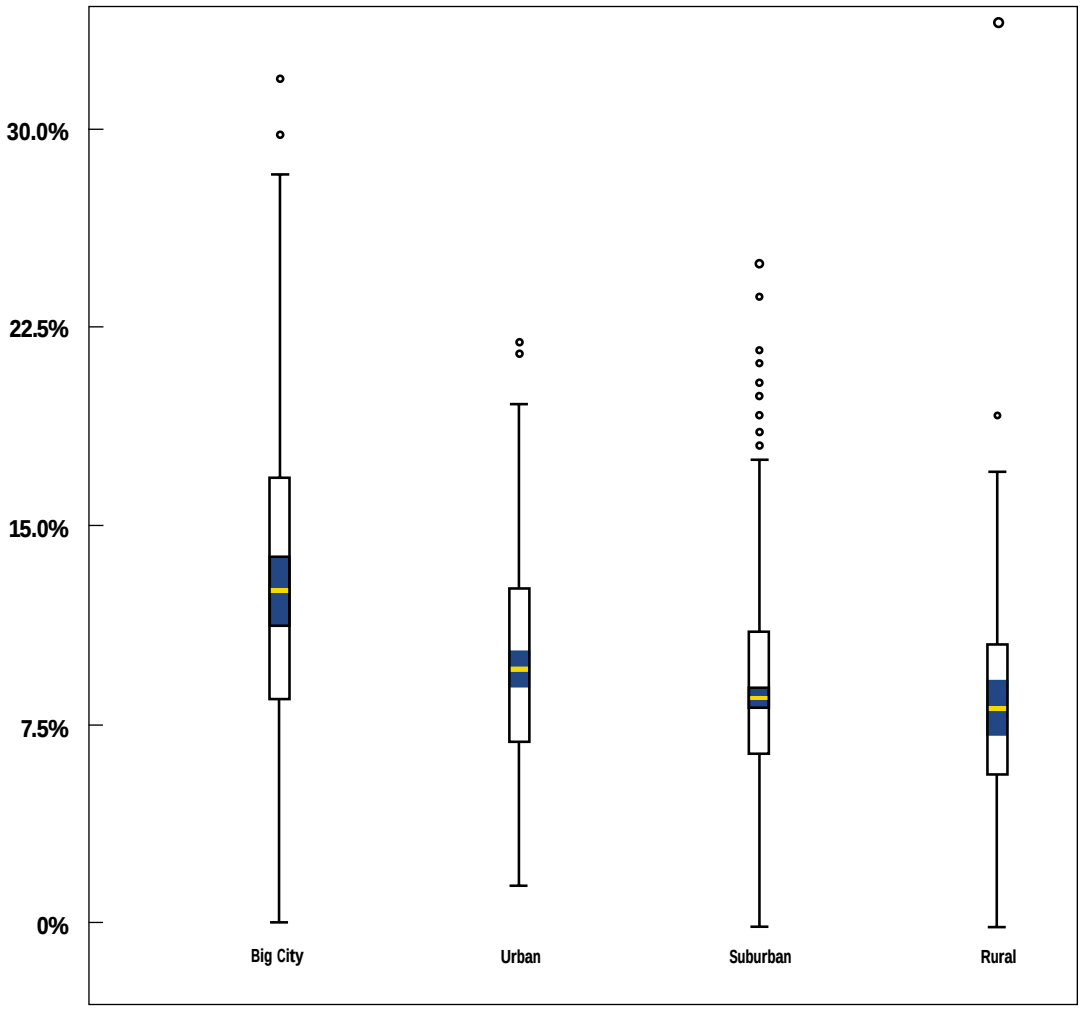
	Participating Schools (n=698)	Asthma Prevalence Rate		
		Mean	10th	90th
All Schools	698	9.8%*	4.9%	15.4%
Urbanicity**				
rural	56	8.8%	4.5%	13.7%
suburban	371	9.0%	4.6%	13.7%
small urban	175	10.1%	5.2%	16.5%
large city	96	13.1%	6.2%	22.9%
Socioeconomic (ERG*)**				
A	47	6.7%	3.7%	10.9%
B	72	8.7%	5.1%	12.9%
C	49	8.5%	4.0%	14.0%
D	95	9.1%	5.7%	13.2%
E	24	9.4%	5.0%	14.0%
F	112	9.9%	5.2%	14.8%
G	36	10.4%	5.4%	15.5%
H	110	9.5%	5.3%	14.6%
I	153	12.2%	5.0%	19.8%

* *Mean prevalence rate in all schools does not match the mean asthma rate for all students surveyed because of differences in school K-5 size. The distribution of rates in schools is shown with percentiles (10th and 90th percentiles represent the range within which the central 80% of the values lie).*

***Urbanicity: rural (population of less than 5000); suburban (5000-49,999); small urban (50,000–119,999); large city (120,000 and larger).*

****ERG (Education Reference Groups) are classifications in which school districts are grouped according to the characteristics of the families with children in public school (income, education, occupation, poverty, family structure, home language, and district enrollment). (See Appendix 3 for listing.)*

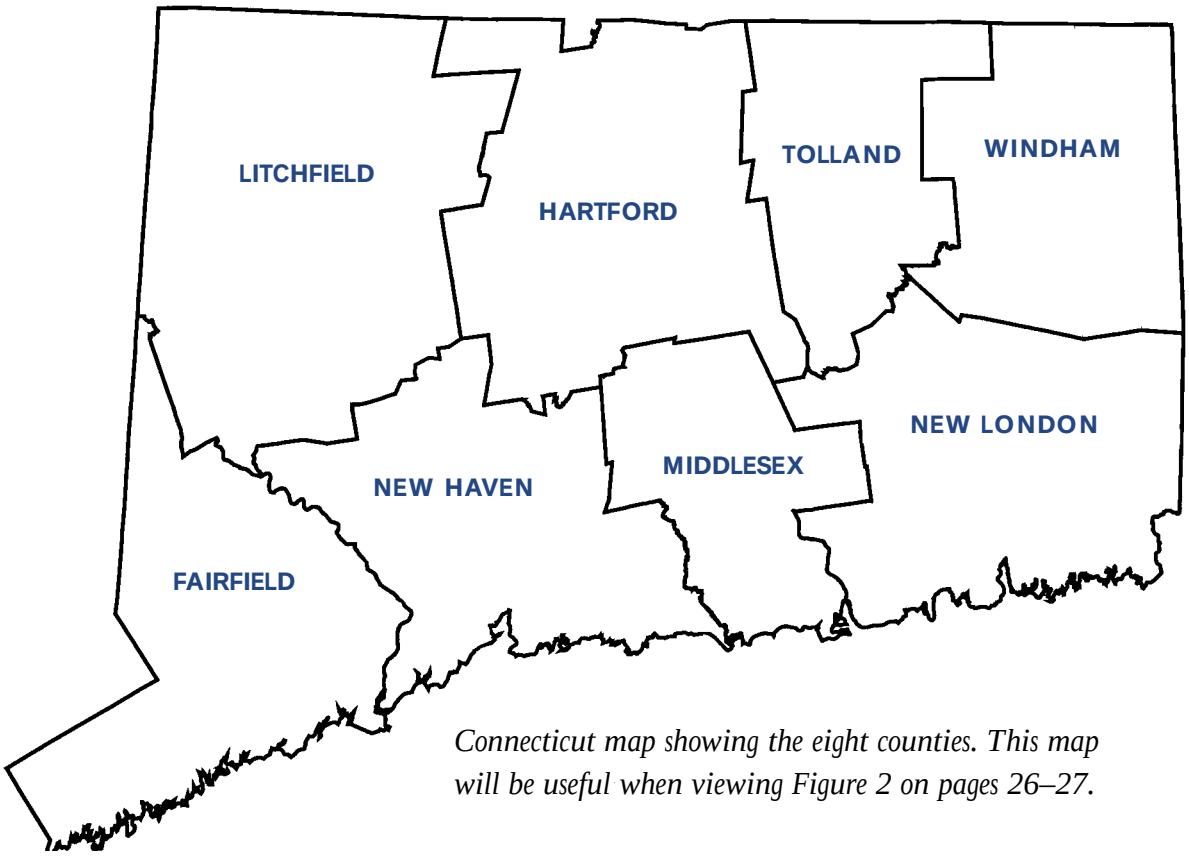
Figure 1: Asthma Prevalence by Urbanicity



