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## Long COVID in children

In their Article, Erika Molteni and colleagues<sup>1</sup> reported that 1.8% (25 of 1379) children testing positive for SARS-CoV-2 have symptoms beyond 56 days. Given important methodological limitations, we believe their results are probably an underestimate. In addition to limitations already highlighted by the authors, including the lack of representativeness of Zoe application (app) users,<sup>1</sup> and the effect of response biases (only 25% of cases had data logged),<sup>1,2</sup> we discuss three other key limitations.

First, only a limited number of symptoms reported in long COVID were assessed,<sup>1</sup> with other symptoms only captured if parents entered them as free text. Given that logging of symptoms regularly is laborious, this is likely to underestimate persisting symptoms for longer periods of time. Some important symptoms, such as brain fog and low mood, were added to the list only later in the study, and not included in the main illness profile analysis, despite brain fog being reported in 11.3% (105 of 932) and low mood being reported in 15.6% (145 of 932) of older children (age 12–17 years).<sup>1</sup>

Second, the study did not adequately account for the well-known relapsing and remitting nature of long COVID.<sup>3</sup> Children with any gap in symptoms longer than 1 week were excluded,<sup>1</sup> so children whose symptoms temporarily resolved for more than a week and then recurred, were not counted.<sup>1</sup>

Third, the duration estimates for long COVID are based on parents either reporting their child as asymptomatic with no symptoms for a week, or the last symptomatic report if parents stopped using the app.<sup>1</sup> Use of cessation of proxy-logged symptom data to signal resolution is unlikely to be valid. The drop off in reporting for many parents could instead be related to ongoing illness in children and the demands of managing the needs of the

child. Incomplete reporting was higher for children with confirmed infection (10.6%) than in children who had tested negative (3.5%).<sup>1</sup> A much higher proportion ceased logging symptoms while still having ongoing symptoms (28.6% among those reporting symptoms for  $\geq 28$  days compared with 9.7% for those reporting symptoms for  $< 28$  days). This assumption of cessation of logging affects both the duration and prevalence estimates of long COVID. Given these data are probably missing not at random, excluding them (as in the authors' sensitivity analysis) is also biased, underestimating the symptom duration.

Collectively, these factors all introduce bias in a single direction, namely, to underestimate the incidence and duration of long COVID. Given all factors, this underestimation might be substantial, which could partly explain why Molteni and colleagues' estimates are at least 7 times lower than those of a recently published prospective large-scale study that allowed for remitting and relapsing symptoms, with follow-up at 3 months,<sup>4</sup> but similar to other studies that were limited in systematic assessment of common symptoms of long COVID (appendix).<sup>5–7</sup>

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See Online for appendix