Epidemiological impact of generalized SARS-COV-2 vaccination of children aged 5 to 11

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BACKGROUND

SARS-COV-2 vaccination has been one of the cornerstones of the global strategy to reduce the burden of the COVID-19 pandemic. With over 80% protection against severe forms of COVID-19 and over 80% vaccination coverage in France, SARS-COV-2 vaccination has likely reduced the hospital and mortality burden of COVID-19. However, because children aged 5 to 11 do not contribute substantially to overall mortality and hospitalization, and because SARS-COV-2 vaccines do not offer a strong protection against transmission, it is unclear whether generalized vaccination of this age group would have any significant impact.

METHOD

We used a previously published epidemiological model that was calibrated and validated for the French setting[1].

The model is a **stochastic agent-based model** that includes:

- A realistic synthetic population generated with demographic characteristics, comorbidities and household structure representative of the French population

- Social contacts among the individuals in the population including intrafamilial, school or work, friends or extended family members (at home or at bars and restaurants), grocery shopping, public transport and cultural activities. Evolution of social contact rates, and protective behaviors were based on Google ™ Mobility data and the COVIPREV study[2], and national restrictions

- a SARS-COV-2 disease model, which translates the social contacts into infection probability, and simulates the patient's pathway from infection to recovery[3]. The risk of contamination is calibrated on the hospitalization rates observed in France while the asymptomatic rate is calibrated on the seroprevalence.

Compared to the 2020 publication[1], the risk of contamination and the percentage of asymptomatic patients was updated to take into accounts seroprevalence results in France[4]. In addition, vaccination[5] and variants[6] were added into the model. Vaccination and natural immunity duration were based on observed data in France.

METHOD

The model was used to compare the epidemiological results of two scenarios, with and without vaccination of children 5-11. The results were estimated for December 2021 to March 2022 as this period match the beginning of children vaccination.

In the scenario with, we assumed that 80% of children 5-11 would be vaccinated, starting December 22, 2021, when the vaccines were authorized, at a similar pace then adult vaccination. We compared hospital and ICU admission, and mortality rates for the full population and for 5-11.

RESULTS

For the whole population, the model estimated that between December 2021 and March 2022, without 5-11 vaccination, hospitalization would have decrease by 1,100 (800-1,300), ICU admissions increase by 100 (100-200) and death increase by 400 (300-400) increases.

For the 5-11 population, hospital admission would have increase by 470 (460-480), ICU admission by 80 (80-90) with no impact on mortality

