Lung inflammation in children with short-term exposure to ambient ozone: evidence of a threshold

Marc Nickmilder[1], Sylviane Carbonnelle[1], Claire de Burbure[1] and Alfred Bernard[1]

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Introduction

Ozone is a major pollutant produced by sunlight-driven reactions involving mainly nitrogen oxides and volatile organic compounds (Fig. 1). During summertime, ground levels of ozone may peak at values exceeding 200 µg/m^3 in central or southern regions of Europe and in many other areas of the world. This gas can produce a variety of pulmonary effects, including a decrement in lung function, inflammatory reactions, an increase in epithelial permeability and airway resistance, and asthma exacerbation.

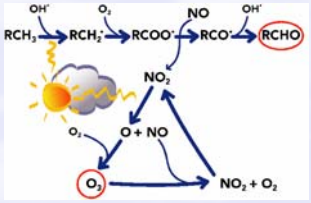

Figure 1

During the last few years, one specific test has emerged and been developed to evaluate the extent of inflammation or damage in the lung: the measurement of exhaled NO, a very sensitive marker of airways inflammation and oxidative stress.

The aim of this study was to assess the inflammatory effect of ambient O_3 in healthy children using nitric oxide in exhaled air (eNO) as a non invasive test.

Methods

• Participation of six groups of children (n = 11-15; age: 6.5- 15 years) attending summer camps in rural southern Belgium in 2002 (Fig. 2).

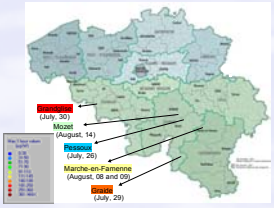

Figure 2

• Ambient O_3 concentrations were continuously monitored and ranged from 48 to 221 µg/m³, 1 hour maximal mean (Fig. 3).

• Other air pollutants were monitored hourly.

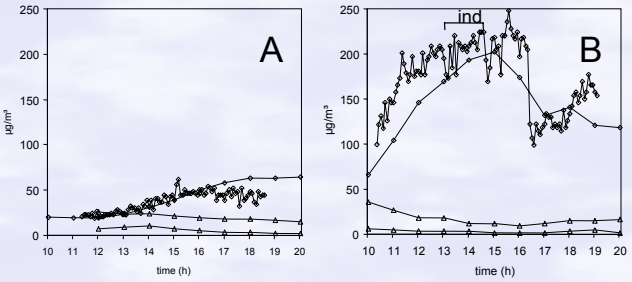

Figure 3: Diurnal variations of O_3 (dark diamonds for in-house measurements and white diamonds for station measurements), NO (dark triangles) and NO_2 (white triangles).
Graph A: day with the lowest ozone levels
Graph B: day with the highest levels

• Children remained outdoors doing various recreational activities.

• Lung function tests and eNO (NIOX®, Aerocrine, Sweden) were measured twice, in the morning (10:00-12:00 am) and evening (18:00-20:00 pm).

• Age, sex, height and weight of each subject were recorded during the morning test.

Results

• Whilst lung function tests didn't show any particularly consistent decrease, a highly significant increase in eNO was found from an ambient 1-hour O_3 level of 167 µg/m³ (Fig. 4 & 5).

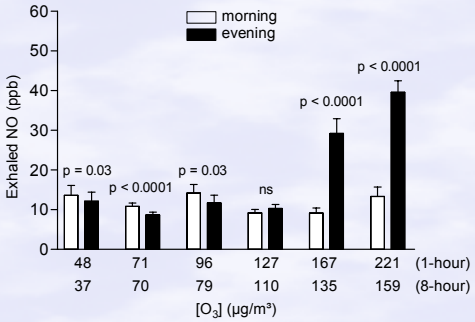

Figure 4

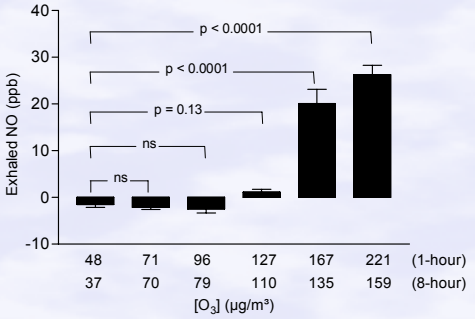

Figure 5

• A multivariate analysis did not reveal any influence of the age, sex and BMI of the children.

Conclusion

•The exact threshold for this O_3-induced increase in eNO might lie around 130 µg/m³ since from this level onwards the significant diurnal decrease of eNO observed in control camps was abolished.

•The observations suggest that ambient ozone produces early inflammatory changes in the airways of children from levels slightly below current air quality standards.

[1]*Unit of Occupational Toxicology, Catholic University of Louvain, B-1200 Brussels, Belgium.*

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