Section 2, Chapter 3
HEALTH STATUS EVALUATION

The prospective pediatric health study was conducted from 1998 through June 2000. The first phase of data collection was completed from January 1999 through May 1999. The second data collection phase included the 1999-2000 academic year and averaged 40 weeks from September through August.

METHODOLOGY

Longitudinal studies were conducted in three different areas (see Chapter 1 of this section). A rural site was represented by East Elementary School located in Athens, which is in Southeastern Ohio. Koebel Elementary School located in South Central side of Columbus represented the urban testing center. A suburban site was located in New Albany and was represented by New Albany school. Conducting health assessments in different locations provided an opportunity to assess different patterns of exposures to air pollutants. All students enrolled in 4th and 5th grades were considered eligible for the study.

Participant Consent

Participation in the project was on a volunteer basis. Consent forms were obtained from the students, parents, and principals of the participating schools. Each consent form included: 1) the purpose of the research, and 2) an outline of proposed student activities. Student responsibilities included: completion of peak flow measurements, monitoring for pulmonary symptoms, and recording of daily attendance.

Consent forms clearly articulated the anonymous character of the study. Parental consent forms also contained information on how parents could contact project personnel. The signed consent forms were collected and kept by project personnel at Ohio University. Child consent forms were designed to introduce students to the project goals and activities. Students choosing to participate in the project were required to obtain permission from their parents. Parental and student consent forms were accompanied by a letter from the school principals and classroom teachers stating the willingness of the school administration to participate in the Study.[1]

Since the project involved studying human subjects, in particular minors, it was subject to review by the Ohio University Institutional Review Board (IRB). Required IRB documents were submitted to the Ohio University IRB including: 1) OU IRB Project Outline Forms, 2) parental and student consent forms, 3) project description, 4) project time line, 5) a copy of Child Health Questionnaire (CHQ), and 6) CHQ FAQs. The primary investigator presented the project proposal to OU IRB. The project proposal was reviewed and received approval.

Media Attention

As Table II.3.1 shows, the project received wide publicity. Participating schools were the center of media attention throughout the length of the project. Communication with persons outside the study, including the mass media, regarding study design and results was primarily managed and conducted by Dr. Kevin Crist (see Appendix for publication clippings).

Table II. 3.1. Summary of Media Attention

Newspaper	Headline(s)	Date
New Albany News	"4th graders part of scientific air pollution study"	12/9/98
This Week (local weekly neighborhood newspaper in Columbus)	"Researchers studying air breathed by fourth graders" "Students Help Study Air Quality"	1999
Columbus Dispatch	"Schools, Pupils Wired for Air Pollution Study: OU Scientists are Interested in Soot"	1/20/99

[1] Consent forms and other questionnaire information is on file at Ohio University.

Project Management

For the prospective study, faculty from College of Health and Human Services (CHHS) designed and implemented the overall management of the project. A medical evaluation team was comprised of faculty and medical students at the Ohio University College of Osteopathic Medicine (OUCOM). Graduate research assistants served as liaisons between schools, hospitals, and project management. Their responsibilities included primary and secondary research, data collection and management, review of previous studies, management of medical evaluations and quality control.

During the initial stage, general guidelines outlining the primary responsibilities and operating procedures for project participants were developed. Principles guiding the development of these operating procedures included data collection, documentation, data analysis, and quality control issues. Also, they specified duties for project coordinators and teachers involved in the project.

To ensure data quality, the project group developed a quality assurance strategy to help sustain student motivation. The strategy included providing a detailed description of peak flow measurement procedures to teachers and students. It also included constant communication with the research personnel through social events such as pizza parties and cross-cultural classes. Other incentives included discount coupons redeemable at local restaurants.

Research personnel updated participants and other project members on progress and intermediate results. This strategy resulted in minimizing dropouts and enhancing data collection. Regularly scheduled meetings of project personnel improved follow-up, facilitated updating of site-visiting procedures, and helped maintain quality control.

Teachers, students, and project coordinators met on regular basis, usually on the day when the research data were collected from the schools. Initially, project coordinators visited sites once a week to provide training and address quality control issues. Once students and teachers developed substantial expertise in using peak flow meters, reporting absenteeism, and daily health status, project coordinators typically visited schools twice a month.

HEALTH STATUS DATA

Components of the prospective pediatric study included: 1) emergency room visits 2) daily monitoring of pulmonary function, 3) daily school and class absenteeism, and 4) a cross-sectional health survey.

Emergency Room Visits

Emergency room (ER) clinic records were obtained from Riverside, Mt Carmel East and Mt Carmel West in Columbus Ohio and Obleness in Athens Ohio. These hospitals were choosen based on the proximity to the sampling sites. Prior to releasing admission data for 1999 and 2000, the institutional review boards for the hospitals verified confidentiality protection. The records included date, principal and additional diagnoses as International Classification of Diseases (ICD-9), age, sex and zip code of the patient's residence.

