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INDOOR ENVIRONMENT AND RECURRENT WHEEZING IN YOUNG CHILDREN

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ABSTRACT

Recurrent wheezing is one of the most common causes of morbidity and hospitalisation among infants and young children in many westernised countries. Respiratory infections and exposure to tobacco smoke have been identified as important risk factors. The indoor environment is also clearly of importance since we spend most of our time indoors. The aim of this thesis was to study the influence of various ventilation systems on indoor air quality, and to elucidate the impact of outdoor and indoor environment, primarily with focus on indoor air, on the development of recurrent wheezing in children up to the age of two years. The thesis is based on two main studies:

The first study assesses the impact of various ventilation systems on the indoor quality of single-family homes, located within a small residential area outside Stockholm. All houses were originally designed for natural ventilation. Twenty-two of the 59 investigated houses had been refitted with mechanical supply and exhaust ventilation systems. In another eight houses the original natural ventilation had been adjusted in order to improve the air change rate.

In the second study, we followed a birth cohort (BAMSE), comprising 4,089 children, born in predefined areas of Stockholm, during the two first years of the children's lives. Both urban and suburban districts were represented, including different types of buildings, dwellings with and without gas stoves for cooking, different socio-economic groups, and areas with various types of traffic exposure. Information on exposures was obtained from parental questionnaires. In addition, children with recurrent wheezing, and two age-matched controls per case, were identified and enrolled in a nested case-control study. Their homes were investigated and ventilation rate, humidity, temperature and NO₂ measured.

In BAMSE, an increased risk of recurrent wheezing was shown for children living in apartment buildings constructed after 1940 and single-family homes with crawl space/concrete slab foundation, compared with those living in buildings erected before 1940, OR 2.5 (1.3-4.8) and OR 2.5 (1.1-5.4). This was not primarily explained by differences in type of ventilation system, measured ventilation rate, occurrence of house dust mite allergen in the home, or other known risk factors for childhood wheezing.

Air change rate (ACH) was inversely related to indoor humidity, and increased humidity above median level 5.8 g/kg was associated with infant recurrent wheezing, OR 1.7 (1.0-2.9). In single-family homes, both studies show that mechanical ventilation increases the possibility of reaching an ACH of ≥ 0.5 , which in cold temperate regions protects buildings from increased indoor humidity, including levels that promote mite survival. Furthermore, occurrence of windowpane condensation on the interior side of double-glazed windows in wintertime indicated indoor humidity above 5.8 g/kg. Windowpane condensation, reported consistently over several years in the same home, was also associated with an increased risk of infant recurrent wheezing, OR 2.2 (1.1-4.5). There was also a higher proportion of recurrent wheezing in children exposed to signs of dampness, prospectively reported by parents, OR 1.4 (0.9-2.2) or observed at home inspections 1.6 (1.0-2.5). Moreover, recently painted surfaces in the child's bedroom were associated with an increased OR for recurrent wheezing, 1.7 (1.3-2.6).

It was further suggested that exposure to air pollution including NO₂, particularly in combination with exposure to environmental tobacco smoke (ETS), increases the risk of recurrent wheezing in children: the OR was 3.1 (1.3-7.3) among children exposed to the highest quartile of indoor (NO₂) and ETS.

It may be concluded that various building-related exposures such as certain types of building constructions, signs of dampness and newly painted interior surfaces, were associated with recurrent wheezing in children up to the age of two. In addition NO₂, especially in combination with ETS seems to increase the risk of infant recurrent wheezing.

Key words: *Child, asthma, allergy, wheezing, air pollution, NO₂, indoor air quality, building construction, ventilation system, indoor humidity, house dust mite, damp buildings, moisture, moulds*

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