Association between Antibody Titers and Protection against Influenza Virus Infection within Households

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Background

Previous studies have established that antibody titer measured by the hemagglutination-inhibiting (HAI) assay is correlated with protection against influenza virus infection, with an HAI titer of 1:40 generally associated with 50% protection.

Objectives

In this study, we aim to estimate the protection conferred by different antibody titers against influenza virus infection during household outbreaks, when there is defined exposure to influenza virus infection.

Methods

We recruited index cases with confirmed influenza virus infection from outpatient clinics influenza seasons in 2008 and 2009 (Figure 1), and followed up their household contacts for 7-10 days to identify secondary infections. Sera collected from a subset of household contacts were tested by HAI and microneutralization (MN) assays against prevalent influenza viruses. We analysed the data using an individual hazard-based transmission model that adjusted for age and vaccination history.

Results

Compared to a reference group with antibody titers <1:10, we found that HAI titers of 1:40 against influenza A(H1N1) and A(H3N2) were associated with 31% (95% CI: 13% to 46%) and 31% (CI: 1% to 53%) protection against PCR-confirmed A(H1N1) and A(H3N2) virus infection, respectively, while a MN titer of 1:40 against A(H3N2) was associated with 49% (95% CI: 7% to 81%) protection against PCR-confirmed A(H3N2) virus infection (Figure 2). We also estimated possible factors affecting influenza transmissions in households including age and vaccination and serial interval distributions (Figure 3).

Conclusion

An HAI titer of 1:40 was associated with substantially less than 50% protection against PCR-confirmed influenza virus infection within households, perhaps because of exposures of greater duration or intensity in that confined setting.

Figure 1. Timeline of subject recruitment and local influenza virus activity. Panel A: Number of index cases with seasonal influenza A(H1N1) and A(H3N2) recruited over time. Panel B: Proxy measure of seasonal influenza A(H1N1) and A(H3N2) virus activity in Hong Kong based on local surveillance data on influenza-like illness and laboratory detections of influenza.