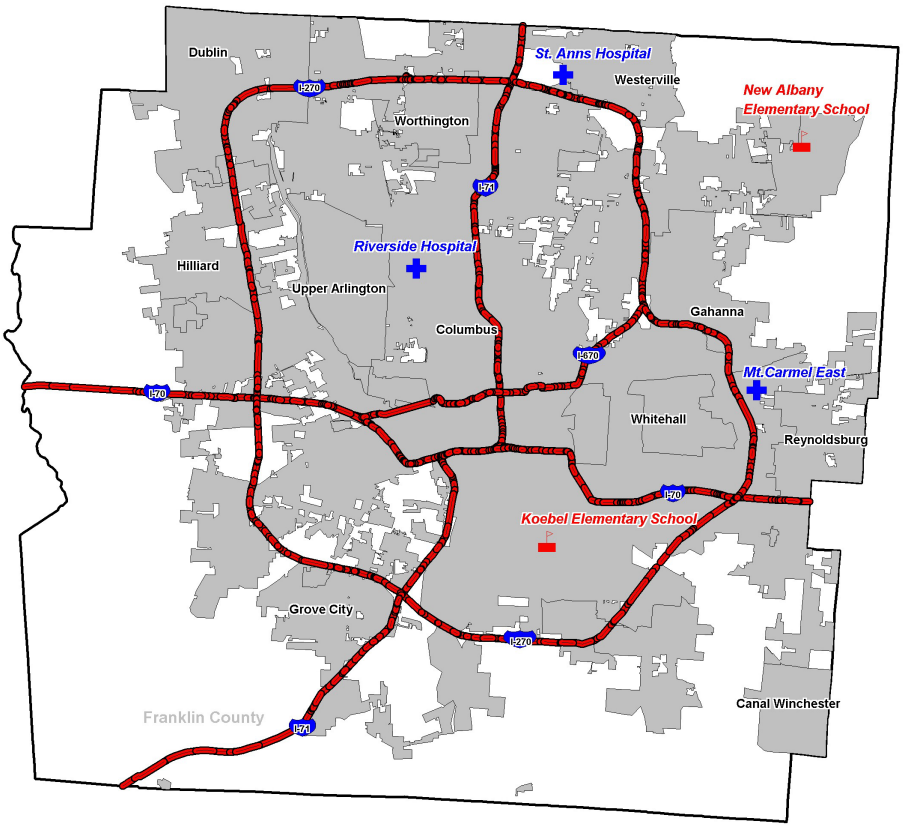


Figure II.3.1. Location of Hospitals in Columbus Ohio where Emergency room data was obtained for 1999 through August of 2000

The daily admissions from all the ERs were aggregated for each sampling site (Koebel, New Albany, and Athens). The admissions were aggregated by utilizing a 20- mile radius from each sampling site as defined by the zip code of the patient's residence. The daily counts were sorted by ICD-9 codes for acute respiratory infections, pneumonias, COPD and asthma. Table II.3.2 provides a listing of the ICD-9 codes corresponding to the respiratory categories used.

Table II.3.2 ER DIAGNOSIS CATEGORIES AND ICD-9 CODES

Diagnosis	**ICD-9 Code**
Acute infections	464, 466
Pneumonias	480-486
COPD	490-492, 496
Asthma	493

Daily monitoring of pulmonary function

The study involved daily monitoring of pulmonary function. Previous studies have used spirometers to assess the response of the pulmonary system to air pollution. Although spirometry is a sensitive method to measure lung function, its operation requires specially trained personnel. Considering the long-term nature of the study and its design that required measuring of lung capacity on daily basis, peak flow meters (PFM) were employed. PFM are easy to use, inexpensive and widely used among patients with pulmonary illnesses in an outpatient environment.

The full range PFMs (60- 880L/min) were purchased from HealthScan Products Inc., a division of Healthdyne Technologies. The ASSESS Peak Flow meter package consisted of a peak flow meter, two plastic mouthpieces, and instructions.

PFMs were distributed to each project participant at the beginning of each school year. During the project study period the PFMs were kept in classrooms and regularly inspected by teachers to ensure their safety and function. Any broken equipment was immediately replaced. To ensure and monitor hygiene standards, the research team developed PFM cleaning logs. School principals or classroom teachers cleaned the mouthpieces of the PMFs using appropriate cleansing solutions and washing equipment.

Three PFM measurements were performed on a daily basis Monday through Friday (weekends and holidays excluded). Each school performed measurements at the time assigned by the investigators. Koebel and Athens completed measurements at 12:00 – 12:30 p.m., while New Albany ran measurements between 8:00 and 9:00 a.m.

Assessment of lung capacity of the elementary school children was performed in two stages. The first stage was from January through May 1999; the second stage during the 1999-2000 academic year. At the beginning of each stage, the project coordinators made a presentation at the three schools. The presentation included general information about the project, its design, methodology, and expected outcomes. Another purpose of the presentation was to educate the community about PFM use. Teachers received handouts on PFM measurement process guidelines, the master peak flow data sheet, and PFM cleaning logs.

To standardize data collection procedures, project personnel designed a form to transcribe the daily PFM data and the highest of three measurements was used for data analysis. Peak flow data sheets were collected from each test center twice a month. Ohio University served as the official repository for all study documents. To ensure anonymity, all data sheets were coded prior to being imputed into the database. Research assistants updated the database on a regular basis.

PFM data was correlated with air pollution monitoring data. Peak flow data was temporally analyzed with absenteeism to identify seasonal variations and provide descriptive characteristic of PFM measurements. Furthermore, for each participating student, daily PFM measures served as the dependent variable in an autoregressive hierarchical linear regression analysis. The independent variables for this regression analysis are various air pollution measures obtained from the school sites. The analysis was hierarchical because it proceeded in two steps. First, items were added to the regression model to represent potential confounding factors, which might be related to both the dependent and predictor variables. These included time-related terms to model whatever trends or cyclical patterns in the data. Second, the air pollution variables were added to the data analysis. Untransformed predictors and the predictors that lagged one or more weeks were evaluated as. At both steps of the analysis, standard procedures were performed including the examination of residual and autocorrelation plots.

Active Surveillance of Daily Absences

An important component of daily health status monitoring was screening for the presence of respiratory symptoms. The required information included the number of students absent due to respiratory conditions (retrospectively according to notes from parents), and number of students present in class with such respiratory symptoms (such as a runny nose, cough, etc).

School absenteeism data were collected from the three participating sites. School secretaries compiled the information on the monthly absentee log

forms. Athens and Koebel[2] were represented by one 4th or 5th grade class; New Albany was represented by two 5th grade classes. Absenteeism data was collected for the second semester of 1998-1999 and the entire1999-2000 school year. Total enrollment in all elementary schools and classes involved in the project was relatively constant during the study period.

Data at Koebel and Athens were incomplete due to teacher workload associated with regular responsibilities and personal health problems. Collection of daily absentee data and recording of respiratory symptoms from the New Albany site was more consistent. Data collection was enhanced due to the fact that the teacher at New Albany participated in the study for its entire period and was highly motivated. This allowed for further analysis of the data from this school site.