The boxplots shown in Figures 1, 2 and 3 (pages 24, 26-27, 28-29) show the distribution of asthma rates for the group of schools defined in each vertical line. The yellow bar in the middle defines the median or middle value for the group. The "box" delimits the highest and lowest quarters of the distribution. The "whiskers" at the top and bottom of the vertical line show the full range of data, excluding only "outliers," the few dots above and below, which represent rates for individual schools that diverge far from the rest of the group to which they belong.

Figure 1 demonstrates the distribution of asthma rates among schools by town size. Significantly higher asthma rates are seen in small urban and large city schools. Public schools in large cities had a mean asthma rate of 13.8 percent. However, rural counties also experience elevated rates of asthma. For example, Windham County reported a mean rate of asthma of 12 percent among K-5 students (Figure 2). Schools in districts in lower ERGs demonstrate significantly higher asthma rates (Figure 3). Statistical analysis of these trends confirms a strong correlation between both of these demographic characteristics of school populations—urbanicity and socioeconomic status—and asthma rates.

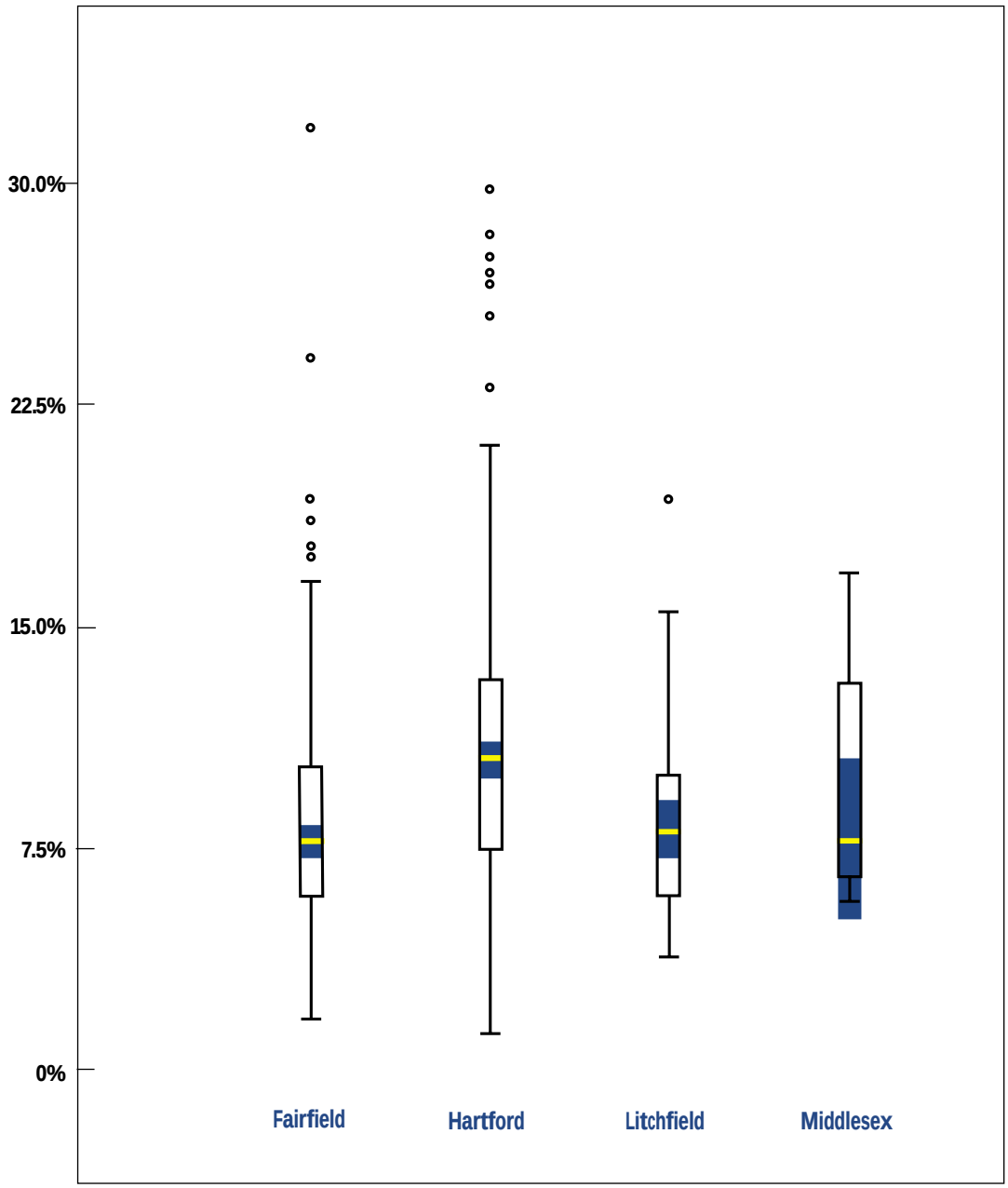
Connecticut Map By County



Connecticut map showing the eight counties. This map will be useful when viewing Figure 2 on pages 26–27.

MAP: COURTESY, CONNECTICUT DEPARTMENT OF PUBLIC HEALTH, OFFICE OF POLICY, PLANNING AND EVALUATION.

Figure 2: Asthma Prevalence by County



Pages 26 and 27 should be read together.

