fungal counts were obtained by using a Rotorod sampler (Multidata, Inc, Plymouth Meeting, PA). Multiple-regression models were developed to examine all potential exposure measures as predictors of the number of daily asthma visits. Poisson regression analysis was used to model the daily number of asthma visits as a function of air quality data and temporal variables. In the data analyses, air quality measures from 0 to 5 days before the asthma visit date were used, to account for delayed effects.

**Results.** A series of Poisson regression models was used to identify predictors of changes in the number of asthma visits. Initially, the logarithm of pollen counts and the month of the year (April to October) were significant predictors of the number of asthma visits. The number of asthma visits per day was associated with pollen counts reported for the same day ($P = .014$). The effect was increasingly strong, however, for pollen counts recorded 1, 2, and 3 days before the visit. The logarithm of the pollen counts lagged 3 days was the most significant predictor of asthma visits ($P < .001$). This effect was very strong during the summer and spring months; however, in the autumn, when pollen counts and asthma visits were both high, daily variations in pollen counts did not account for the variations in daily asthma visits as they did during other seasons. The analyses also showed a synergistic effect between pollen and particulate levels, in that the exposure-response to pollen counts was moderately high on days when particulate matter levels were low but was significantly higher on days when particulate matter levels were $>33 \mu g/m^2$. Fungal spore counts and average ozone concentrations were not significant predictors of asthma visits.

**Conclusions.** Ambient concentrations of pollens and small particles were strongly associated with emergency visits for treatment of pediatric asthma in Cincinnati, Ohio. Concentrations of ozone did not appear to be associated with pediatric asthma exacerbations.

**Reviewer’s Comments.** Several studies have demonstrated associations between particulate matter levels and emergency department visits, and several have shown correlations between pollen counts and asthma symptoms. This study shows the added effects of both on asthma symptoms. It would be interesting to evaluate particulate matter levels and pollen counts in various urban, suburban, and rural settings, to assess their influence. In addition, examination of particulate matter levels inside and outside households, schools, and offices might give us a better understanding of the conditions that influence asthma. The fact that pollen counts influenced asthma admissions in the spring and summer but not the autumn might be secondary to other factors that dominate during that season (eg, cold weather and respiratory infections).

**HELEN SKOLNICK, MD**
Princeton, NJ

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**ASSOCIATION OF LOW-LEVEL OZONE AND FINE PARTICLES WITH RESPIRATORY SYMPTOMS IN CHILDREN WITH ASTHMA**


**Purpose of the Study.** Exposure to ozone and particulate matter of $\leq 2.5 \mu m$ (PM$_{2.5}$) in air at levels above current US Environmental Protection Agency (EPA) standards is a risk factor for respiratory symptoms among children with asthma. This study sought to examine the simultaneous effects of ozone and PM$_{2.5}$ at levels below EPA standards, on daily respiratory symptoms and rescue medication use among children with asthma.

**Study Population.** Daily respiratory symptoms and medication use were examined prospectively for 271 children, $<12$ years of age, with physician-diagnosed, active asthma who were residing in southern New England.

**Methods.** Exposure to ambient concentrations of ozone and PM$_{2.5}$ from April 1, 2001, through September 30, 2001, was assessed with peak 1-hour and 8-hour ozone levels and 24-hour PM$_{2.5}$ levels. Logistic regression analyses with generalized estimating equations were performed separately for maintenance medication users ($n = 130$) and nonusers ($n = 141$). Associations between pollutant levels (adjusted for temperature and controlling for same- and previous-day levels) and respiratory symptoms and rescue medication use were evaluated. Major outcome measures were respiratory symptoms and rescue medication use, as recorded on calendars by the subjects’ mothers.

**Results.** Mean $\pm SD$ levels were $59 \pm 19$ ppb (1-hour average) and $51 \pm 16$ ppb (8-hour average) for ozone and $13 \pm 8 \mu g/m^3$ for PM$_{2.5}$. In copollutant models, ozone but not PM$_{2.5}$ levels were significantly associated with respiratory symptoms and rescue medication use among children using maintenance medication; a 50-ppb increase in 1-hour ozone levels was associated with increased likelihood of wheeze (by $35\%$) and chest tightness (by $47\%$). The highest levels of ozone (1-hour or 8-hour averages) were associated with increased shortness of breath and rescue medication use. No significant, exposure-dependent associations were observed for any outcome with any pollutant among children who did not use maintenance medication.

**Conclusion.** Asthmatic children using maintenance medication were particularly vulnerable to ozone, controlling for exposure to fine particles, at levels below EPA standards.

**Reviewer’s Comments.** This is an excellent study that provides persuasive evidence regarding the adverse effects of air pollution in childhood asthma, even at levels that are generally regarded as safe.

ROBERT A. WOOD, MD
Baltimore, MD

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**PERSONAL EXPOSURE TO NITROGEN DIOXIDE AND THE SEVERITY OF VIRUS-INDUCED ASTHMA IN CHILDREN**


**Purpose of the Study.** Nitrogen dioxide (NO$_2$) exposure has been linked to respiratory tract illness. This study examined the relationship between the level of personal exposure to NO$_2$ and the severity of asthma exacerbations caused by respiratory viral infections.

**Study Population.** The subjects were 114 asthmatic children, 8 to 11 years of age (63 male subjects and 51 female subjects).

**Methods.** The cohort of 114 children collected daily upper and lower respiratory tract symptom scores and peak expiratory flow (PEF) values for up to 13 months. During this time, NO$_2$ collection tubes were worn on the children’s outer clothing, placed in the subjects’ bedrooms at night, and changed weekly. Symptom scores determined the likelihood of an upper respiratory tract infection and prompted the collection of nasal aspirates, for assessment of the presence of common respiratory viruses and atypical bacteria with reverse transcription-polymerase chain reaction assays. NO$_2$ exposure levels were divided into tertiles of low ($<7.5 \mu g/m^3$), medium (7.5–14 $\mu g/m^3$), and high ($>14 \mu g/m^3$). Exposure levels in the week before
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Robert A. Wood

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