

Impact of viral infection on respiratory allergy – an update

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Prof. Jürgen Schwarze
Child Life and Health
Centre for Inflammation Research
University of Edinburgh



Outline

Focus on respiratory viruses & development of asthma & airway allergy

- Recent epidemiological findings
- Recent mechanistic insights
 - Innate immune cells
 - Epithelial cells



Epidemiology

Established association between RSV / RV **bronchiolitis** / **LRTI** in infancy and asthma development.

Causality?

Is viral infection just an early marker of genetic asthma risk?

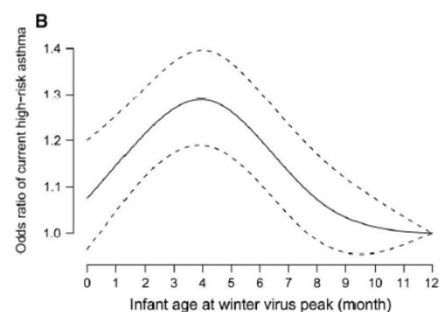


Young age (2-6 months) during RSV season increases risk of childhood asthma.

TennCare cohort
(Wu P, *AJRCCM* 2008)

Age at winter virus peak
→ Definable risk of childhood asthma

→ Causal factor
→ Window of susceptibility



RSV infection in 1st year of life increases risk of childhood asthma

Prospective birth cohort (2012/13, n = 1946)

- RSV rtPCR every 2nd week, RSV serology at 1 year (**independent of disease severity**)
n = 1741 (89%)
- Asthma diagnosis at 5 years

RSV+ (54%) → 21% 5-year asthma

RSV- (46%) → 16% 5-year asthma, **RR 0.74** (0.58-0.94), p=0.014

→ RSV infection in 1st year is a risk factor for childhood asthma

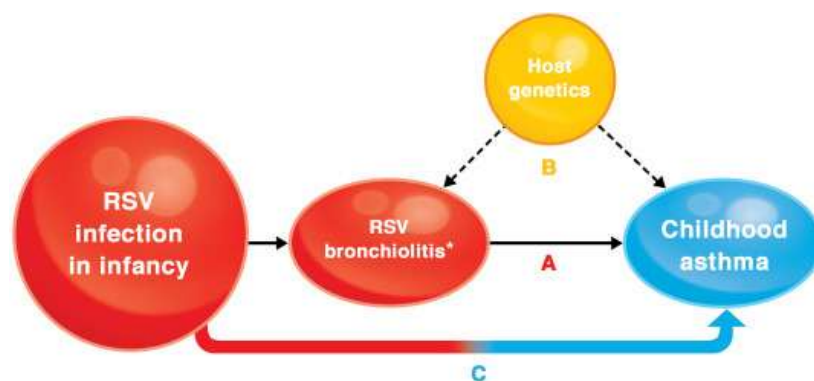
→ **causal factor**

Delay of RSV infection beyond 1st year → 15% decrease in asthma at 5 years.

Rosas-Salazare et al. Lancet. 2023; 401:1669-1680.



RSV infection vs RSV bronchiolitis and risk of childhood asthma



Rosas-Salazare et al. JACI 2023; 152:866-9



Innate immunity



Persistent Sendai virus in lung innate immune cells sustains chronic lung pathology

Summary

- In mice Sendai virus RNA and protein persist in ILC-2s and tissue macrophages
- Viral persistence induces type 2 immune genes and chronic lung inflammation
- Depletion of infected cells reduces chronic lung inflammation
- Viral RNA/protein persistence may contribute to the development and maintenance of asthma

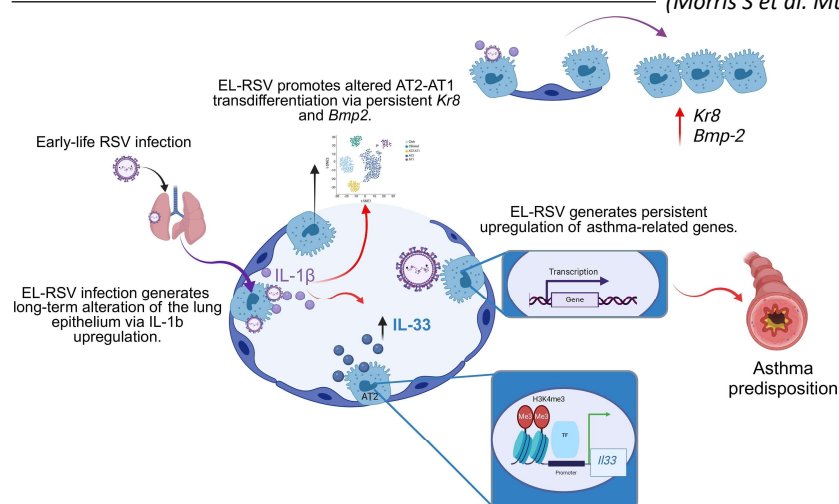
*(Castro et al. Nat Microbiol
2024;9:2803)*

Epithelial cells



Early life RSV enhances allergic responses through IL-1 β -induced long-term changes in lung ECs

(Morris S et al. *Muc Immunol* 2024;17:1072-88)



Epithelial memory after respiratory viral infection in mice results in prolonged enhancement of antigen presentation.

Summary

RSV results in sustained

- Up-regulation of MHC-I and MHC-II molecules on lung EC
- Increased antigen processing and T cell activation

Conclusion

This likely facilitates activation of memory T cells in lung tissue

→ Faster / stronger anti-viral / anti-bacterial responses, quick resolution of infection

→ Increased responses to allergens, increased allergic inflammation.

(Janas P et al. *Allergy* 2025; 80:2501)



Interactions between viral LRTI and asthma development

