Seroconversion and pseudo-neutralization in a cohort of food and retail workers in the Québec City region

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Introduction

The development of portable and rapid detection technologies has become essential to evaluate immunity. This study focussed on the understudied population of front-line workers in food and retail services. Serological assays monitored seroconversion to SARS-CoV-2 induced by vaccination or infection. In parallel to an in-house ELISA assay, we developed a portable surface plasmon resonance (SPR) platform for affinity and rapid pseudo-neutralization tests against SARS-CoV-2 variants.

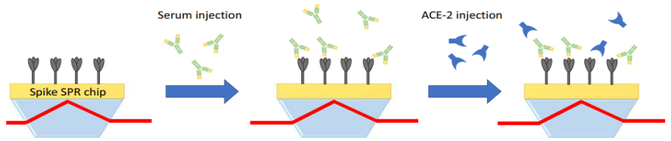
Objectives

- Investigate seroconversion and pseudo-neutralisation in a population of 300 front-line workers from the Québec city region throughout various phases of the pandemic.
- Monitor and compare natural and vaccine-induced seroconversion over time.

Methods

Blood samples were collected over an 18-month period (April 2021- September 2022) from 300 participants in the Québec City region. Colorimetric ELISA was performed to detect IgG against ancestral and omicron spike, and nucleocapsid antigens. Pseudoneutralisation used SPR sensors bearing spike protein where sample addition was followed by competitive addition of recombinant human ACE-2 **(Figure 1)**.

Figure 1. Schematic illustration of the principle of the SPR pseudo-neutralization assay to quantify the inhibition of the interaction between spike protein and ACE-2 in the presence of SARS-CoV-2-positive sera.



Results

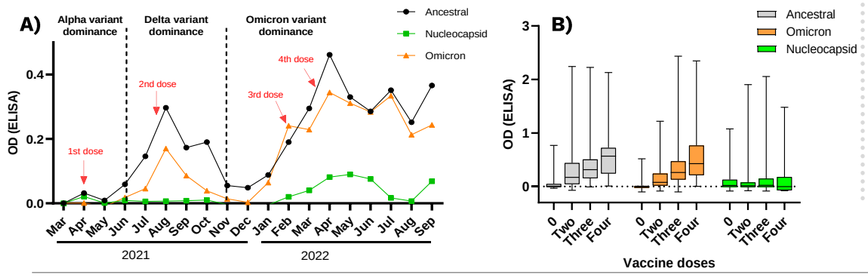
A) ELISA

Table 1. Comparison of vaccine and natural seroprevalence in vaccinated participants between two different analysis sites (UdeM: in-house ELISA and Ottawa: automated ELISA).

	Visit 1		Visit 2		Visit 3		Visit 4		Visit 5	
Sites	UdeM	Ottawa	UdeM	Ottawa	UdeM	Ottawa	UdeM	Ottawa	UdeM	Ottawa
Total samples	304	304	296	296	289	288	194	198	194	194
Vaccine Immunity [1]	77%	79%	60%	93%	85%	92%	94%	98%	93%	99%
Natural immunity [2]	22%	9%	10%	8%	34%	16%	60%	52%	43%	59%

[1] Defined by the combination of anti-S and anti-RBD positives (Ottawa) and anti-S positives (UdeM)
[2] Defined by the combination of anti-N and anti-RBD positives (Ottawa) and anti-N positives (UdeM)

Figure 2. (A) Longitudinal assessment of antibody levels during pandemic development and **(B)** the impact of booster doses in vaccinated participants, using an in-house ELISA protocol. Samples were tested against ancestral spike (grey), omicron spike (orange) and nucleocapsid (green). Red arrows show periods during which participants received their different vaccine doses (1st dose: n= 290, 2nd dose: n= 283, 3rd dose: n= 152 and 4th dose: n= 28).



B) Pseudo-neutralization by SPR

Figure 3. Measurement of the neutralizing capacity of antibodies produced in vaccinated individuals using portable SPR. Samples were collected during different waves of the pandemic and were tested against the ancestral spike antigen (total samples included: n= 929).

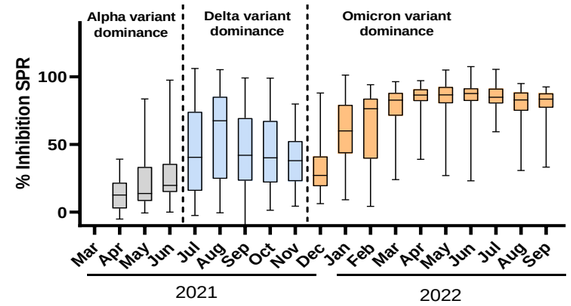
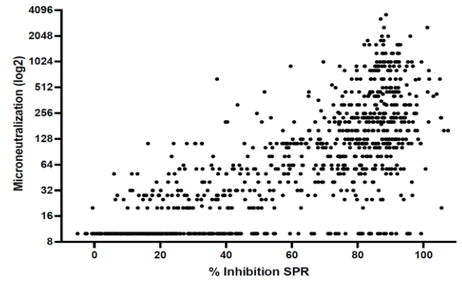


Figure 4. Cross-validation assays between the micro-neutralisation results (y-axis) and pseudo-neutralisation results (x-axis). Samples were tested against ancestral spike antigen (total samples included: n= 929). The Pearson correlation coefficient was 0.74, showing collinearity of the data.



Conclusions

- Seroconversion in this cohort of front-line food and retail workers correlated with vaccination status and with infection. In house ELISA signal was weaker against omicron than ancestral spike antigen, as expected.
- Our SPR method is a reliable alternative to the micro-neutralisation assay with the extra advantages of being portable, allowing a real-time monitoring and requiring a lower biosecurity level to operate.

References

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