Figure 2 (Continued): Asthma Prevalence by County

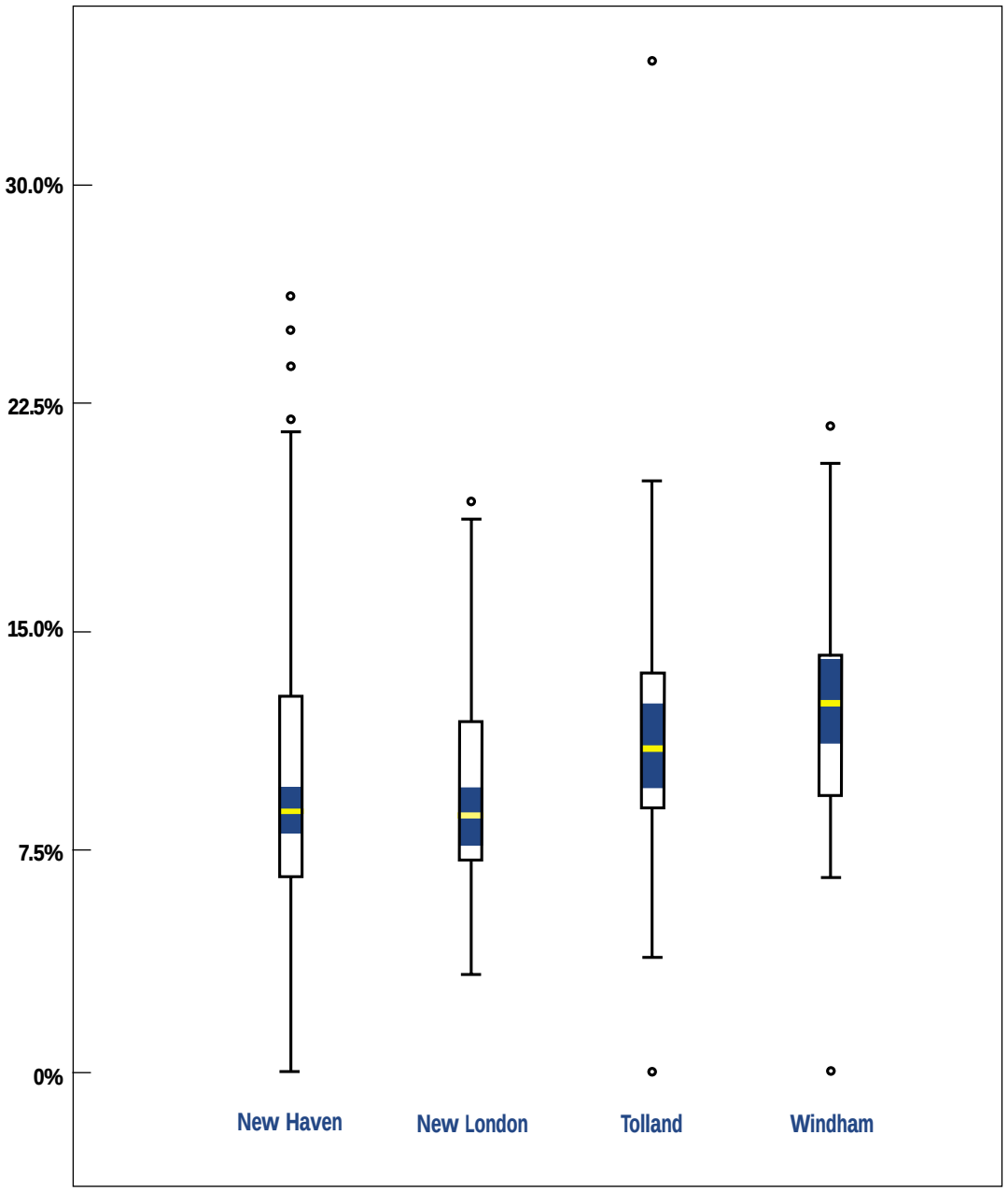
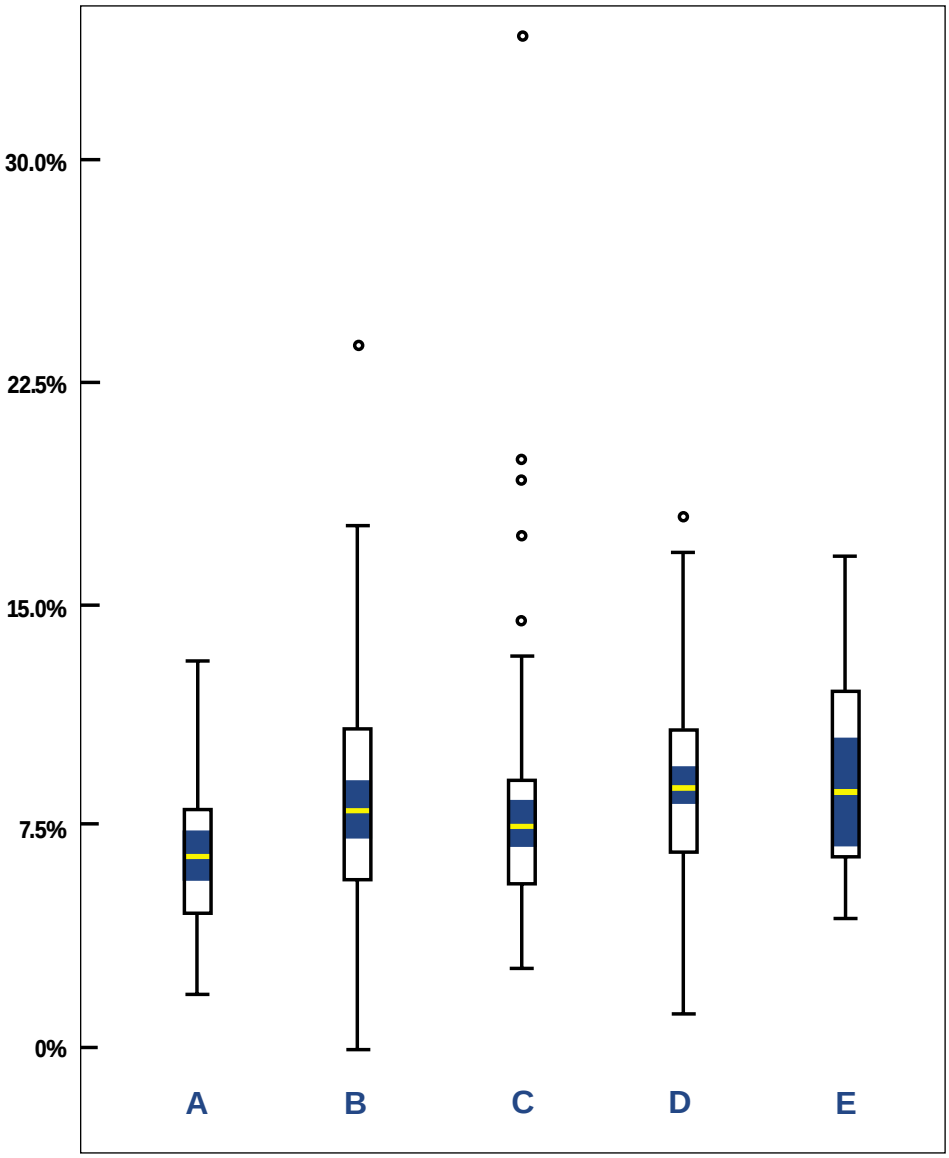
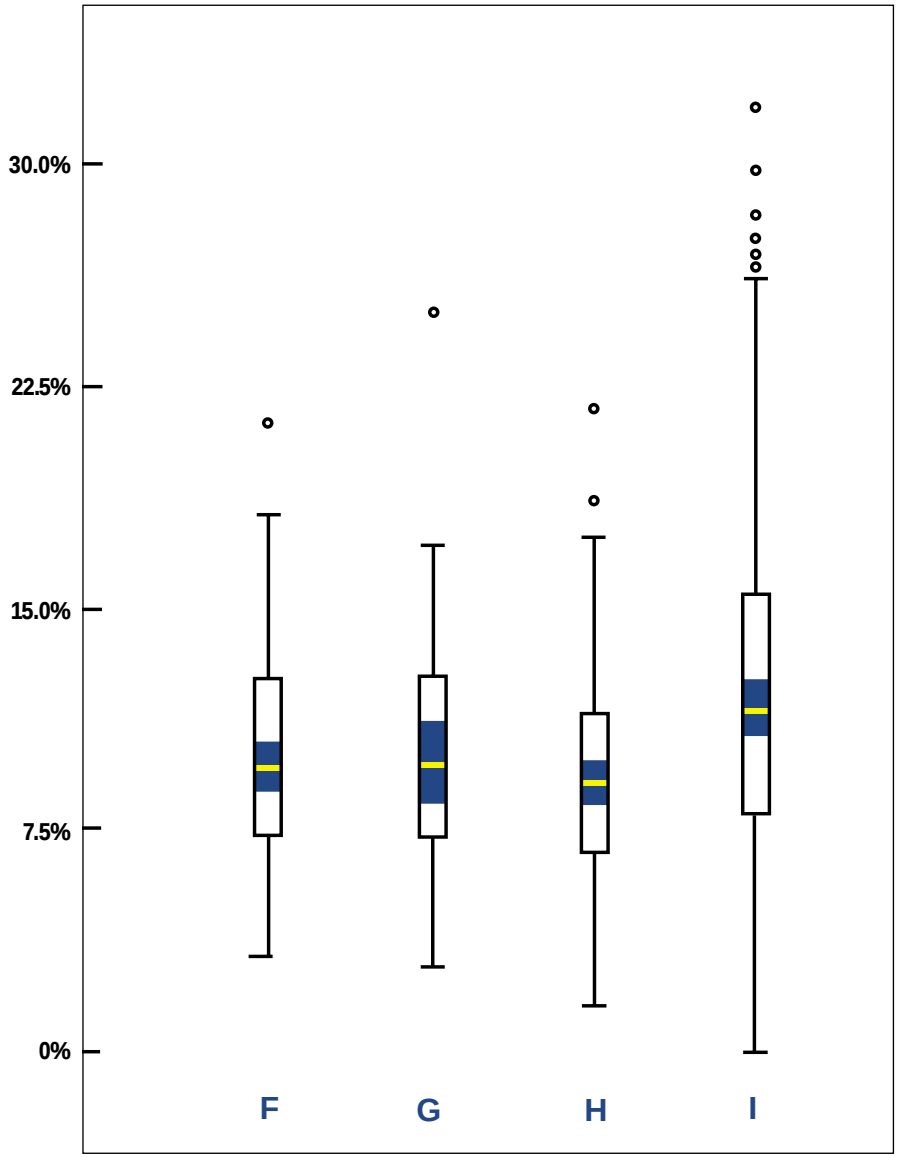


