Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Serology-informed estimates of SARS-CoV-2 infection fatality risk in Geneva, Switzerland

	Population	Seroconverted population as of May 6 (95% CrI)	Deaths as of June 1	IFR (95% CrI), %
5–9 years	26 466	1200 (400–2400)	0	0·0016 (0 to 0·019)
10–19 years	53 180	6100 (3900–8800)	0	0·00032 (0 to 0·0033)
20–49 years	219 440	28 800 (21 400–37 300)	2	0·0092 (0·0042 to 0·016)
50–64 years	98 528	10 300 (7200–13 900)	16	0·14 (0·096 to 0·19)
≥65 years	83 574*	5700 (3200–8800)	268	5·6 (4·3 to 7·4)
All	506 765	54 800 (41 300–70 700)	286	0·64 (0·38 to 0·98)

CrI=credible interval. IFR=infection fatality risk. SARS-CoV-2=severe acute respiratory syndrome coronavirus 2.
*Of whom approximately 4065 (4·9%) live in assisted care facilities.

Table: **Age-stratified estimates of the IFR of SARS-CoV-2 in the canton of Geneva, Switzerland**

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The infection fatality risk (IFR) is the average number of deaths per infection by a pathogen and is key to characterising the severity of infection across the population and for specific demographic groups. To date, few empirical estimates of the IFR for severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) have been published owing to challenges in measuring infection rates.[1,2] Outside of closed, closely observed populations where infection rates can be monitored through viral surveillance, we must rely on indirect measures of infection, such as antibodies. Representative seroprevalence studies provide an important opportunity to estimate the number of infections in a community, and when combined with death counts can lead to robust estimates of the IFR.

We estimated overall and age-specific IFRs for the canton of Geneva, Switzerland, using age-stratified daily case and death incidence reports combined with population-based seroprevalence estimates done each week for 5 consecutive weeks (table).[3] From Feb 24, to June 2, 2020, there were 5039 confirmed cases of COVID-19 and 286 reported deaths within Geneva (population of 506 765). We inferred age-stratified (5–9 years, 10–19 years, 20–49 years, 50–64 years, and ≥65 years) IFRs by linking the observed number of deaths to the estimated number of infected individuals from each serosurvey. We account for the delays between infection and seroconversion, as well as between infection and death (including deaths that had not yet been observed at the time of the analyses).[4] Inference is drawn in a Bayesian framework that incorporates uncertainty in seroprevalence estimates (appendix p 3).

Of the 286 reported deaths caused by SARS-CoV-2, the youngest person to die was 31 years old. Infected individuals aged 20–49 years had an IFR of 0·0092% (95% credible interval 0·0042–0·016; one in 10 870 risk of death), with the IFR increasing to 0·14% (0·096–0·19) for those aged 50–64 years and to 5·6% (4·3–7·4) for those aged 65 years and older. After accounting for demography and age-specific seroprevalence, we estimated a population-wide IFR of 0·64% (0·38–0·98; table).

Our results are subject to two notable limitations. Of 268 individuals aged 65 years and older who died, 134 (50%) were residents of assisted care facilities, where around 0·8% of the Geneva population resides. Although the serosurvey protocol did not explicitly exclude these individuals, they are likely to have been absent or severely under-represented. This under-representation would lead to an overestimation of the IFR in the 65 years and older age group if seroprevalence in this institutionalised population was higher than in the general population of the same age (appendix p 6). Furthermore, our IFR estimates are based on existing evidence regarding post-infection antibody kinetics, which might differ between severe and mild infections. If mild infections have substantially lower and short-lived antibody responses, our estimates of the IFR might be biased upwards.[5]

Estimates of the IFR are key to understanding the true pandemic burden and for comparing different risk-reduction strategies. The IFR is not solely determined by host and pathogen biology, but also by the capacity of health systems to treat severe cases. Despite having among the highest per-capita incidence of confirmed COVID-19 in Switzerland, Geneva's health system, with additional COVID-19 surge capacity, accommodated the influx of cases needing intensive care (peak of 80 of 110 surge capacity intensive care unit beds were in use at one time) while maintaining care quality standards. As such, our IFR estimates can be seen as a best-case scenario with respect to health system capacity. Our results reveal that population-wide estimates of IFR mask great heterogeneity by age and point towards the importance of age-targeted interventions to reduce exposures among those at highest risk of death.

See **Online** for appendix

We declare no competing interests. SS and ASA are co-senior authors. The code and data needed to reproduce analyses are available at https://github.com/HopkinsIDD/sarscov2-ifr-gva.

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