To standardize the collection procedure, special forms were designed to monitor class and overall school attendance and were reviewed monthly. Similarly, to monitor class attendance, daily absentee logs included information on the total number of students enrolled and absent in each class. Teachers were responsible for collecting data to complete the absentee form daily. These data included day, date, total number of children enrolled in the class, and the number of students absent (reasons for absenteeism were specified after the explanation notes were received).

Cross Sectional Health Survey

Pediatric health assessment was performed in two cohorts of the project. The first group was surveyed in March - April 1999; the sample is hereafter referred to as the "1998-99 data." For this survey, an 18-page questionnaire was designed by combining two questionnaires: 1) modified *Parent Form 28 Child Health Questionnaire* (CHQ- PF 28) and 2) the *American Thoracic Association Questionnaire* (see Appendix A for samples). Questionnaires were distributed to 4th and 5th grade students. All 4th and 5th graders of three participating schools represented the target group.

The response rates for the 1998-99 survey was 70 percent for all students and 99 percent for the PFM children. Total number of surveyed PFM children was 73 rural, 74 urban, and 160 suburban at the three school sites. The survey results were compared with data for General U.S. Population Sample presented in CHQ Manual.

The second survey was initiated in the Fall of 1999; hereafter referred to as the "1999-00 data." The short form of the questionnaire contained questions

[2] Unfortunately, due to issues related to the administrative structure, some data from Koebel Elementary school are presented as the aggregate monthly data (September, October, and May).

adapted from the *American Thoracic Association Questionnaire.* Only students participating in PFM measurements participated in the survey. In both years, the questionnaire was self-administered and completed by parents of 4th and 5th graders voluntarily. In 1999-2000, 23 rural students responded, 25 urban and 44 suburban students responded to the questionnaire, for a response rate of approximately 99 percent.

The questionnaire assessed: child's global health, overall physical and psychological health, general and pulmonary medical history, child's respiratory status, living conditions, and parents' demographic information.

Meteorology

A meteorological monitoring station was located at each elementary school. The weather stations recorded wind direction, wind speed, precipitation, barometric pressure, and solar radiation (refer Chapter 1 of this section for a complete description of the meteorological monitoring). This data was augmented with data from the National Climatic Data Center (NCDC). Daily values for average and maximum temperature, average relative humidity, total precipitation, average barometric pressure, and average wind speed were used for the statistical analysis.

Air Quality Data

Indoor and outdoor monitoring for $PM_{2.5}$ was conducted at all three elementary schools participating in this study Koebel, New Albany, and Athens. A detailed description of the sampling sites, and the monitoring, and analytical methods is described in Section 2 Chapter 1 of this report. For evaluating the relationship between respiratory health and air quality the monitoring data was limited to $PM_{2.5}$ mass outdoors and indoors, Sulfate (as a component of the $PM_{2.5}$) indoor and outdoor and, personal $PM_{2.5}$ mass obtained at the elementary schools participating in this study.

A 24-hour average mass concentration for the outdoor monitoring was used. The indoor, personal, and outdoor particulate matter sulfate concentrations were seven hour averages (8am -3pm) tagged to the school day. During the second phase of this study the filter based ambient monitoring, ($PM_{2.5}$ sulfate concentrations) was extended to 23 hours to increase the limit of detection. For consistency an estimate of the seven hour average (8am-3pm) was calculated by using the ratio of the 8am-3pm to the 23 hour mass averaged concentration obtained from the TEOM.

The indoor, outdoor and personal monitoring data was used to evaluate the relationship between air quality and respiratory illness for the 4rd and 5th graders participating in this study. The ambient measurements, TEOM mass data and sulfate concentrations, were used to evaluate the relationship between

air quality and respiratory illness for the adjacent community (Emergency room data sorted within a 20 mile radius).

RESULTS AND DISCUSSION

Statistical Analyses

The relationship between respiratory health and air quality may be confounded by other variables, such as meteorological indices, that are related to both. In the analyses that follow, we controlled for a long-term trend by including a linear effect of time. We controlled for seasonal variation in respiratory health by including dummy variables for study months and days of the week.

In analyzing the relationship between emergency room visits as a function of the 24-hour TEOM average, we included a dummy variable for each month of the study, e.g., one dummy variable to represent January of 1999, and so on. In every other analysis, we included a dummy variable for each pair of months in the study, e.g., one dummy variable to represent January and February of 1999, another to represent March and April of 1999, and so on. This was necessary because of the amount of missing data in the dataset, which was primarily due to weekends, holidays, and vacations, when many of the outcome and explanatory measures could not be collected. In all analyses, we included a dummy variable for each day of the week.

For most of the analyses, this set did not include dummy variables representing Saturday and Sunday because data was not collected on these days. We also controlled for a variety of meteorological variables, including linear effects for average temperature, average wind speed, average relative humidity, average barometric pressure, and the occurrence of precipitation. Although many researchers have argued that the relationship between weather, particularly temperature, and respiratory health should be modeled using more complex curvilinear effects, we chose to model it using linear effects primarily because of the size of these datasets.

In any analysis of time series data, the possibility that the residuals exhibit autocorrelation must be considered. Preliminary analyses were conducted with only the seasonal and weather variables in the models. Analyses of the residuals indicated the presence of autocorrelation. A first-order autocorrelation structure was as effective as any of the more complex structures examined for modeling the autocorrelation present in the data.

Separate analyses were conducted for each pollutant. Analyses were also conducted for each pollutant lagged one day. Because data were generally not available on the weekends, holidays, and vacations, for most outcome measures, a lag of one day reduced the available data by more than 20%. A lag

of two days would have reduced the number of days by more than 40%. For this reason, only a one-day lag of the pollution variables was examined.

For the peak flow measures, we used linear regression models with a first-order autoregressive structure. For the emergency room data, we used poisson regression models based on the generalized estimating equations approach developed by Liang and Zeger (1986a, 1986b) with a first-order autoregressive structure

Meteorology

Table II.3.3. summarizes meteorological variables at all three locations. Considering that all three sites area within relatively close proximity to each other, it is not unexpected to find similar levels of precipitation, relative humidity, barometric pressure, and temperature. The one notable meteorological difference is found in wind speed; New Albany is the windiest location of the three.