Figure 2. Comparison of the model-estimated and observed hospitalization, ICU admission and hospital mortality in France
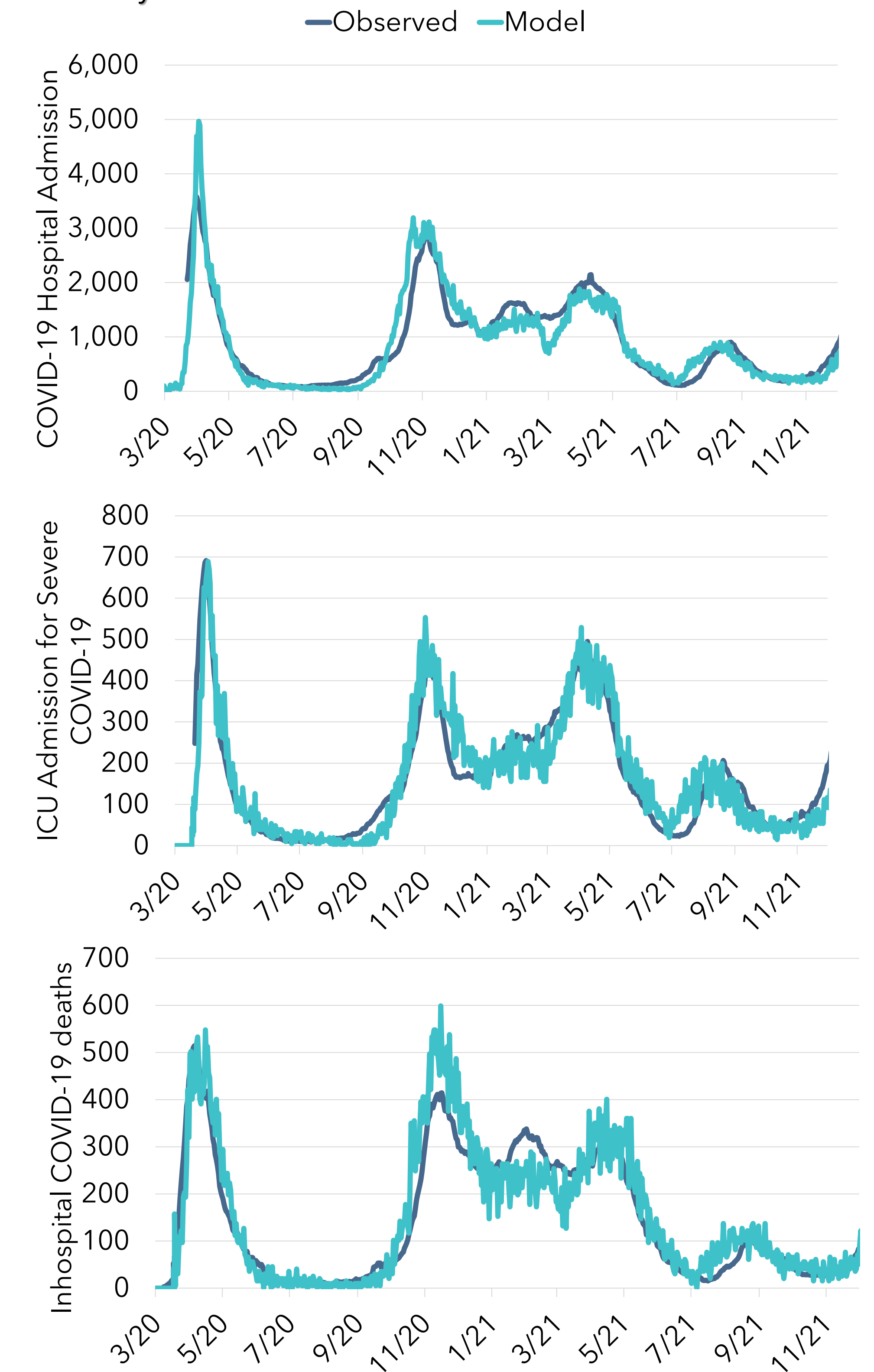
Table 1. Comparisons epidemiological results with and without of France for the whole population between December 2021 and March 2022

	With	Without	Difference
Hospital Admissions	101.1 (69.0-133.2)	133.2 (70.0-130.1)	1.1 (0.8-1.3)
ICU Admissions	12.5 (6.1-18.8)	18.8 (6.2-18.9)	-0.1 (-0.2--0.1)
Hospitals occupation (beds-day)	1719.0 (1403.0-2035.0)	2035.0 (1431.7-2022.1)	-7.9 (-10.3--5.6)
ICU occupation (beds-day)	211.0 (150.5-271.6)	271.6 (153.7-275.9)	-3.8 (-4.3--3.3)
Deaths	18.9 (11.0-26.9)	26.9 (11.0-26.2)	0.4 (0.3-0.4)

Table 1. Comparisons epidemiological results with and without of France for the 5-11 between December 2021 and March 2022

	With	Without	Difference
Hospital Admissions	0.6 (-0.2-1.5)	1.5 (-0.1-0.4)	0.5 (0.5-0.5)
ICU Admissions	0.1 (-0.1-0.3)	0.3 (0.0-0.1)	0.1 (0.1-0.1)
Hospitals occupation (beds-day)	14.8 (7.3-22.3)	22.3 (0.9-7.4)	10.7 (10.6-10.7)
ICU occupation (beds-day)	2.1 (-0.3-4.6)	4.6 (-0.3-1.1)	1.7 (1.7-1.7)
Deaths	0.0 (0.0-0.0)	0.0 (0.0-0.0)	0.0 (0.0-0.0)

CONCLUSION

While vaccinated children between 5-11 was associated with a reduction of the COVID-19 epidemiological burden, the overall effect was very modest for the whole population when considering that they were over 7,000 hospitalizations a week in early December 2021 weakening the argument that 5-11 substantially contributed to infection.

For 5-11 the average benefit was greater but was still modest overall given the small risk in this population.

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