Figure 3: Asthma Prevalence by Education Reference Groups (ERGs)



Pages 28 and 29 should be read together.

Figure 3 (Continued): Asthma Prevalence by Education Reference Groups (ERGs)



Within all of the categories of schools there is a broad range of asthma rates. Schools in the top tenth percentile have rates that exceed 11 percent in ERG A to 20 percent in ERG I. This variability is seen in rural and suburban schools where the top tenth percentile exceeds 14 percent and in small urban and large city schools where asthma rates in the 90th percentile begin at 17 percent and 23 percent, respectively.

Results of the survey of school environmental factors

There are many risk factors within school environments that may be associated with asthma. In this pilot survey, several school characteristic categories were targeted: potential for water incursion (location of school, roof type, roof leaks); allergens and irritants (cockroaches and rodents); pesticide usage (use indoors and outdoors); renovations (construction-related dusts and fumes); and bus idling. For example, school nurses were asked to describe the location of the school (e.g., on a hill or below a hill and whether land around the school was dry or wet) and simple structural characteristics (e.g., flat roof vs. pitched roof). They also estimated events to characterize possible repeated water incursion (e.g., number of roof leaks). In addition, the presence of carpets was described because carpets can retain moisture and dirt and become reservoirs for microbial growth. School nurses also provided information about the presence of pests associated with asthma symptoms and building activities (e.g., pesticide use or renovations) that may affect the environment. This information was collected to begin to characterize schools with regard to potential risk factors for asthma symptoms. In itself, the information does not necessarily relate to the frequency of asthma in schools or communities.

Table 3. Frequency (%) of environmental characteristics of participating Connecticut schools according to urbanicity*

Numbers in parentheses represent the number of schools that answered the survey question. Not all schools answered every question. (n) = 698 schools that participated in the survey. Frequencies reported reflect participants responding to the question.

Environmental Characteristics	Participating Schools (n=698)	Rural (*n*=56)	Suburban (*n*=371)	Small Urban (*n*=175)	Large City (*n*=96)
Location into or below hill	17% (697)	21%	18%	18%	11%
On damp or marsh land	31% (696)	38%	33%	31%	23%
Roof flat	67% (695)	46%	70%	68%	66%
2 or more roof leaks**	49% (681)	52%	50%	52%	39%
Carpets in all classrooms	24% (698)	30%	28%	22%	13%
Cockroaches present	7% (696)	0%	0.5%	15%	21%
Rodents present	17% (695)	16%	13%	15%	32%
Regular pesticide use	21% (690)	9%	20%	27%	22%
Children present during renovations	18% (698)	11%	19%	13%	28%
Buses idling	55% (682)	38%	52%	61%	66%

**Urbanicity: rural (population of less than 5000); suburban (5000-49,999); small urban (50,000–119,999); large city (120,000 and larger).*

***leaks that occurred within the past 12 months*

Table 4. Frequency (%) of environmental characteristics of participating Connecticut schools according to socioeconomic status

Environmental Characteristics	Participating Schools (*n*)	ERG Classification A (*n*=47)	B (*n*=72)	C (*n*=49)	D (*n*=95)
Location into or below hill	17% (697)	13%	24%	14%	18%
On damp or marsh land	31% (696)	43%	38%	31%	37%
Roof flat	67% (695)	64%	69%	57%	77%
2 or more roof leaks	49% (681)	49%	52%	55%	53%
Carpets in all classrooms	24% (698)	45%	43%	25%	38%
Cockroaches	7% (696)	0%	1%	0%	0%
Rodents	17% (695)	13%	12%	25%	14%
Regular pesticide use	21% (690)	15%	23%	8%	25%
Children present during renovations	18% (698)	17%	15%	20%	18%
Buses idling	55% (682)	52%	64%	37%	54%

Numbers in parentheses represent the number of schools that answered the survey question. Not all schools answered every question. (n) = 698 schools that participated in the survey. Frequencies reported reflect participants responding to the question.

Pages 32 and 33 should be read together.

Table 4 (continued). Frequency (%) of environmental characteristics of participating Connecticut schools according to socioeconomic status

Environmental Characteristics	ERG Classification				
	E (*n*=24)	F (*n*=112)	G (*n*=36)	H (*n*=110)	I (*n*=153)
Location into or below hill	13%	19%	28%	16%	14%
On damp or marsh land	25%	28%	47%	32%	23%
Roof flat	54%	72%	53%	67%	66%
2 or more roof leaks	58%	51%	40%	50%	43%
Carpets in all classrooms	13%	22%	17%	17%	11%
Cockroaches	0%	2%	0%	12%	21%
Rodents	17%	12%	6%	9%	30%
Regular pesticide use	13%	16%	22%	22%	30%
Children present during renovations	13%	19%	17%	6%	29%
Buses idling	25%	57%	40%	58%	64%

Numbers in parentheses represent the number of schools that answered the survey question. Not all schools answered every question. (n) = 698 schools that participated in the survey. Frequencies reported reflect participants responding to the question.