Table II.3.3. Descriptive Statistics (Mean, Standard Deviation, Minimum, Maximum, and Quartiles) for the Meteorological Variables

	N	M	SD	Min	25th	Mdn	75th	Max
			Athens					
Average wind speed[3]	601	2.2	1.6	0.0	1.0	1.8	3.0	11.3
Average relative humidity[4]	601	71.2	13.0	32.5	62.6	71.1	80.2	100.0
Precipitation	609	0.1	0.3	0.0	0.0	0.0	0.0	2.7
Barometric pressure[5]	601	30.1	0.2	29.4	30.0	30.1	30.2	30.7
Average daily temp[6]	601	56.8	16.6	10.0	43.8	59.7	70.8	87.3
			Koebel					
Average wind speed	603	6.72	3.51	1.38	4.08	6.10	8.60	23.90
Average relative humidity	602	70.71	11.46	40.85	62.50	70.00	78.59	100.0
Precipitation	609	0.95	0.28	0.00	0.00	0.00	0.05	2.67
Barometric pressure	603	29.43	0.39	28.63	29.13	29.30	29.79	30.54
Average daily temp	603	55.34	18.43	4.00	40.69	58.00	71.33	89.00
			New Albany					
Average wind speed	603	7.08	3.34	1.38	4.69	6.50	8.90	23.90
Average relative humidity	603	71.78	11.86	40.85	62.58	71	80.00	100
Precipitation	609	0.095	0.28	0.00	0.00	0.00	0.05	2.67
Barometric pressure	603	29.35	0.33	28.63	29.12	29.28	29.51	30.54
Average daily temp	603	55.11	18.27	4.00	40.69	58.00	71.00	89.00

[3] Miles/hour
[4] Percent
[5] In Hg^0 (inches of mercury
[6] ^oF

Air Quality

Descriptive statistics relating to air quality measurements are shown in Table II.3.4. As this table shows, Athens recorded the highest average values for personal and indoor $PM_{2.5}$; however, average ambient levels of $PM_{2.5}$ were highest at the Koebel site in Columbus. The Koebel site also recorded the highest level of indoor SO_4, with a recorded maximum value of 24.52. Even so, the levels for SO_4 across the three sites are not notably different.

Table II.3.4. Descriptive Statistics (Mean, Standard Deviation, Minimum, Maximum, and Quartiles) for the Air Quality Variables (micrograms/cubic meter)

	N	M	SD	Min	25th	Mdn	75th	Max
			Athens					
$PM_{2.5}$ Personal	207	17.6	17.8	0.2	6.2	9.5	22.8	88.4
$PM_{2.5}$ Indoor	298	17.2	13.6	0.5	8.6	12.3	20.8	71.6
Weight – Outdoor	296	13.7	9.0	0.5	8.3	11.8	17.2	61.1
SO_4 – Indoor	216	2.3	2.1	0.1	0.6	1.6	3.5	11.1
SO_4 – Ambient	243	2.6	2.3	0.0	0.8	1.9	3.5	9.4
$PM_{2.5}$ Ambient	438	15.3	7.2	4.5	10.1	13.4	18.8	41.0
			Koebel					
$PM_{2.5}$ Personal	194	14.59	13.05	0.42	7.49	10.18	15.14	66.97
$PM_{2.5}$ Indoor	251	14.98	12.30	1.05	7.22	10.55	16.26	68.36
Weight – Outdoor	303	13.83	8.81	0.24	8.69	11.65	16.29	61.29
SO_4 – Indoor	191	2.35	3.16	0.04	0.54	1.31	2.63	24.52
SO_4 – Ambient	199	2.71	2.46	0.02	0.98	2.03	3.62	13.79
$PM_{2.5}$ Ambient	491	18.47	8.64	4.89	12.26	16.61	22.44	60.22
			New Albany					
$PM_{2.5}$ Personal	205	13.93	12.25	0.95	6.82	9.45	15.09	56.90
$PM_{2.5}$ Indoor	270	16.52	13.52	0.24	8.40	11.56	19.52	69.51
Weight – Outdoor	297	12.79	8.53	0.05	8.04	10.95	15.45	61.34
SO_4 – Indoor	208	1.97	2.59	0.06	0.40	1.17	2.42	16.59
SO_4 – Ambient	222	2.12	2.00	0.01	0.94	1.51	2.80	13.76
$PM_{2.5}$ Ambient	552	14.72	7.08	4.00	9.62	13.07	18.51	47.81

Emergency Room Visits and Peak Flow Meters

Peak flow readings are an imperfect indicator of a child's respiratory health. Children are capable of producing spuriously low or high readings. Therefore, before conducting any analyses, unusually high and low peak flow readings were identified and deleted from the dataset; fewer than 1% of these data were deleted. Table II.3.5. provides a summary of health data that includes emergency room data and results of the peak flow meter measurements.

Table II.3.5. Descriptive Statistics (Mean, Standard Deviation, Minimum, Maximum, and Quartiles) for Daily Respiratory Measures

