

Childhood Immune Imprinting and Seasonal Influenza-Driven Boosting of Cross-Reactive Avian Influenza A Antibody Landscapes in Adults: Evidence from a German Population-Based Longitudinal Cohort (2020-2024)

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Avian A(H5N1) in birds/poultry is a pandemic threat, but how imprinting and seasonal immunity shape antibody recognition of avian subtypes is unclear. We assessed whether birth-cohort imprinting was associated with H5N1/H7N9 binding antibodies and whether H1N1/H3N2 infections boosted antibodies within matched HA groups.

We analysed 7,232 sera from 2,871 adults in the population-based MuSPAD cohort (born 1927–2001), sampled in 2020–2024. Binding antibodies to group 1 antigens (H5N1, three H1N1 strains) and group 2 (H7N9, three H3N2 strains) were measured by Luminex. Birth-year imprinting probabilities were estimated from German influenza circulation data. Infection was defined by ≥ 2 log₂ titre rise. Age-adjusted mixed models assessed the H5N1–H7N9 contrast and HA-group-specific boosting.

Higher group 1 imprinting probability was associated with a higher H5N1–H7N9 contrast ($\beta=0.82$ log₂ BAU; 1.76-fold increase; $p<0.001$), independent of age, and remained stable over time (ICC=0.85). H1N1 infection increased group 1 titres 3.4-fold versus 1.2-fold for group 2; H3N2 showed the reciprocal pattern (group 2: 3.2-fold; group 1: 1.1-fold; interaction $p<0.001$). Vaccination increased both groups similarly (~2.3-fold).

Birth-cohort imprinting shapes avian influenza binding-antibody landscapes, while seasonal infection induces HA-group-specific boosting. These patterns may support age-stratified pre-pandemic risk assessment and interpretation of vaccination-induced cross-reactive responses.

Keywords

Influenza A virus; Antibodies, Viral; Immunologic Memory; Seroepidemiologic Studies; Vaccination; Cross reactions

Professional status of the speaker

PhD student

Junior scientist status

Yes, I am a junior scientist.

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