



Eczema, respiratory allergies, and traffic-related air pollution in birth cohorts from small-town areas

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ABSTRACT

Background: Traffic-related air pollution (TAP) impairs respiratory health and could influence the development of allergies, as was demonstrated in urban areas with relatively high pollution. Whether eczema is affected by TAP was rarely investigated.

Objective: To investigate whether exposure to TAP affects eczema and respiratory allergies also in small-town areas with lower concentrations of pollution.

Methods: Between 1995 and 1999, we recruited 3390 newborns from small-town areas. Diagnoses and symptoms of eczema and respiratory allergies were recorded by annual questionnaires. Seventy-seven percent of families participated until the child's 6th birthday, when a clinical test for eczema and IgE-sensitization was performed. Individual exposure to traffic-related soot and NO₂ at the children's home addresses was determined by land-use-regression. We used Cox-regression/log-binomial-regression to determine its confounder-adjusted association with incidence and prevalence of eczema and respiratory allergies.

Results: The prevalence of eczema at age 6 was significantly higher in children who resided in areas where TAP was higher. The adjusted relative risk for doctor diagnosed eczema for instance was 1.69 (95% confidence interval 1.04–2.75) per 90%-range of soot concentration. Current eczema at the 6 year clinical investigation was likewise associated, children with parental allergies showed significantly stronger effects ($p < 0.05$). Incidence of eczema was not affected. No associations between TAP and asthma, hay fever, or allergic sensitization emerged.

Conclusion: Eczema was sensitive to TAP, effects emerged even in lower polluted small-town areas of Germany. They could be seen for prevalence but not incidence of eczema. This is equivalent to a longer duration of eczema in exposed children.

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1. Introduction

In affluent industrialized countries, traffic-related air pollution (TAP) constitutes an increasing fraction of anthropogenic air pollution. Numerous studies have investigated the effects of exposure to TAP on children's respiratory health and allergies. [1–

24]. Most studies done so far demonstrated the effects of TAP on asthma or related symptoms; most found positive associations although not all were significant. Nine studies of those mentioned above specifically investigated hay fever or related symptoms, and all but one [1] found a positive association. Eight studies investigated allergic sensitization and one-half found a positive association with TAP. The association between eczema and exposure to TAP has not been well investigated. Eight studies have addressed this association [3,7,8,10,12,13,21,24], and four showed a significant positive one. We therefore specifically focused on eczema.

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Most of the studies were conducted in urban areas with relatively high levels of pollution. Thus we lately demonstrated for children from the urban portion of the GINIplus and LISApplus birth cohorts [25,26] (Munich, South Germany), that asthma, hay fever, eczema and allergic sensitization against outdoor allergens were associated with TAP. [24] It is unknown, whether effects also emerge in rural, small town areas, where pollution is lower. To clarify this question we used the rural portion of the GINIplus and LISApplus birth cohorts (Wesel, North/West Germany).

2. Material and methods

2.1. Study area

The study was conducted in the North-Western part of North-Rhine Westphalia (Germany), which comprises 37 adjacent communities up to 100 km north of the Ruhr area that are inhabited by 8000–80,000 people each. The landscape is flat, ranging from 25 to 50 m above sea level and farm houses lay singly between small central towns. Only a few highways and major roads cross the area, connecting the Ruhr area with the Netherlands and northern Germany and interconnecting the towns. The study area covers approximately 3300 km² and is referred to as the “Wesel” area.

2.2. Study subjects

Subjects were participants in two ongoing birth cohort studies: the “German Infant study on the influence of Nutrition Intervention plus air pollution and genetics on allergy development” study (GINIplus) and the “Life style Immune System Allergy plus air pollution and genetics” study (LISApplus). Detailed descriptions of recruitment are provided elsewhere. [27,28] Briefly, in GINIplus, 5991 newborns were recruited between September 1995 and June 1998 from 16 maternity wards in Munich and “Wesel”. Families with a history of allergies ($n = 2252$) agreed to participate in the nutrition intervention arm of GINIplus, all others participated in the non-intervention arm. Children from both groups were followed up with identical instruments at the ages of 1, 2, 3, 4, and 6 years. In LISApplus, 3097 neonates from Munich, Leipzig, Bad Honnef, and “Wesel” were recruited between December 1997 and January 1999. They were followed up at the ages of 0.5, 1, 1.5, 2, 4, and 6 years.