	N	M	SD	Min	25th	Mdn	75th	Max
Athens								
Mean Peak Flow – 1999	87	0.01	0.02	-0.05	-0.01	0.01	0.02	0.06
Mean Peak Flow – 1999 (Ill)	83	0.04	0.04	-0.05	0.02	0.04	0.07	0.14
Number Attending – 1999 (Ill)	87	8.9	1.3	4.0	9.0	9.0	10.0	10.0
Mean Peak Flow – 2000	124	0.00	0.02	-0.08	-0.01	0.00	0.01	0.05
Proportion Absent – 2000	168	0.03	0.02	0.00	0.03	0.04	0.04	0.09
Total - Respiratory Illness	545	1.0	1.1	0.0	0.0	1.0	1.0	7.0
Children – Asthma	545	0.1	0.0	0.0	0.0	0.0	0.0	2.0
Elderly – COPD	545	0.1	0.3	0.0	0.0	0.0	0.0	2.0
Koebel								
Mean Peak Flow – 1999	90	0.00	0.43	-0.06	-0.02	0.00	0.01	0.16
Mean Peak Flow – 2000	145	0.00	0.04	-0.09	-0.02	0.00	0.02	0.09
Mean Peak Flow – 2000 (I11)	145	0.00	0.05	-0.12	-0.03	0.00	0.02	0.16
Number Attending – 2000 (I11)	149	9.74	1.58	2.00	9.00	10.00	11.00	12.00
Proportion Absent – 2000	138	0.07	0.04	0.02	0.05	0.06	0.07	0.31
Total - Respiratory Illness	547	35.29	13.46	12.00	27.00	32.00	40.00	89.00
Children – Asthma	547	1.28	1.26	0.00	0.00	1.00	2.00	6.00
Elderly – COPD	547	3.86	2.12	0.00	2.00	4.00	5.00	11.00
New Albany								
Mean Peak Flow – 1999	95	-0.00	0.02	-0.08	-0.01	0.00	0.01	0.07
Mean Peak Flow – 1999(Ill)	95	0.00	0.06	-0.16	-0.04	0.00	0.05	0.16
Number Attending -1999(Ill)	95	5.37	0.83	3.00	5.00	6.00	6.00	6.00
Mean Peak Flow – 2000	168	0.00	0.02	-0.05	-0.02	0.00	0.02	0.06
Mean Peak Flow – 2000 (Ill)	168	0.00	0.03	-0.07	-0.02	0.00	-0.02	0.09
Number Attending –2000(Ill)	168	13.29	1.31	8.00	12.00	13.00	14.00	15.00
Proportion Absent – 2000	175	0.04	0.02	0.01	0.02	0.04	0.04	0.09
Total - Respiratory Illness	547	36.44	13.82	13.00	28.00	33.00	41.00	90.00
Children – Asthma	547	1.31	1.29	0.00	0.00	1.00	2.00	6.00
Elderly – COPD	547	3.99	2.20	0.00	2.00	4.00	5.00	12.00

An aggregate daily peak flow measure was computed for each school. First, each child's daily peak flow reading was standardized. A child's mean peak flow reading for the year was subtracted from each of the child's daily peak flow recordings. These differences were then divided by the child's mean peak flow reading for the year. Second, the daily standardized peak flow readings were aggregated by averaging them across all of the children in each school. Separate analyses were performed for each of the three schools and for each of the two years in the study.

At the start of each school year, parents completed the Child Health Questionnaire. In completing this questionnaire, parents reported whether their children had ever been diagnosed with a respiratory illness. Separate daily mean standardized peak flow measures were computed for children whose parents had reported that their children had been diagnosed with a respiratory

illness. This was done for New Albany (6 children) and Athens (10 children) in 1998-1999 and for New Albany (15 children) and Koebel (13 children) in 1999-2000.

Health Status Questionnaire

Survey results indicate that children living in the urban study area are most likely to live in a home in which there are smoking adults. On the other hand, urban children are less likely than rural and suburban children to own pets and to have air conditioning in their homes.

The general health status of the children participating in the study is depicted in Figures II.3.2 and II.3.3. As these figures show, the perceived health status of students in the urban area is worse than those students who are in both the rural and suburban districts.

In both study years, only about 20 percent of the urban students stated that they were in "excellent" health. Contrast this with the more than 50 percent of rural students in both years who state they are in excellent health. In terms of the suburban sample, almost 60 percent of the respondents indicated that they were in excellent health during the 1998-99 school year, and almost 48 percent assessed their health as excellent in the 1999-00 school year.

Reported respiratory symptoms from the 1998-99 survey are summarized in Figures II.3.5 and II.3.6. As these figures show, the urban children are more likely to say that they have experienced chronic cough, wheezing and asthma.