Table 3 (page 31) and Table 4 (pages 32-33) show the frequencies of school characteristics or activities by urbanicity and ERG, respectively. Presented in Tables 3 and 4 are the characteristics that may serve as risk factors for conditions that could contribute to asthma symptoms. Schools are rarely situated at the top of a hill (20 percent) and 17 percent are located into the side of or at the bottom of a hill. Most are surrounded by dry land, but nearly a third are thought to have damp or marsh-like land near the school building. Pitched roofs are present in only 13 percent of schools, with two thirds of schools having what are described as flat roofs. Rodents were noted to be present in 17 percent of all schools. This rose to 30 percent among schools in ERG Classification I and 32 percent in the large city schools (Tables 3 and 4). Cockroaches were reported in 7 percent of all schools. However, they were reported in 21 percent of large city schools and 15 percent of small urban schools (Table 3). Nurses in 21 percent of schools in ERG I reported cockroaches, whereas the majority of other ERG classifications reported none (Table 4).

Nearly 50 percent of all participating schools reported more than one roof leak (Table 3). There were somewhat fewer leaks reported in schools in large cities and there were few differences in roof leaks among schools by ERG Classification (Table 4). School nurses reported that renovations had taken place in the past 24 months in 249 or 36 percent of the schools. This rose to 46 percent in large city schools (data not shown). Children were more likely to be present while renovations were going on in schools in large cities (Table 3). Pesticides are reportedly used indoors in 40 percent of schools. This use is on a regular scheduled basis in 21 percent of schools. Thirty percent of the schools in ERG Classification I used pesticides regularly, whereas this trend was found in fewer schools

(8-23 percent) among ERG Classifications A-C. Fewer schools in rural areas (9 percent) used pesticides regularly as compared to schools located in suburban/urban areas (20-27 percent). More than half of the schools reported buses idling for more than three minutes outside the school. Most notably, 66 percent of schools in large cities reported bus idling as compared to 38 percent in rural areas (Table 3).

Several interesting patterns of environmental characteristics were found among the ERG and urbanicity categories. While most schools have carpeted libraries (72 percent) and administrative areas (70 percent), both tables 3 and 4 show that a consistent pattern exists for the presence of carpets in all classrooms. For example, 25-45 percent of schools with ERG classification A-D have carpets in all classrooms. Fewer than 25 percent of schools with ERG classifications E-I have carpeting in all classrooms. A similar trend is found among the urbanicity categories. Thirty percent of schools located in rural areas have carpets in all classrooms, as opposed to13 percent of schools located in large city areas.

Tools for Schools

Tools for Schools is a U.S. Environmental Protection Agency (EPA) program for implementing healthy indoor air quality in schools. Twenty-four percent of schools have implemented *Tools for Schools* or a similar program. These programs provide an opportunity for teachers, school nurses, parents, custodians, and administrators to learn about concerns in the building, to systematically evaluate the status of the building and its functioning, and to troubleshoot problems when they arise.

Evaluation of possible associations between school environmental factors and asthma rates

Associations across all participating schools

When urbanicity and socioeconomic status (ERG) are not taken into account, environmental factors recorded in this study were not correlated with asthma prevalence with the exception of the presence of cockroaches. Because of the dominant influence of urbanicity and socioeconomic status, a further assessment of the possible role of school building characteristics was made using a case control study.

Nested case control study

To further explore potential relationships between the reported school characteristics and activities with asthma prevalence rates, the 70 schools with the highest asthma rates were compared to schools with lower rates matched for geography and socioeconomic status (Table 5). Schools with the highest asthma rates (cases) were more likely to be located on the side of or at the bottom of a hill, had more roofs described as flat, more roof leaks, were more likely to have carpets in all classrooms, reported more cockroaches and rodents, and more often engaged in renovations with children present. The presence of carpets in all classrooms reached significance ($p<.05$) and the occurrence of roof leaks approached significance ($p=.05$) between case and control schools.

Inhaler use as potential marker of asthma severity

School nurses are playing a significant role in the management of asthma among students. Approximately half of asthmatic children in school have inhalers in the nurse's office. School nurses reported having an average of 15.5 inhalers in their offices for use by K-5 students with asthma. The range reported was 0–75 inhalers per school.

Thinking that inhaler use in school might represent an index of severity of asthma among students, we analyzed the proportion of students with asthma using inhalers in the school nurse's office relative to the environmental factors recorded for the schools. This analysis demonstrated no relationship between inhaler use and school environmental factors.

Table 5. Nested case control study. Frequency (%) of environmental characteristics of schools with the highest asthma rates and control schools

Environmental Characteristics	Case Schools* (n=70)	Control Schools** (n=70)	Chi-squared P value
Location into or below hill	19%	11%	0.24
On damp or marsh land	24%	27%	0.69
Roof flat	71%	59%	0.11
2 or more roof leaks	59%	44%	0.05***
Carpets in all classrooms	26%	11%	0.03
Cockroaches	20%	14%	0.34
Rodents	29%	23%	0.35
Regular pesticide use	27%	29%	0.17
Children present during renovations	49%	39%	0.41
Buses idling	60%	61%	0.86

**Case schools represent 10% of schools with the highest rates of asthma (90th percentile).*

***Control schools were selected according to the following criteria: 1) same district or another school district from the same size in the same county and in the same ERG and 2) asthma rate below the 90th percentile.*

****The chi-square analysis includes three categories: no leaks, 1 leak, and >1 leak.*

Discussion

Rates of asthma among K-5 students are rising and there appears to be a broad range of rates within communities.

This study demonstrates a rising rate of asthma among students in Connecticut schools. The estimated mean rate of asthma is close to that estimated by the BRFSS for current asthma (symptomatic in the past 12 months). The BRFSS estimate actually declined between 1998-99 and 2001, from 10.4 percent to 8.9 percent for children under 18 years of age.[22,23] The estimate generated by school nurses in EHHI's 1999 asthma study showed a mean rate of 7.8 percent for elementary schools by district, while this current 2002 study shows a mean rate of 9.8 percent for elementary schools, K-5.

This study also demonstrates significant differences in asthma rates among students in K-5 grades across the state. While urbanicity and socioeconomic status seemed to be the most important factors evaluated in this study, the range of asthma was wide in all categories, indicating variation within communities.

Urbanicity appears to make a difference

The factor most influencing asthma rates in Connecticut appears to be living in an urban community. Other efforts to evaluate patterns of asthma prevalence in Connecticut have not found these differences. The Connecticut Report "Asthma in Connecticut" issued by the Department of Public Health in 2001 found insignificant differences in asthma rates

among rural and urban residents. A prior report by EHHI found no difference by urbanicity but was not able to analyze patterns of asthma prevalence at the level of detail allowed in this study. Because that study relied on district level data, the role of the urban status of schools could not be assessed.

