Supporting Information

Supplementary methods and results

This appendix was part of the submitted manuscript and has been peer reviewed. It is posted as supplied by the authors.

Appendix to: Costantino V, Grafton Q, Kompas T, et al. The public health and economic burden of long COVID in Australia, 2022–24: a modelling study. *Med J Aust* 2024; doi: 10.5694/mja2.52400.

1. Estimation of incidence of SARS-CoV-2 infections

Data from a serological survey of Australian blood donors were available at four time points for adults (23 February – 3 March 2022; 9–18 June 2022; 23 August – 2 September 2022; 29 November – 13 December 2022)[1] and a single time point for children (8 June – 31 August 2022).[2] Most people in Australia had received two coronavirus disease 2019 (COVID-19) vaccine doses by September 2021, and the peak of the first severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) Omicron variant infection wave was in January 2022.[3] We used seroprevalence data[1] based on the testing of blood specimens from all Australian states and territories for two types of antibody to SARS-CoV-2 using commercial Roche assays. The presence of anti-spike antibodies indicates exposure to vaccination or natural infection; that of anti-nucleocapsid protein antibodies specifically indicates infection with SARS-CoV-2, because the vaccines used in Australia do not generate this antibody. As for children and adolescents (0–19 years) we had specific seroprevalence data for only one time point, we estimated the values for the three missed time points on the basis of relative changes in seropositivity for adults. Age-specific seroprevalence (by month) was estimated by interpolating values between the four time point values for each age group (Table 1), using the MATLAB function *interpol1*, which derives interpolated values of a 1-D function using linear interpolation.

Table 1. Data used for estimating cumulative seropositivity over time[1,2] (main manuscript, Box 1)

Age group	Population	March 2022	June 2022	September 2022	December 2022
0-19	6,095,818	963,139 (15.8%)	2,743,118 (45.0%)	3,901,324 (64.0%)	4,236,594 (69.5%)
20-29	3,351,223	911,533 (27.2%)	2,067,705 (61.7%)	2,670,925 (79.7%)	2,788,218 (83.2%)
30-39	3,691,904	801,143 (21.7%)	1,941,942 (52.6%)	2,676,630 (72.5%)	2,816,923 (76.3%)
40-49	3,284,795	528,852 (16.1%)	1,560,278 (47.5%)	2,243,515 (68.3%)	2,499,729 (76.1%)
50-59	3,152,854	375,190 (11.9%)	1,226,460 (38.9%)	1,986,298 (63.0%)	2,106,106 (66.8%)
60-69	2,766,566	229,625 (8.3%)	835,503 (30.2%)	1,361,150 (49.2%)	1,657,173 (59.9%)
70+	3,079,629	197,096 (6.4%)	791,465 (25.7%)	1,281,126 (41.6%)	1,582,929 (51.4%)
Total	25,422,789	4,321,874 (17.0%)	11,745,329 (46.2%)	16,575,658 (65.2%)	17,999,335 (70.8%)

2. Long COVID: age-specific rates over time

The definition of long COVID differs between WHO, CDC, and other public health entities[4-6] with respect to symptoms included and duration of persistence. Estimates of long COVID prevalence consequently vary widely in the literature.

The prevalence of long COVID (assessed at differing times after infection) is estimated to be 15–30% in adults aged 18–64 years old and 26.6-45.4% in adults aged 65 years and over.[7-39] The prevalence of long COVID in children and adolescents (0-17 years) is estimated to be 4-66% 4 or more weeks after COVID-19.[20,40-54] Varying lengths of recovery time further complicate the long COVID trajectory; one study reported that after 18 months 6% of people had not recovered, and that 42% had partially recovered.[11]

People with long COVID symptoms experience impairment in their ability to conduct normal day-to-day activities.[55,56] Specifically, rapid physical exhaustion, neurocognitive impairment, memory disturbance, loss of executive function, and concentration difficulties may result in impairment of ability to work.[57] One study found that 44.3% of respondents reported that they had not recovered to their full pre-COVID-19 working capacity 6-12 months after infection.[57] In the USA it is estimated that between 2 and 4 million people were out of work because of long COVID in 2021, 15% of the workforce shortage.[58] Another study identified that people who are able to return to work are frequently returning to work with reduced hours or responsibilities.[59]