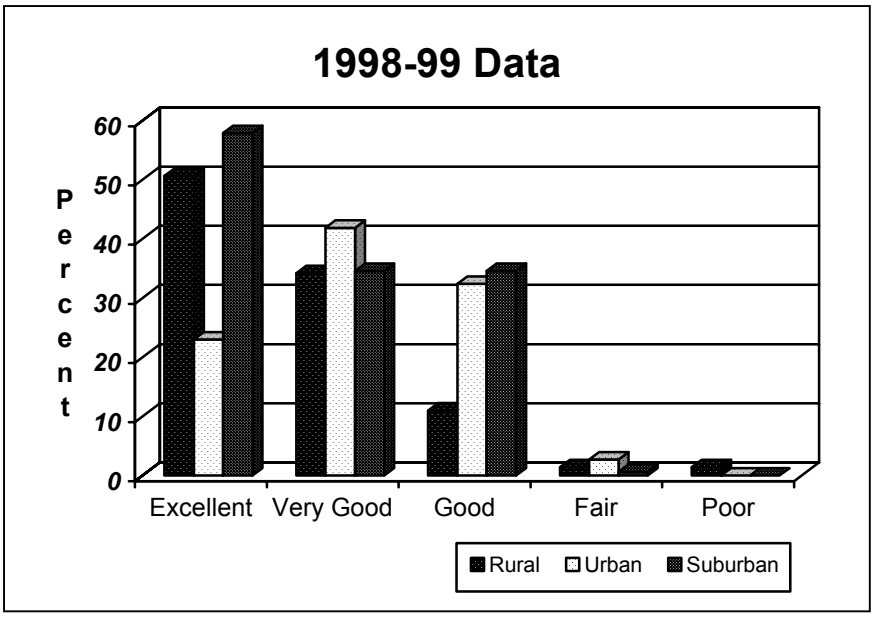


Figure II.3.2. General Health Status, 98-99 Sample

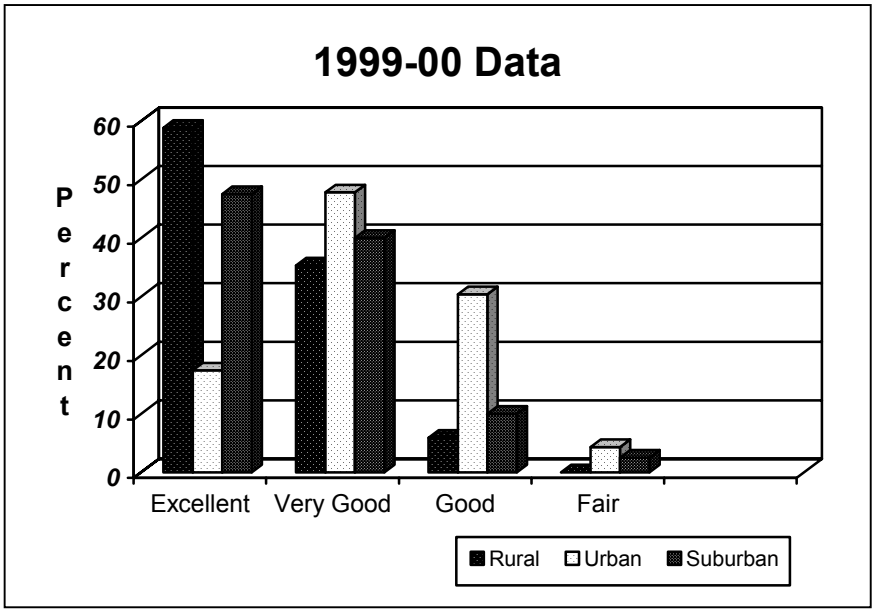


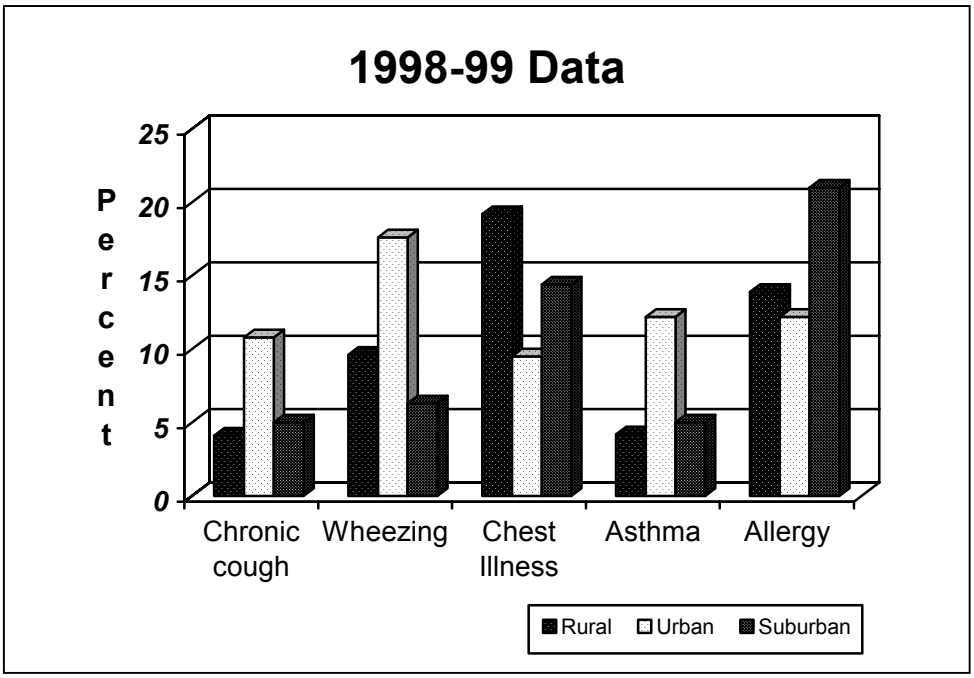
Figure II.3.3. General Health Status, 99-00 Sample

Rural children indicated that they have experienced chest illness more often than children in urban and suburban area. An interesting finding is that suburban children report the highest percentage of allergies. This may be due to the fact that these children are most likely to have access to medical care. Reported respiratory symptoms from the 1999-2000 survey are summarized in Figures II.3.4 and II.3.5. The results from this survey should be interpreted with caution because of the low number of respondents, especially in the urban cohort.

Parents were asked to identify several other illnesses that their children have had. These illnesses included: measles, sinus trouble, bronchiolitis, bronchitis, asthmatic bronchitis, pneumonia, whooping cough, croup and cystic fibrosis. Figures II.3.6. and II.3.7. summarize the results from the two survey years.

For the 1998-99 survey period, rural parents reported the highest percentage of incidence of measles, bronchitis, and pneumonia. Suburban children had the highest percentage of sinus trouble and croup. Urban children reported the highest incidence of whooping cough.

During the 1999-2000 survey period, urban children reported the highest percentage of measles. Suburban children reported the highest percentage of sinus trouble, bronchitis, pneumonia, and croup. Rural children had the highest percentage of whooping cough. Complete results for the health status questionnaires can be found in Appendix B.



