

Environmental exposures early in life modify immune responses – effects visible even in adolescence

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Exposure to the farm environment in childhood, and even prenatally, decreases the risk of allergic diseases. Credit: University of Eastern Finland

The prevalence of allergic diseases has increased significantly over the last decades, creating substantial financial and societal burdens. Due to this, researchers are trying to discover new approaches to the prevention and treatment of these diseases. A new Ph.D. thesis from the University of Eastern Finland shows that there is a link between immune responses

and diverse early life exposures, such as obstetric factors, farm dust and air pollution. Some changes in immune responses are visible up until adolescence.

There is strong evidence that different exposures early in life can alter the risk of allergic diseases. One of these exposures is farming. Exposure to the [farm](#) environment in childhood, and even prenatally, has been shown to decrease the risk of allergic diseases. On the other hand, being born by caesarean section is recognised as a risk factor. The roles of other obstetric factors are less studied. Another harmful [exposure](#) is air pollution, and especially exposure to particulate matter, which has been shown to increase [asthma prevalence](#) and exacerbations in children. However, the underlying mechanisms are unclear, causing a delay in the development of asthma-preventive strategies.

Earlier studies have shown that immunological development and maturation starts already during pregnancy and in early childhood. Therefore, exposure at this critical point of immune development may modify immune responses and cells, and thus influence the risk of allergies and other immune diseases.

The study explored how different exposures during pregnancy, birth or childhood modulate asthma-related immune responses in children. The study focused on three different exposures: one that is asthma-protective (farming) and two that predispose to asthma (caesarean section and air pollution).

"We studied whether circulating dendritic cells associate with farming, asthma or atopy, whether obstetric factors affect immune responses at teenage in children born by caesarean section, and whether farm dust and urban air particulate matter have immunomodulatory effects on children's circulating immune cells," says Early Stage Researcher Maria-Viola Martikainen, MSc, from the University of Eastern Finland.

To answer these questions, the researchers studied associations between exposures and immunological responses. Circulating dendritic cell subsets of farm and non-farm children were examined at the age of 6 to assess whether they mediated the protective effect of farm exposure. Cytokine secretion of unstimulated and stimulated peripheral blood mononuclear [cells](#), PBMCs, at teenage were examined to identify whether obstetric factors alter immune responses later in life. PBMCs of 4-year-old children were stimulated with farm dust and size-segregated particulate matter to discover shared and distinct immune pathways between two different environmental exposures.

The studied environmental exposures were associated with asthma-related immune responses. Inverse association between farm exposure and one of the subsets studied, and the association between this subset and asthma in farm [children](#), suggested that this subset plays a role in farm-related immunoregulation. On the other hand, the lack of natural birth processes during delivery and neonatal intensive care treatment seemed to lead to long-lasting alterations of immune responses. The observed stimulatory effects of farm dust and inhibitory effects of [particulate matter](#) on immune responses indicate that these exposures could modify responses towards respiratory pathogens and allergens, and partly explain differences in asthma prevalence between the studied environments.

The study demonstrated associations between diverse early life exposures and immune responses, both ex vivo and in vitro. Some changes in immune responses seemed to be observable up to teenage. The study revealed some of the potential immunological mechanisms behind different exposures and advanced knowledge of immune mechanisms that either protect from or predispose to asthma. Moreover, the developed methodological approach offered a new perspective, which could be used when studying environment-related immune diseases and their mechanisms. These studies suggest that acquiring

comparable data from various exposure environments could lead to the discovery of new immunological pathways and provide novel tools for risk assessment and for the development of preventive strategies.

More information: Maria-Viola Martikainen et al. Integrating farm and air pollution studies in search for immunoregulatory mechanisms operating in protective and high-risk environments, *Pediatric Allergy and Immunology* (2018). [DOI: 10.1111/pai.12975](https://doi.org/10.1111/pai.12975)

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