To estimate the age-specific proportion of people suffering from long COVID symptoms, we collected data from studies focused on children, adolescents, or adults.[6,8,11,12,54] If a study compared cases with controls, prevalence was calculated to estimate the difference (cases minus controls). This method was used for symptoms lasting up to 3 months. For symptoms lasting up to 12 months, we used the estimated proportion of people who had no recovery at 12 months and subtracted this from the baseline prevalence.[11]

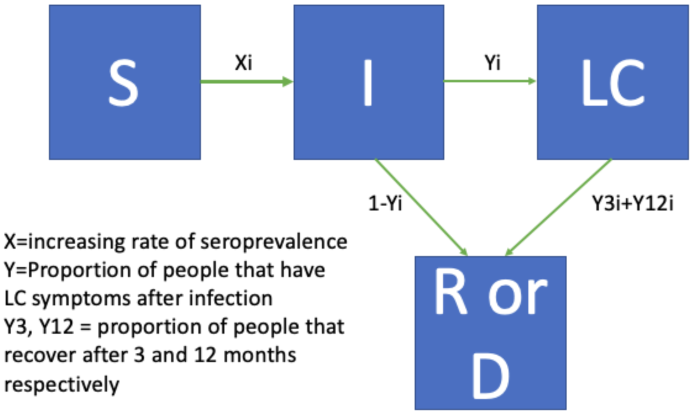
As long COVID rates differed between studies (4.7% to 80%), we conducted a sensitivity analysis using low and high estimates of long COVID.[8,11,12,25,38,48,54] The high estimates come from studies reporting recovery after 3 and 12 months and proportions who never recover.[11,54] For the low estimate, we used the rates from a study conducted by the Australian National University, for symptoms up to 3 months after infection (Table 2).[11)]

Table 2. Age-specific rates of long COVID lasting up to 3 months, 12 months, and never recovered for the low and high ranges rates before the weighted calculation with the inclusion of asymptomatic infections

Age groups	Symptoms up to 3 months	Symptoms up to 12 months	Never recovered (>12 months)
High range long COVID rates			
0-4	12.8%[54]	6.14%[11,54]	3%
5-9	4.4%[54]	2.11%[11,54]	1%
10-19	4.7%[54]	2.26%[11,54]	1%
20-59	20.8%[6]	9.98%[8,11]	6%[11]
60+	26.9%[6]	12.91%[8,11]	6%[11]
Low range long COVID rates			
0-4	3.29%[12]	1.58%	0.79%
5-9	1.13%[12]	0.54%	0.27%
10-19	1.21%[12]	0.58%	0.29%
20-29	3.8%[12]	1.82%	0.91%
30-39	7.4%[12]	3.55%	1.77%
40-49	5.4%[12]	2.59%	1.3%
50-59	4.8%[12]	2.3%	1.15%
60-69	4.4%[12]	2.11%	1.05%
70+	2.6%[12]	1.25%	0.62%

To estimate the long COVID prevalence over time we used an adjusted SEIR model.

Figure 1. SEIR model diagram with susceptible (S), infected (I), with long-COVID symptoms (LC), and recovered or dead (R or D), while every compartment is age-specific following *i*=1,…,9 age groups and the time *t* is in months



The S compartment includes people who had never had SARS-CoV-2 during 2022. To inform this compartment we used the age-specific population for Australia in 2020-2021.[60] The infected (I) compartment includes people who had at least one SARS-CoV-2 infection during 2022 (seroconverted), and this compartment and the rate of people passing from being susceptible (S) to I, have been estimated by interpolating values from the serosurvey surveillance (Table 1). After infection, people may develop long-COVID (LC), recover (R), or die (D). Recovery from LC may be partial or complete. Rates of long COVID used are shown in the previous paragraph. Each of the compartments is age specific (i), with the population divided into nine age groups: 0-4, 5-9, 10-19, 20-29, 30-39, 40-49, 50-59, 60-69 and 70 years or older.