II.3.4. Reported Respiratory Symptoms, 98-99 Sample

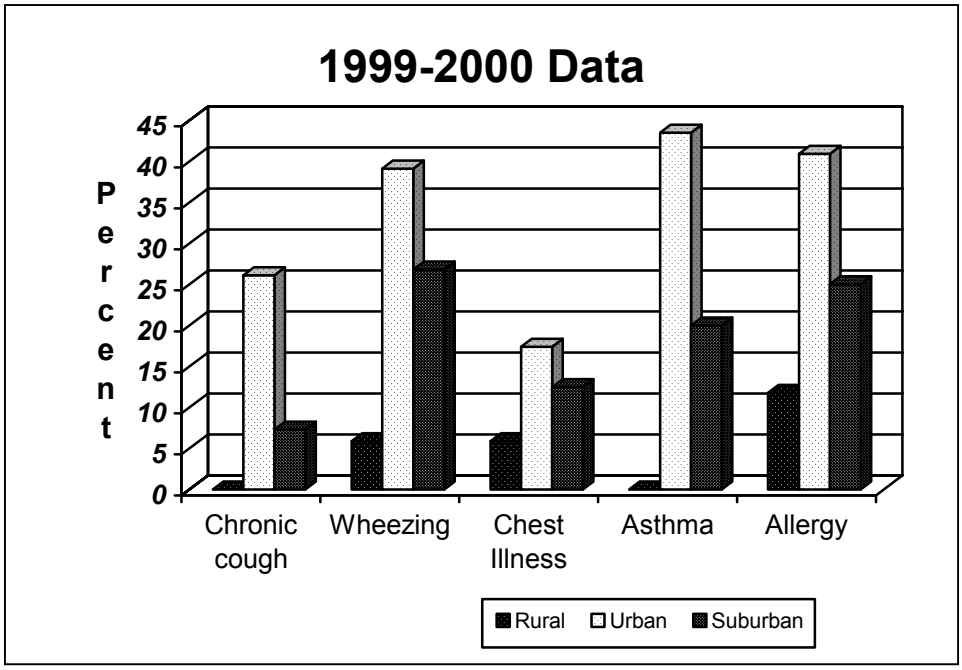
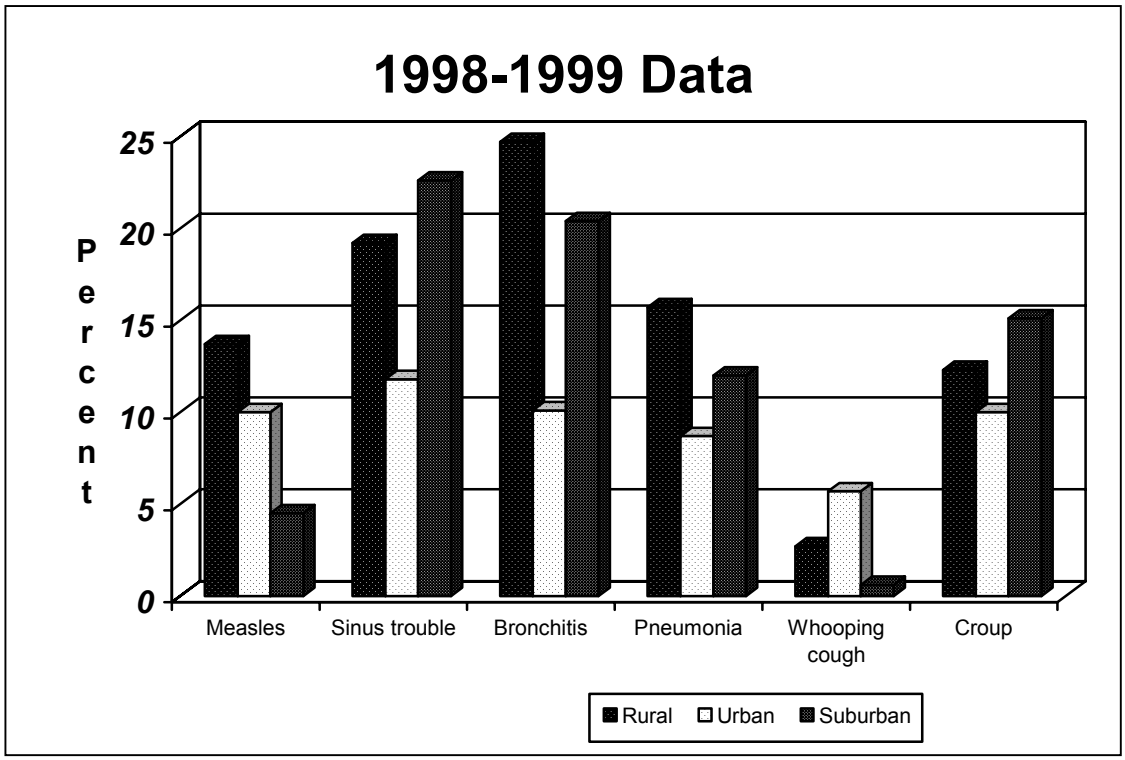


Figure II.3.5. Reported Respiratory Symptoms, 99-00 Sample



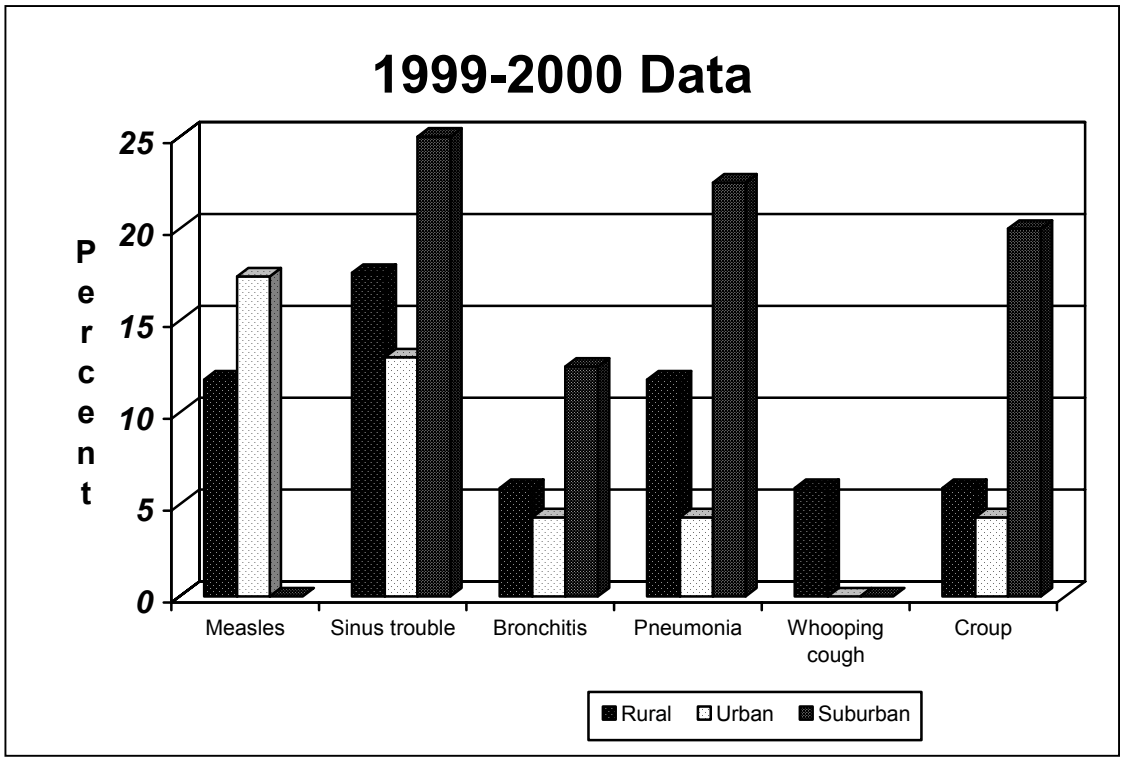


Figure II.3.6. and II.3.7. Responses from Parents Relative to Child's Respiratory Status