Asthma as an urban problem is well recognized in larger cities in the United States. In Chicago, for example, a survey of seventh and eighth graders demonstrated an asthma rate of 14.8 percent, which was highest among students in schools in poor communities (23.1 percent).[24] New York City is among four urban centers in the country with the highest annual increase in asthma mortality. Within the city, asthma rates vary, with higher hospitalization rates in Harlem and higher prevalence of asthma among minority populations in the South Bronx.[25]

Hospitalization rates for asthma show striking differences between urban and other populations in Connecticut. The DPH reported that in 1995, the rate of hospitalization of children for asthma in Connecticut's five largest cities was more than twice the average for the state and higher than the national average.[26] Whether this reflects higher rates of asthma in urban populations, more severe disease, or patterns of health care (such as use of emergency rooms for primary care) has been a point of concern and investigation over the past three years. The results of the survey reported here and the recent BRFSS data suggest that these high rates of hospitalization in cities reflect truly higher rates of asthma and not only health care utilization patterns.

Higher rates of asthma in urban populations may be due to a wide variety of factors including housing, outdoor air quality, prenatal and early childhood exposures,

nutrition, infections, environmental tobacco smoke, obesity, and school characteristics. There is likely some element of increased identification of children with asthma in urban schools because of the extensive outreach and education among physicians and school nurses caring for this population over the past decade.

Socioeconomic status plays a large role in asthma prevalence

The study also found significant differences in asthma rates correlated with measures of socioeconomic status. While the three largest cities had the highest rates of asthma, once the size of the community was taken into account, socioeconomic status remained a large predictor of asthma rates, with poorer communities having higher rates of asthma. This finding is consistent with the prior EHHI study that showed a rising rate of asthma from the highest to lowest ERG. Information obtained through the BRFSS in 2001 indicates that asthma rates among children in Connecticut are highest among children in households with less than $25,000 in income (13.5 percent) and lowest in children in households with incomes higher than $75,000 (7.2 percent).[27]

Schools as environments that may contribute to asthma symptoms

This is the first study in Connecticut to attempt to collect simultaneous information on asthma prevalence and factors in school environments that may influence asthma symptoms. This survey indicates that many Connecticut schools have building

characteristics and activity patterns that may contribute to asthma. It does not provide conclusive evidence that these factors are in fact contributing to asthma prevalence. Future work is needed to investigate potential relationships between school factors and asthma symptoms.

Asthma in children is strongly influenced by demographic characteristics such as urban location and socioeconomic status. Evaluating the role of environmental factors is difficult given these strong social influences. In this study we attempt to begin the process by first describing the distribution of environmental factors in schools in different sizes of towns and in the ERGs. Interestingly, with few exceptions, environmental factors that may influence asthma do not show consistent patterns across the demographic groups. For example, roof leaks as reported by school nurses occur at varying rates in communities of all socioeconomic levels. On the other hand, carpeting in all classrooms is most common in ERGs where schools have more local resources. The variability in asthma rates within schools of each category of town size and ERG suggests opportunities for further research into the role that environmental factors may play.

On the other hand, given general knowledge about the role of moisture and common allergens in buildings in promoting asthma symptoms,[28] this study does point to areas in which schools can engage in efforts to reduce risks for asthma among school children. Preventive maintenance and observation of guidelines regarding the renovation of occupied structures will help to protect children at risk.[29]

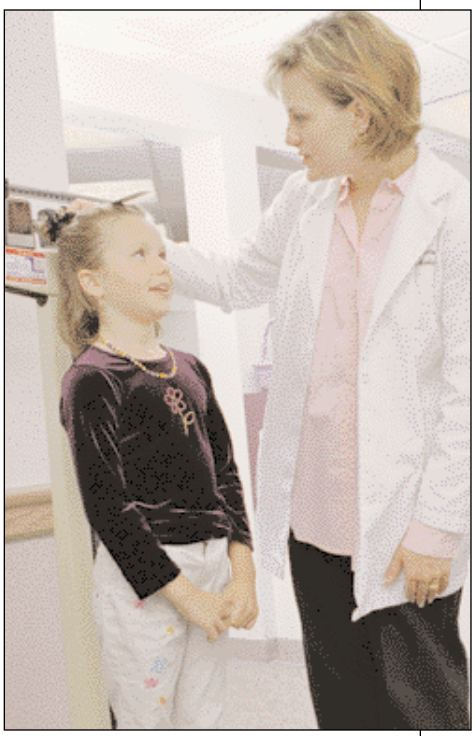
The causes of the rising rates of asthma in the United States are not fully understood. It is thought that contributing factors include childhood infections, changes in environmental stimuli in utero and in the first years of life that may affect the

propensity towards developing an allergic response, and subsequent exposures to allergens (agents that can cause allergic responses) and irritants. Irritants include agents such as ozone and particulates and may include indoor agents such as cleaning agents and components of molds. Allergens include components of dust mites, cockroaches, pets (most importantly cats), chemicals, and molds. The extent to which these contribute to the development of asthma as opposed to the severity of asthma once it is present is controversial. However, studies convincingly link wet indoor environments with asthma prevalence. It is thought that the mechanism by which moisture leads to asthma is that wet materials support the growth of dust mites, cockroaches, and molds. A recent study of the onset of asthma in young children demonstrates a role for airborne and settled mold indoors as a risk factor for the development of asthma.[30]

Teachers are among the leading occupations developing work-related asthma in the states that track occupational asthma.[31] In Connecticut, teachers are the most commonly reported group of workers to have new onset occupational asthma.[32] This observation leads to concerns about the impact that school environments may be having on children—both in terms of development of asthma and in terms of the severity of asthma for those with the condition. Recent studies of school environments confirm that biological and chemical agents that can contribute to asthma symptoms are frequently present in schools and that water incursion and the presence of carpets can increase the potential exposures.[33-35] This survey attempted to collect information regarding building factors that can lead to chronic water incursion in buildings (location, type of roof) and that can lead to microbial growth after water incursion (immovable carpets).

Evaluation of building-related lung disease provides evidence that not only do factors intrinsic to the building play a role in respiratory symptoms of occupants, but activities in the building such as renovations can have a significant impact. A recent analysis of 80 building evaluations revealed that one of the factors most directly connected to asthma-like symptoms in occupants was renovations while the building was occupied, and specifically the installation of drywall.[36]

School nurses provide an opportunity for asthma tracking



School nurses provide a potential source of information on the health status of children because they collect this information on nearly the entire population in particular age groups in order to provide appropriate health services during the school day. In Connecticut, legislation requiring information regarding asthma from parents and physicians on the health forms submitted to school nurses at entry (most often kindergarten), in 6th or 7th grade, and 10th or 11th grade will result in systematic collection of information on asthma at these grade levels as of the fall of 2003. This tracking system will tap only one of the several sources of information used by school nurses to respond to the survey reported here.

Limitations of the study

One of the most challenging aspects of asthma tracking is defining the condition "asthma." This study asked school nurses to report the number of students with a "diagnosis of asthma," intending to approximate the estimates generated by the BRFSS question "has a doctor ever told you that you had asthma." Left ambiguous was whether students were to be counted regardless of the presence or absence of recent symptoms.

Interviews with school nurses in the pilot phase suggest that most school nurses record any documented physician diagnosis of asthma, but that some school nurses and some parents make the judgment that the asthma is no longer pertinent, in which case what is being counted by the school nurse is "current asthma." A strength of the study design was that it tapped the expertise and experience of the school nurses with their communities and allowed them to make judgments as to the presence of asthma based on multiple sources of information. While the investigators believe that this provides a better estimate of the prevalence of asthma, it also introduces variability into the case definition and may account for some of the breadth of the range of estimates of asthma prevalence.

