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Air Pollution, Weather, and Illness in a New York Population

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EVIDENCE has accumulated over the past several years to justify the statement that air pollution, as a generality, has an effect on health. While the effect has been most dramatically shown in the few recorded acute air pollution disasters[1,2] and in the exacerbation of pre-existing cardiopulmonary disease,[3-5] recent studies indicate that an adverse effect of urban air pollution at regularly occurring levels can be shown for normal children.[6,7] Attempts to understand the mechanism by which air pollution produces its effect on health have been frustrating, and it has not been possible, thus far, to isolate individual pollutants whose effects by themselves are capable of explaining the entire air pollution effect.

Previous reports from our group have indicated some effect of urban air pollution on a normal population,[8-11] but rather than clarifying the mechanisms, these have pointed to the multivariate nature of both the stimulus and the response.

This paper presents the results of analyses of some of the complex and interacting variables in the environment that appear to participate in the production of adverse health effects. These analyses represent steps in the larger process of delineating complex mechanisms.

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Methods

The study population, methods of data collection, and environmental monitoring have been described in previous reports.[12] A daily record of the prevalence of a number of common symptoms or illnesses was maintained for a period of three years, for a panel of New York City families living within a restricted geographic area. Persons (1,747) participating in the study were followed by weekly interviews for an average of 45 weeks each, providing 61,000 person weeks of information. In addition, air pollutants were measured in the study area and meteorologic measurements were available from both the study laboratory and from the city. Included in the first step in the analysis to be reported were the symptoms "common cold," cough, headache, and eye irritation. The four pollutants under consideration were particulate matter (COH), total hydrocarbons (THC), carbon monoxide (CO), sulfur dioxide (SO_2). The seven meteorologic factors considered initially were wind speed (wnd), precipitation (ppt), solar radiation (rad) in calories per unit area, temperature (tmp), relative humidity (rlh), sky cover (sky), and barometric pressure (bp). The daily average of each factor was used except for barometric pressure, for which the daily range—difference between maximum and minimum—was used.

Multiple correlation coefficients, to be report-

Table 1.—*Correlation Coefficients Between Pairs of Environmental Factors*

	Wnd	Ppt	Rad	Tmp	Rlh	Sky	Bp	Coh	Thc	So_2	Co
Wind	...	0.062	0.085	−0.372	−0.259	−0.089	0.439	−0.296	−0.260	−0.381	...
Ppt	...	...	−0.346	0.010	0.449	0.378	0.300	0.011	−0.087	−0.061	...
Rad	...	...	...	0.347	−0.641	−0.660	−0.252	−0.363	0.075	−0.230	−0.194
Tmp	...	...	...	...	0.122	−0.055	−0.366	−0.369	0.283	−0.138	−0.100
Rlh	...	...	...	...	...	0.707	0.107	0.124	−0.024	0.074	0.083
Sky	...	...	...	...	...	...	0.213	0.160	−0.018	0.055	0.031
Bp	...	...	...	...	...	...	...	0.131	−0.176	−0.040	0.016
Coh	...	...	...	...	...	...	...	...	−0.002	0.664	0.540
Thc	...	...	...	...	...	...	...	...	...	0.002	0.148
So_2	...	...	...	...	...	...	...	...	...	...	0.431

ed first, are appropriate for studying several variables simultaneously. This form of statistical analysis provides useful indicators of the relative importance of association of the environmental factors and each of the symptoms under inspection for the day of occurrence—the effect of time delay is not seen in this analysis.

Results of the Analysis

Table 1 shows the strength of association expressed as product moment correlation coefficients among pairs of environmental factors. Of the daily average of pollutants, the strongest associations were among pairs of the three pollutants COH, SO_2, and CO. Total hydrocarbon appeared least associated with the other pollutants. The relative strength of association among the pairs of the seven meterologic factors is also shown in Table 1. The strong positive correlation between sky cover and relative humidity is expected as well as the strong negative correlation of each of these with solar radiation.

Table 2 shows the relationship between certain pollutants measured at the study monitoring station (CFIS) and those measured at the New York City station, 110 blocks away.

The strength of association between four

Table 2.—*Correlation Coefficients Between Environmental Factors Measured at New York City Laboratory and Cornell Family Illness Monitoring Station (CFIS)*

		New York City Lab		
		Particulate Matter	SO_2	CO
CFIS	COH	0.563	0.602	0.391
	SO_2	0.452	0.559	0.349
	CO	0.378	0.352	0.413

symptoms and certain environmental factors has been expressed as correlation coefficients displayed in a simple matrix in Table 3.

As shown in Table 3, low tmp (as well as low humidity and a wide range in bp) is highly associated with the daily prevalence of "common cold" and cough symptoms. High tmp and the daily prevalence of eye irritation are positively associated. Also found in association with "common cold" and cough are the environmental factors of wnd and COH. Carbon monoxide appears to be associated with respiratory symptoms while THC show a negative association with those symptoms. The relationships of SO_2 appears to be less strong than COH.

This multiple regression analysis sought to clarify the relationships between the levels of some pertinent environmental factors and the prevalence of certain symptoms in a panel of a normal urban population. Of the four symptoms studied, the prevalence of respiratory symptoms (common cold and cough) was found more strongly associated with atmospheric factors than was prevalence of headache or eye symptoms.

Previous reports from our group using other methods of analysis have also pointed to an association between certain symptoms in the study population and pollutants.[8-11] In this analysis an apparent association is demonstrated not only between certain of the symptoms and pollutants but the symptoms and weather factors. But here, as in the previous analyses, it has not been possible to single out one factor whose contribution appeared so strong as to negate the importance of the other environmental variables or which could solely account for the variation in prevalence of the symptoms. Similarly, while the results of this analysis