Respiratory health and air pollution

Tables II.3.6 through II.3.8 contains zero-order correlations between the respiratory measures and the air quality measures. Table II.3.7 contains summaries of the statistical analyses conducted to examine the relationship between the respiratory measures and the air quality measures while controlling for seasonality and weather.

Table II.3.6. Correlation Matrix (and Significance Levels) for Daily Respiratory Measures with the Air Quality Variables at Athens

	$PM_{2.5}$ Personal	$PM_{2.5}$ Indoor	SO_4 – Indoor	SO_4 – Ambient	$PM_{2.5}$ Ambient
Mean Peak Flow – 1999	.148 (.258)	.087 (.442)	.179 (.208)	.112 (.390)	.175 (.143)
Mean Peak Flow – 1999 (Ill)	-.041 (.760)	.004 (.970)	.100 (.501)	.169 (.210)	-.175 (.149)
Number Attending – 1999 (Ill)	.076 (.564)	.131 (.242)	.144 (.314)	.034 (.795)	-.071 (.554)
Mean Peak Flow – 2000	.210 (.033)	.161 (.095)	-.139 (.212)	.044 (.663)	.090 (.455)
Proportion Absent – 2000	.189 (.033)	.262 (.002)	-.169 (.089)	.020 (.830)	-.041 (.697)
Total - Respiratory Illness				.142 (.038)	-.151 (.003)
Children – Asthma				.077 (.263)	-.006 (.906)
Elderly – COPD				.032 (.644)	.041 (.429)

Table II.3.7. Correlation Matrix (and Significance Levels) for Daily Respiratory Measures with the Air Quality Variables at Koebel

	$PM_{2.5}$ Personal	$PM_{2.5}$ Indoor	SO_4 – Indoor	SO_4 – Ambient	$PM_{2.5}$ Ambient
Mean Peak Flow – 1999	.125 (.260)	.114 (.298)	.321 (.030)	.160 (.283)	-.062 (.596)
Mean Peak Flow – 2000	.296 (.003)	.271 (.007)	-.242 (.024)	-.062 (.602)	.057 (.566)
Mean Peak Flow – 2000 (I11)	.102 (.324)	.009 (.927)	.001 (.991)	.036 (.763)	-.051 (.607)
Number Attending – 2000 (I11)	-.152 (.132)	-.052 (.606)	.029 (.784)	-.218 (.057)	-.100 (.305)
Proportion Absent – 2000	-.155 (.147)	-.161 (.135)	-.118 (.315)	-.017 (.890)	-.113 (.284)
Total - Respiratory Illness				-.090 (.250)	-.278 (.000)
Children – Asthma				.142 (.070)	-.071 (.141)
Elderly – COPD				-.040 (.615)	-.083 (.083)

Table II.3.8. Correlation Matrix (and Significance Levels) for Daily Respiratory Measures with the Air Quality Variables at New Albany

	$PM_{2.5}$ Personal	$PM_{2.5}$ Indoor	SO_4 – Indoor	SO_4 – Ambient	$PM_{2.5}$ Ambient
Mean Peak Flow – 1999	.260 (.025)	.180 (.103)	.069 (.634)	-.124 (.386)	.083 (.430)
Mean Peak Flow – 1999(Ill)	.044 (.712)	-.300 (.006)	.024 (.867)	-.066 (.645)	-.064 (.544)
Number Attending - 1999(Ill)	.055 (.644)	.077 (.490)	-.156 (.281)	.067 (.639)	.019 (.854)
Mean Peak Flow – 2000	.372 (.000)	.441 (.000)	-.057 (.565)	.198 (.040)	.321 (.000)
Mean Peak Flow – 2000 (Ill)	.120 (.178)	.302 (.001)	-.070 (.478)	.100 (.302)	.253 (.002)
Number Attending –2000(Ill)	.340 (.000)	.410 (.000)	-.056 .572	.080 (.413)	.139 (.098)
Proportion Absent – 2000	.024 (.784)	-.054 (.551)	-.178 (.070)	-.122 (.209)	-.134 (.103)
Total - Respiratory Illness				-.036 (.630)	-.224 (.000)
Children – Asthma				-.054 (.470)	.006 (.894)
Elderly – COPD				.027 (.716)	.002 (.963)

There were few consistent relationships between the respiratory measures and the air quality measures, after controlling for seasonality and weather. At two of the three sites (Koebel, New Albany), indoor filter weights with a one-day lag were negatively related to the attendance of students who had a prior history of respiratory illness. At New Albany, outdoor filter weights were negatively related to mean standardized peak flow, but only significantly so for all students in 2000, but not for just those with a history of respiratory illness, and for all students with a history of respiratory illness in 1999, but not for all students. Although negative correlations between mean standardized peak flow and outdoor filter weights were also observed at the other two sites in 2000, none were statistically significant. Additional correlation tables can be found in Appendix C.

Limitations

The failure to detect expected relationships between the respiratory measures and the air quality measures, after controlling for seasonality and weather, may be due to several possible causes. First, relatively little data were available for analyses. Because students do not attend school on weekends, on holidays, or during the summer, there were only approximately 100 observations available for each of the analyses. Second, this problem was probably aggravated by the relatively conservative approach that was taken in conducting the statistical analyses. To adequately control for seasonality and weather, more covariates were entered into the model than was desirable, given the number of observations. This suggests that the analyses probably had relatively little power.