Asking school nurses to characterize their school buildings and report on activities in buildings that relate to maintenance practices may introduce another element of variability. While the interviews with a small number of nurses indicated that they felt knowledgeable about the areas queried or had a good working relationship with the maintenance staff in the school, the data collected may more accurately reflect the knowledge of maintenance staff. This may in fact be more reliable, but the investigators have no way of knowing to what extent this knowledge is represented here. In addition, many aspects of school environments were not assessed in this study. Issues such as building materials, ventilation, cleaning methods, temperature, and humidity were not addressed.

The study did not collect information at the level of individual students and so no assessment of risk factors that operate at the level of the individual could be made. The study also did not assess outdoor pollution levels in communities or at schools. Such an assessment could be made by linking geographically identified environmental data with schools. This was not within the scope of this study.

Recommendations

Recommendations for the Federal Government

1. As asthma prevalence rates continue to rise among school children, it becomes more important than ever that the federal government encourage states to track asthma prevalence. Federal dollars should be provided to the states to help them accomplish this.

    (A) Schools provide a place where asthma data can be collected. School nurses have access to asthma information, which has shown to be most reliable among younger school children, K-5.

    (B) Once the asthma prevalence data is collected it should be made available to the federal, state and local health departments.

2. Additional federal money should be made available to those states that have the highest rates of asthma. This would not only encourage states to track the disease, but would also send money to the areas where there is the greatest need.

3. The Environmental Protection Agency has developed a program called *Tools for Schools* that is designed to help schools improve their indoor air quality as well as other environmental problems. The federal government should encourage schools to adopt this program, or comparable programs, by expanding its financial support to either the states or to the school districts that are the most in need.

4. The American Lung Association has developed a program for schools called *Open Airways.* This program is designed to be used to help asthmatic students better manage their disease. The federal government should encourage schools to adopt these programs by providing states with funds that they can distribute to school districts with the highest rates of asthma.

5. The federal government needs to continue its efforts to conduct research into the underlying causes of asthma and in particular into the reasons why poorer children and children living in urban areas are disproportionately affected.

Recommendations for the State Government

1. States should track asthma prevalence rates among their school children.

    (A) School nurses provide a potential source of asthma data collection. Physical health forms, doctor's medication orders, parent-provided health history, and the students' own school health records should all be used when assessing asthma prevalence rates in schools.

    (B) States should provide school nurses with electronic health reporting systems.

    (C) Our studies have shown that the most reliable asthma prevalence data come from younger school children, preferably K-5. This is because older children often carry their own medications and do not always inform the school nurses of their disease.

2. States should adopt and implement legislation that stipulates school indoor air quality programs that provide ongoing maintenance and facility reviews. Legislation should also address siting of new schools, new construction guidelines when school buildings are occupied, and roof construction guidelines. Such legislation was adopted in Connecticut in 2003 as Public Act 03-220. It can be found on the Internet at: *http://www.cga.state.ct.us/2003/act/Pa/2003PA-00220-R00HB-06426-PA.htm*.

3. EPA has developed a program called *Tools for Schools,* which is designed to help schools improve their indoor air quality as well as other environmental problems. The State should encourage school districts to adopt this program, or comparable programs, by providing funds to those school districts that are the most in need.

4. The American Lung Association has developed a program for schools called *Open Airways.* This program is designed to be used to help asthmatic students better manage their disease. The state should encourage schools to adopt these programs by providing funds to school districts that have the highest rates of asthma.

5. School bus idling outside of schools must be stopped. Although Connecticut has a law that forbids school bus idling for more than three minutes, (Public Act No. 02-56), the data collected in this study show that more than 50 percent of the schools surveyed still have school buses idling outside their buildings.

6. School pesticide use needs to be reduced. Even though Connecticut has a law in place to help reduce the regular use of pesticides in schools, this study shows that more than 20 percent of the schools responding still are using pesticides on a regular basis.

7. Schools should be encouraged to remove their wall-to-wall carpeting in classrooms. Those that cannot, should clean their carpets only when ventilation is on and only at a time when the carpets will quickly dry. Carpet cleaning guidance can be found on the website of the Institute of Inspection, Cleaning and Restoration at *http://www.iicrc.org/pdf/buydocs.pdf.*

    (A) Those schools that feel carpets are important for learning reasons should be encouraged to use area rugs that can be picked up and cleaned easily, instead of wall-to-wall carpeting.

8. Schools should be appropriately ventilated to promote indoor air quality during school time and should remain ventilated in nonuse periods such as vacation weeks and summer months. Indoor air quality guidance is available on the EPA website at *http://cfpub.epa.gov/schools/index.cfm.*

Recommendations for School Administrators and Local and Regional Boards of Education

1. Schools should have the best indoor air quality possible.

    (A) Schools should be encouraged to adopt EPA's *Tools for Schools* or comparable programs.

2. School districts must enforce the state "no idling" school bus law that presently exists. Although the law, Public Act No. 02-56, forbids school bus idling for more than three minutes, the data collected in this study show that more than 50 percent of schools surveyed still have school buses idling outside their school buildings. Diesel exhaust is a known respiratory irritant and components of diesel exhaust are carcinogenic.

3. Roof leaks should be fixed as soon as possible.

4. Wall-to-wall carpeting should be eliminated from classrooms when possible. When not possible, carpets should be cleaned only when ventilation is on and only when they can dry quickly. Carpet cleaning guidance can be found on the website of the Institute of Inspection, Cleaning and Restoration at *http://www.iicrc.org/pdf/buydocs.pdf*.

    (A) Those schools that feel carpets are important for learning reasons should be encouraged to use area rugs that can be picked up and cleaned easily, instead of wall-to-wall carpeting.

5. Construction should be done preferably when children are not in school. If that is not possible, then methods should be implemented that will protect school children from harmful exposures. Schools having to do construction when students are in school should follow the "Indoor Air Quality Guidelines for Occupied Buildings Under Construction, Sheet Metal and Air Conditioning Contractors' National Association, Inc." (SMACNA), 1995.

6. Pesticides should only be used when needed and schools should not have regular monthly spraying contracts when there are no pest problems.

7. Cleaning agents should be carefully chosen and the least toxic products should be used.

8. Schools should be appropriately ventilated to promote indoor air quality during school time and should remain ventilated in nonuse periods such as vacation weeks and summer months. Indoor air quality guidance is available on the EPA website at *http://cfpub.epa.gov/schools/index.cfm*.

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Appendix 1

Asthma Survey of K-5 Students in Connecticut
Environment and Human Health, Inc.

School Nurses: It is critical that you fill in or check **every** item. If you need to request information from other school officials, please do. If you have questions about the survey, call Nadine Schwab at (203) 795-0652. **Thank you** in advance for your time and efforts.

School Name _____ District _____

Number of students in K through 5 _____ Grades in the school_____

1. Is your school public or private non-profit? (check one) ☐ Public ☐ Private Non-Profit
2. Please provide your best estimate of the extent of asthma among students in grades K-5:

   Number of K-5 students diagnosed with asthma ___ [***K-5** grade students only please]

   Number of K-5 students for whom you have an inhaler or nebulizer in your office ___

3. In general, your information is based on which of these source(s) of information? (check as many as apply)

   ☐ HAR3 (blue form)
   ☐ Emergency information
   ☐ Parent report
   ☐ Cumulative health record
   ☐ Medication orders
   ☐ Other (specify _____

Please check, in questions 4, 5, 6 and 7, the *single* best answer about your school building.