In our analysis, inclusion was restricted to the 3390 children recruited from the “Wesel” area, 3042 from GINIplus and 348 from LISApplus. The study protocol was approved by the local ethics committee and written informed consent was obtained from all participating families.

2.3. Exposure assessment

Exposure assessment procedures were identical to those in the “Traffic Related Air Pollution and Childhood Asthma” (TRAPCA) study [29], which was done in the Munich metropolitan area as well as in the Netherlands and in Stockholm and based on one measurement campaign in 1999/2000. Details of the exposure assessment for the small town “Wesel” area have been described elsewhere. [30] In short, the models were based on a 1-year measurement program conducted in 2002, concentrations of NO₂, fine particulate mass (PM_{2.5}), and filter absorbance of PM_{2.5} as a marker for soot concentration, were measured at 30 points and 14-day samples were taken for each season and site. The NO₂ concentration and PM_{2.5} absorbance as a marker of soot, but not PM_{2.5} mass, could be described by a linear combination of daily traffic and the distance to a highway. These land-use regression-models for NO₂ and PM_{2.5} absorbance (“soot”) were applied to the

home addresses of the cohort members to describe individual levels of long-term exposure. Additionally, exposure was characterized by the distance from the domicile to the next major road: living near (<50 m using Geographic Information System (GIS)) a major road traversed by more than 10,000 cars per day. If the child moved between birth and 6 years of age the mean of the values calculated for the different addresses was used to characterize lifelong exposure.

2.4. Determination of outcomes and covariates by questionnaires

At each follow-up, the subjects' parents completed questionnaires about health outcomes and covariates.

2.4.1. Outcomes

At each follow up, parents were asked whether a physician had diagnosed asthma, asthmoid/spastic/obstructive bronchitis, hay fever, or atopic eczema in the child since the last follow-up. If the last follow up was 2 years ago, then the prevalence of the diagnosis was asked separately for the 2 individual years. Additionally, parents were asked whether the child had experienced the following: wheezing, sneezing/running stuffed nose without a cold, or an intermittent, itchy skin rash that lasted at least two weeks. In the 6th year questionnaire, the ISAAC (International Study on Asthma and Allergies in Childhood [31]) core questions for 6- and 7-year olds were included (different definition of eczema symptoms: intermittent itchy rash lasting at least 6 months).

2.4.2. Covariates

Covariates were parental allergy (asthma, hay fever, or eczema in the father or mother, determined at the birth of child); gender; education of parents (maximum education of either parent categorized as <10 years = 10 years, and >10 years); maternal smoking during pregnancy; smoking in the child's home; contact with dog, cat, or other furry animal in the 1st year of life; elder siblings; use of gas for cooking; home dampness, indoor moulds; and living on a farm. The list of covariates was the same as in the Munich portion of this cohort with the exception of “living on a farm”, which was not relevant for the urban Munich children.

2.5. Determination of specific IgE and eczema

Upon the child's 6th birthday, a clinical examination was offered to all families. Current eczema was determined following the ISAAC II protocol. [32] Specific IgE against common food allergens and inhalant allergens were determined by standardized methods with CAP-RAST FEIA (Pharmacia Diagnostics, Freiburg, Germany). A screening test for atopy was used to detect specific IgE antibodies against inhalant allergens (SX1: timothy grass, rye, birch, mugwort, house-dust mites, cats, dogs and moulds) in the serum. The children who had positive results for SX1 were tested for single specific allergens. Sensitisation to pollen allergens (outdoor) included timothy grass, rye, birch, and mugwort and sensitisation to indoor allergens included house-dust mites, cats, dogs and moulds. Inhalant sensitisation and specific allergen sensitisation were defined as any specific IgE-antibody value ≥ 0.35 kU/l.

2.6. Statistical analysis

We used Cox-regression analysis to evaluate the risk for allergy diagnosis and symptoms associated with TAP exposure at birth. The development of eczema, itchy skin rash, and sneezing between the birth and the age of 6 years was analyzed. For asthma/spastic/obstructive bronchitis, wheezing and hay fever the analysis was restricted to the 3- to 6-years age range because asthma and hay

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