Are post-vaccination antibody levels correlated with protection against COVID after household exposure?

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Introduction

Response to COVID-19 immunization in adults is variable with lower neutralizing antibody levels associated with a higher risk of infection[1,2]. As the pandemic evolves, there is a need to determine an antibody correlate of protection to guide timing of additional vaccine doses and ensure future vaccines offer sufficient protection[3].

Objective

To determine whether post COVID-19 vaccination antibody levels at the time of exposure are correlated with protection of household contacts of a SARS-CoV-2 infected individual

Methods

Prospective cohort of adults (age >18) recruited from October 21, 2021 until June 30, 2022 who were living with a household member who contracted COVID-19 and who were asymptomatic. Study participants provided a blood sample (serum or dried blood spot) and were then followed for 28 days to identify whether symptoms compatible with COVID-19 developed. Oral-nasal swabs for SARS-CoV-2 polymerase chain reaction or rapid antigen testing were collected at day 7 after enrolment or if symptoms developed. Repeat blood samples were collected 28-days after enrolment. Initial specimens were tested for anti-spike and anti-receptor binding domain IgG antibodies and those who provided serum had pseudoneutralization titres against BA.1 measured. Convalescent serology was used to assess for seroconversion using anti-nucleoprotein antibody. Positive swabs from a household member (either participant or index case) were sequenced to identify the SARS-CoV-2 variant.

A Bayesian hierarchical logistic regression model was used to model the probability of developing COVID-19 based upon antibody and pseudoneutralization titres.

Results

282 household contacts from 200 households participated; of whom 134 (48%) developed COVID-19.

Table 1. Characteristics of enrolled household contacts.

	Did not develop COVID (n=148)	Developed COVID (n=134)
Age (IQR)	44.82 [40.67, 51.31]	41.91 [37.53, 48.87]
Male Sex	68 (45.9)	72 (53.7)
Prior COVID (%)	8 (5.4)	3 (2.2)
Received only mRNA Vaccines (%)	96 (64.9)	94 (70.1)
Relationship to Index (%)		
Partner	34 (23.0)	27 (20.1)
Parent	104 (70.3)	100 (74.6)
Other	10 (6.8)	7 (5.2)
Used Mitigation Strategies (%)	97 (65.5)	51 (38.1)
Work		
Not Working	10 (6.8)	24 (17.9)
Work at Home	72 (48.6)	58 (43.3)
Work in Office	16 (10.8)	14 (10.4)
Work in Healthcare	24 (16.2)	22 (16.4)
Other	26 (17.6)	16 (11.9)
Comorbidities*		
Diabetes	5 (3.4)	1 (0.7)
Cardiac	1 (0.7)	6 (4.5)
Respirology	2 (1.4)	3 (2.2)
Active Malignancy	6 (4.1)	0 (0.0)

* No participant had renal disease, liver disease or hematologic disease

Figure 1 – Boxplots of anti-Receptor Binding Domain (RBD) and anti-Spike IgG antibody titres at enrolment by whether the household member contracted COVID-19

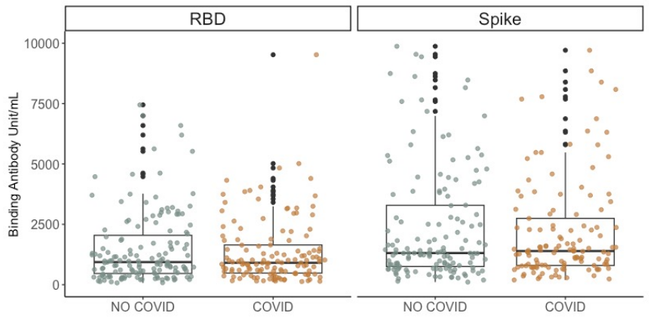
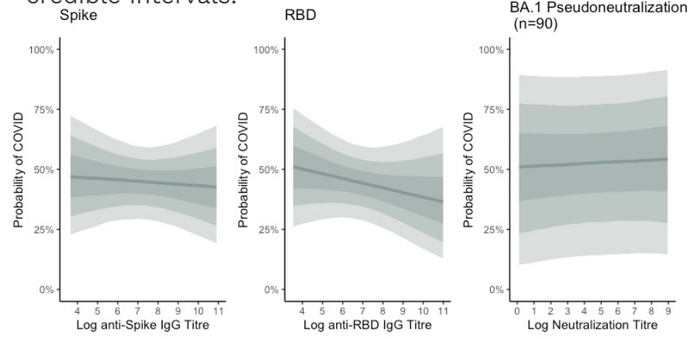


Figure 2. Probability of adult household contact developing COVID-19 based on IgG antibody titre. Shaded areas represent credible intervals.



The differences in the odds ratios of COVID-19 between the 75th and 25th quantiles were 0.99 (0.92-1.07) for anti-Spike, 0.98 (0.91-1.05) for anti-RBD and 1.01 (0.93-1.09) for BA.1 pseudoneutralization.

Conclusions

Vaccine derived anti-Spike and anti-RBD IgG and BA.1 pseudoneutralization titres of exposed, asymptomatic household contacts do not correlate with protection. This could be due to measuring titers against incorrect antibodies, the nonexistence of humoral correlates of protection, rapid rise in antibody titres after exposure, or changes in behaviour due to known exposure. Measurement of neutralization titers and IgA antibodies are being explored.

References

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