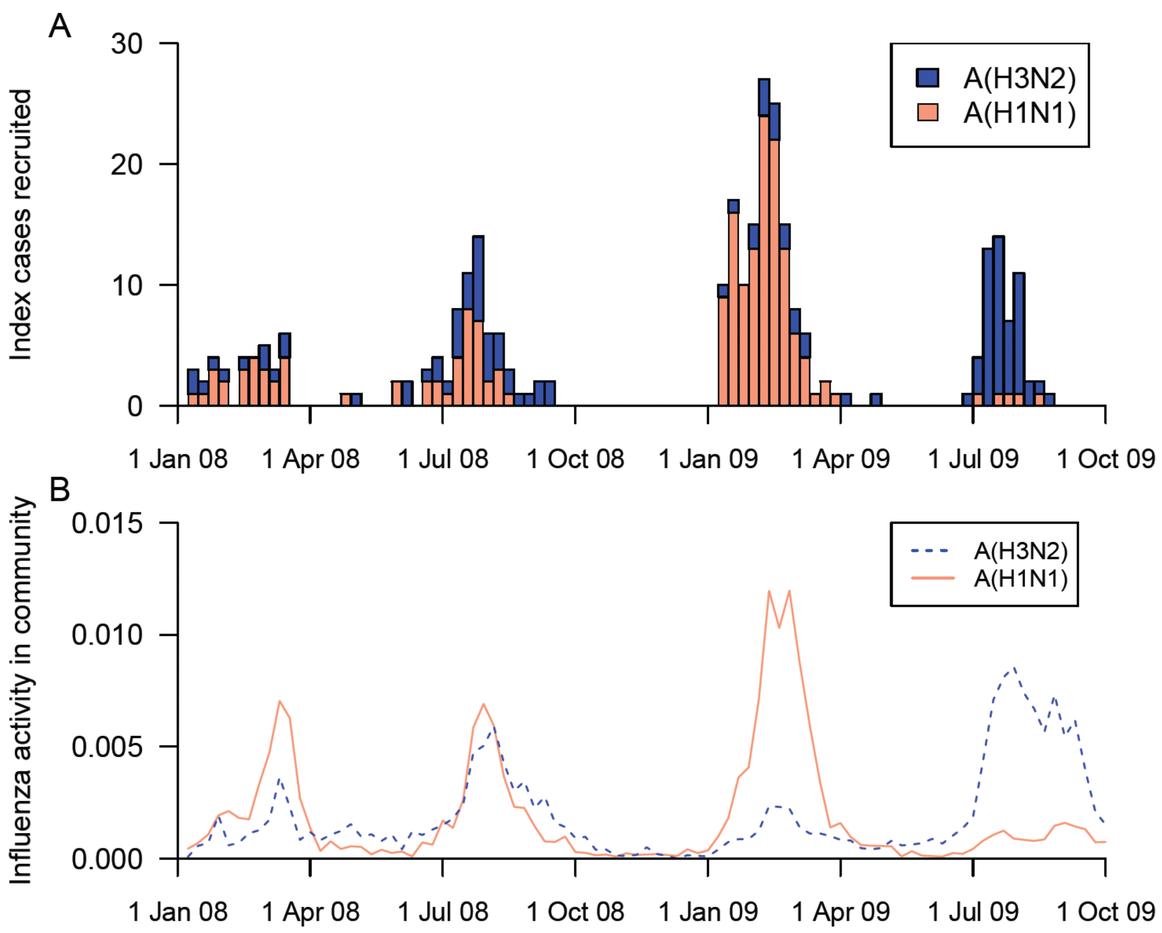


Figure 2. Correlation between antibody titers and protection against PCR-confirmed influenza virus infection. Panel A: seasonal A(H1N1) with HAI titers. Panel B: seasonal A(H3N2) with HAI titers. Panel C: seasonal A(H3N2) with MN titers.