4. Location of school:

   ☐ Level ground
   ☐ Top of hill
   ☐ Into side of hill
   ☐ Below a hill

5. Land around school:

   ☐ Dry
   ☐ Damp
   ☐ Marsh-like

6. School Structure:

   ☐ Pitched roof
   ☐ Flat roof
   ☐ Both

7. History of roof leaks in past 12 months: ☐ Never ☐ Once ☐ More than once

8. Are you aware of water leaks in the past 12 months, other than from the roof, such as from pipes, floors, walls, faulty air conditioners or radiators? ☐ Yes ☐ No

Please see facing page for the continuation of this survey.

Appendix 1 (continued)

9. Is there carpeting anywhere in your school that is stationary or cannot be moved?

☐ No ☐ Yes **If yes, check all categories that apply to your school:**

- ☐ All classrooms
- ☐ Some classrooms
- ☐ No classrooms
- ☐ Library or media center
- ☐ Auditorium
- ☐ Administrative space

10. Does your school have a rodent problem? ☐ Yes ☐ No ☐ Not sure

11. Does your school have a cockroach problem? ☐ Yes ☐ No ☐ Not sure

12. Use of Pesticides:

Does your school use pesticides (either insecticides or herbicides) on its playing fields?

☐ Yes ☐ No ☐ Not sure

Have pesticides been used inside your school during the past two years?

☐ Yes ☐ No ☐ Not sure

Does your school use pesticides inside your building on a regular schedule?

☐ Yes ☐ No ☐ Not sure

13. Has your school been renovated or had new construction in the past 2 years?

☐ Yes ☐ No ☐ Not sure

If yes, have the children been in school during the renovations or new construction?

☐ Yes ☐ No ☐ Not sure

14. Has your school implemented the EPA "Tools for Schools" or a comparable program?

☐ Yes ☐ No ☐ Not sure

15. Do school buses idle adjacent to your school for more than 3 minutes?

☐ Yes ☐ No ☐ Not sure

16. Is there anything else of relevance that you think we should know?_____

_____

_____

_____

17. How long did it take you to complete this survey? _____

PLEASE RETURN THIS FORM TO YOUR SCHOOL NURSE SUPERVISOR BEFORE JANUARY 31, 2003

Appendix 2

Environment & Human Health, Inc.
EHHI

1191 Ridge Road • North Haven, CT 06473
Tel: (203) 248-6582 • Fax: (203) 288-7571

January 3, 2002

Dear School Nurse Supervisor:

Environment and Human Health (EHHI), a non-profit organization, is once again seeking your assistance in carrying out a study of the prevalence of asthma in Connecticut school age children. The 1999-2000 EHHI study succeeded in enhancing knowledge about the prevalence of asthma among Connecticut school-age children, due in large part to the collaboration of school nurses. As a result, the Centers for Disease Control and Prevention, U.S. Department of Health and Human Services, funded EHHI to conduct a follow-up study. Because the data in our first study was most accurate at the elementary level, this study focuses on the prevalence of asthma in kindergarten through 5th graders. It also looks at the related influence, if any, of environmental and geographical characteristics of the school buildings they attend. We hope the study findings will augment our understanding of factors that may or may not be related to the increasing prevalence and severity of asthma among school-age children.

This study, as before, is designed to protect personally identifiable health information of students. You are asked only to provide data in aggregate form: the total number of K-5 students, by grade and building; and, of those, the total number of students in each grade and building who are diagnosed with asthma. Student names and identifying information are not included. School districts and individual school buildings will also remain anonymous: data regarding school district and building characteristics will be reported in aggregate, such as by ERG, county, and type of school building. As in the first study, only EHHI investigators will have access to the names of school buildings and districts in order to check for accuracy, and to group and analyze the data correctly. Once grouped by EHHI investigators, the data will be aggregated and not identifiable by district or school. Only the aggregate data will be made public. For your information, school nurses who tested this survey took from five to thirty minutes to complete it.

Enclosed with this letter are (1) a return, stamped envelope, and (2) a survey instrument for each school in, or served by, your district with students in any grade from kindergarten through fifth. Non-profit private schools served by your district under C.G.S. Section 10-217a are included. Middle schools with fifth graders are included, while those with only sixth grade and above are not. If your elementary or middle schools have grades other than K-5, ***only K-5 students*** should be included in this survey. Please distribute the survey forms to the responsible school nurse for each building. An extra form is provided in case we miscalculated the number of schools you serve. The school nurses should collect the data, complete the survey, ***answering all questions***, and return it to you within two weeks. Please mail back all of the completed survey forms together in the enclosed return envelope by ***January 31, 2003.***

Thank you in advance for your assistance in this important public health study. If you have any questions or need assistance with explaining or completing the survey, please contact me at (203) 795-0652.

Sincerely,

Nadine C. Schwab

Nadine C. Schwab, RN, MPH, PNP
Asthma Study Co-Investigator

Appendix 3: School Districts by Education Reference Groups (ERGs)

ERG A

Avon
Darien
Easton
New Canaan
Redding
Regional #9
Ridgefield
Simsbury
Weston
Westport
Wilton
Woodbridge

ERG B

Bethel
Brookfield
Cheshire
Fairfield
Farmington
Glastonbury
Granby
Greenwich
Guilford
Madison
Marlborough
Monroe
New Fairfield
Newtown
Orange
Regional #5
South Windsor
Trumbull
West Hartford

ERG C

Andover
Barkhamsted
Bethany
Bethlehem
Bolton
Bozrah
Canton
Cornwall
Deep River
Durham
East Granby
Ellington
Essex
Hebron

ERG C (Cont'd)

Ledyard
Litchfield
Mansfield
New Hartford
Oxford
Pomfret
Preston
Regional #10
Regional #13
Regional #14
Regional #15
Regional #17
Regional #18
Regional #19
Regional #4
Regional #6
Regional #7
Regional #8
Salem
Salisbury
Sherman
Somers
Suffield
Westbrook
Willington
Woodstock

ERG D

Berlin
Branford
Clinton
Colchester
Columbia
East Hampton
East Lyme
Hamden
New Milford
Newington
North Branford
North Haven
Old Saybrook
Regional #12
Rocky Hill
Shelton
Southington
Tolland
Washington
Watertown
Wethersfield
Windsor

ERG E

Ashford
Brooklyn
Canaan
Canterbury
Chester
Colebrook
Coventry
Cromwell
East Haddam
Eastford
Franklin
Hampton
Hartland
Kent
Lebanon
Lisbon
Norfolk
North Stonington
Portland
Regional #1
Regional #11
Regional #16
Scotland
Sharon
Union
Woodstock Academy

ERG F

Bloomfield
Enfield
Groton
Manchester
Milford
Montville
Naugatuck
Seymour
Stonington
Stratford
Torrington
Vernon
Wallingford
Waterford
Windsor Locks
Wolcott

ERG G

Chaplin
East Haven
East Windsor
Griswold
North Canaan
Plainfield
Plainville
Plymouth
Sprague
Stafford
Sterling
The Gilbert School
Thomaston
Thompson
Voluntown
Winchester

ERG H

Ansonia
Bristol
Danbury
Derby
East Hartford
Killingly
Meriden
Middletown
Norwalk
Norwich
Putnam
Stamford
West Haven

ERG I

Bridgeport
Hartford
New Britain
New Haven
New London
Waterbury
Windham

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