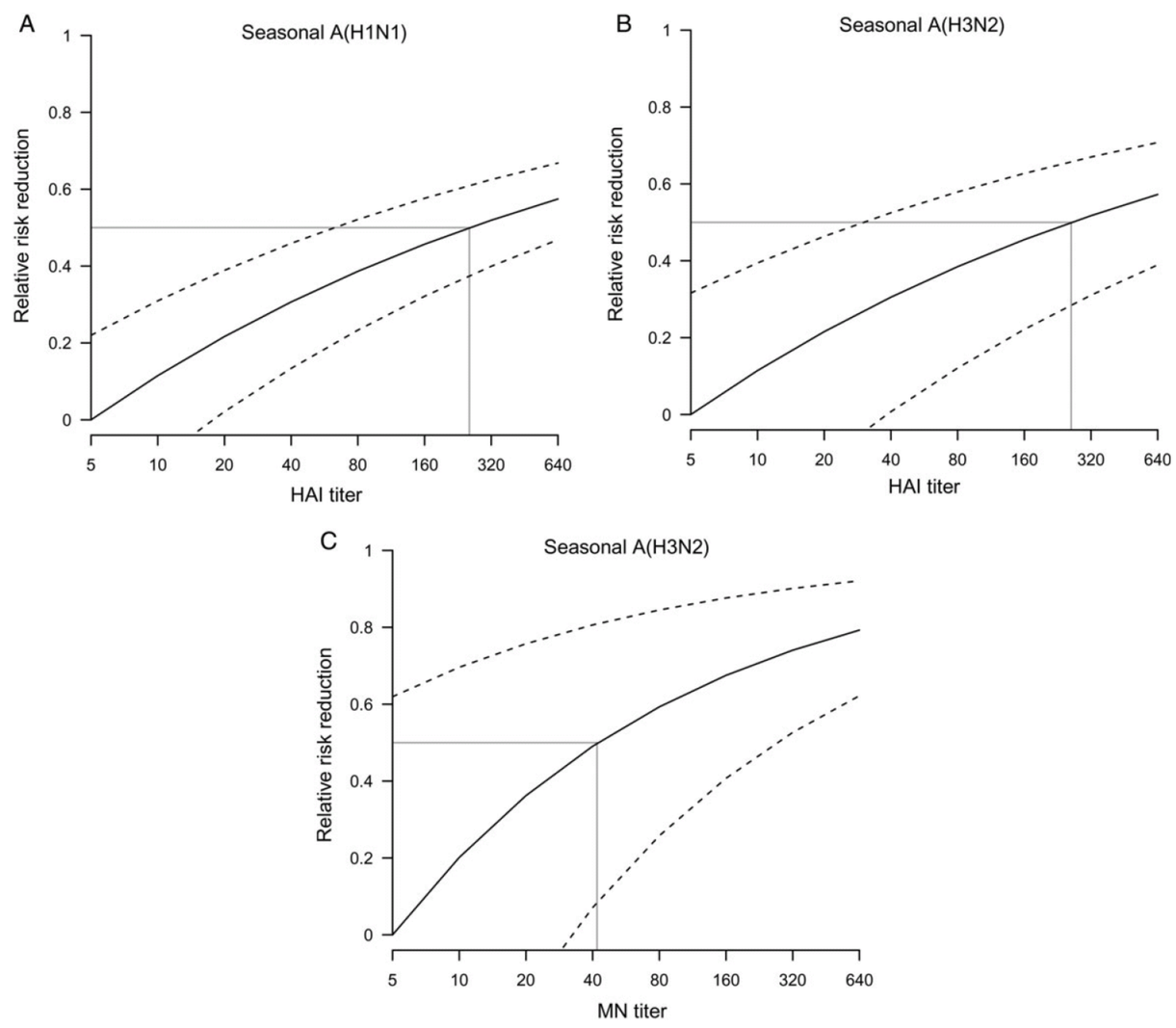
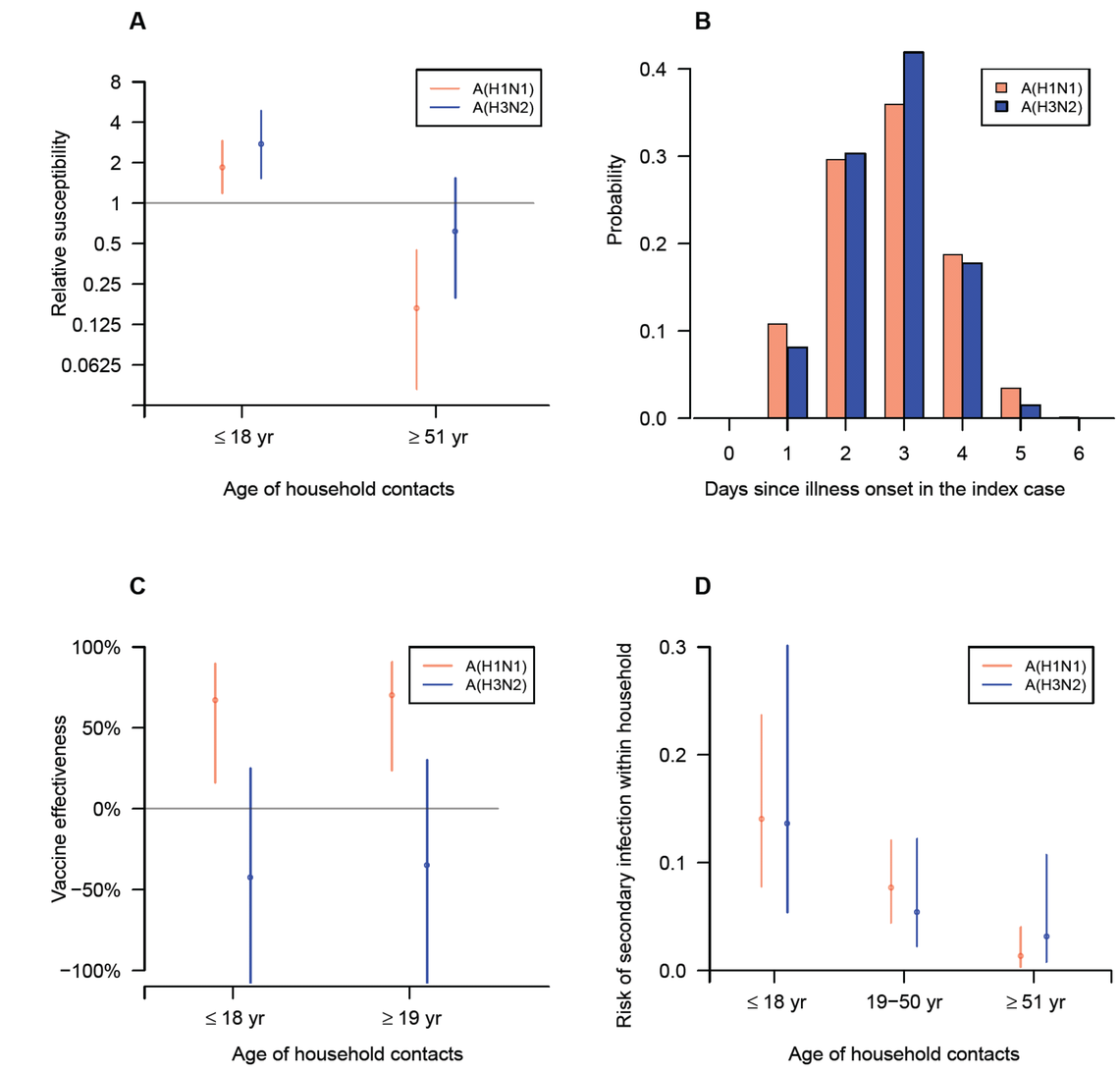


Figure 3. Factors affecting household transmission and the household serial interval. Panel A: Estimates of the age-relative susceptibility of household contacts. Panel B: Serial interval distributions estimated under the transmission model. Panel C: Age-specific estimates of vaccine effectiveness against infection for household contacts. Panel D: Age-specific risk of infection for household contacts



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