3a. Impact of loss of labour supply on GDP

The approach we use to estimate the reduction in labour supply is formalised in equation (1). This equation specifies that the reduction in labour supply is estimated by aggregating the loss caused by long COVID in the labour force across working age groups and across types of severity. In equation (1), Δlab is the reduction in the labour supply; POP_a and μ_a are the population and the participation rate in labour force in age group a; LC_a is the rate of long COVID cases in age group a in a given period (eg, the year 2022); subscript r is the index of three levels of severity of long COVID (i.e., normal recovery, partial recovery within 6 months, non-recovery within 6 months); $W_{a,r}$ is the number of working weeks (or hours) lost for each recovery type; and $\gamma_{a,r}$ is the share of normal recovery, partial recovery, and non-recovery types of long COVID cases.

$$\Delta lab = \sum_a POP_a \times \mu_a \times LC_a \sum_r W_{a,r}\gamma_{a.r} \quad (1)$$

The productivity loss in contribution of labour to GDP is estimated using equation (2). This equation specifies that the loss of contribution of labour to GDP is estimated by the fraction of the labour loss caused by long COVID in the total contribution to labour to GDP. In equation (2), θ^{labor} is the share of labour contribution to GDP; T_a is the mean labour supply (in worked weeks or hours) by one employed person in age group a .

$$LOSS^{labor} = GDP \times \theta^{labor} \times \frac{\Delta lab}{\sum_a POP_a \mu_a T_a} \quad (2)$$

3b. Loss to GDP, including non-labour production factors

To estimate the loss of GDP, we undertook an input-output (IO) analysis, using the input-output data published by the Australian Bureau of Statistics with 114 aggregate sectors of Australia's economy. The IO data indicate how much input is required per unit of output in each of the 114 sectors. The inputs required by each sector include the output of other sectors (intermediate inputs), imported inputs, capital, and labour. The output of each sector can be used as inputs for other sectors (intermediate inputs) and for the final demand, including private and public consumption, investment, and export.

The IO flows of the economy are formalised in equations (3)-(7). Equation (3) illustrates the basic accounting principle that the supply of each sector $i \in [1..114]$ is equal to the demand, including intermediate inputs from other sectors and final demand. In this equation, $z_{i,j}$ are the technical coefficients that are the input requirements from sector i per unit of output of sector j, which can be estimated from real-life data; D is the total final demand, and d_i is the proportion of the final demand for the output of sector i in the total demand.

Equation (4) formalises the constraint in terms of labour supply in paid employment in the economy. This equation specifies that the labour requirements for labour from all sectors is constrained by the total labour supply. In equation (4), $z_{lab,j}$ are the technical coefficients of the labour requirements per unit of output of sector j , which are estimated from actual economic data.

Equations (5)-(7) specify the income of capital, government tax revenue, and demand for imports respectively. In these equations, $z_{cap,j}$ and $z_{im,j}$ are the requirement for capital and imported inputs per unit of output in sector j; $z_{tax,j}$ is the tax per unit of output in sector j . Given all technical coefficients z which can be calibrated from data, equation (8) defines GDP using the income approach given the constraint in labour supply; ie, the sum of the income of labour, capital, and government.

$$X_i = \sum_j z_{i,j} X_j + D \times d_i \ \forall i = 1..114, \forall j = 1..114 \quad (3)$$

$$\sum_j z_{lab,j} X_j = \bar{L}, \forall j = 1..114 \quad (4)$$

$$\sum_j z_{cap,j} X_j = K, \forall j = 1..114 \quad (5)$$

$$\sum_j z_{im,j} X_j + z_{im,D} D = I, \forall j = 1..114 \quad (6)$$

$$\sum_j z_{tax,j} X_j = G, \forall j = 1..114 \quad (7)$$

$$GDP(\bar{L}|z) = \sum_j z_{lab,j} X_j + \sum_j z_{cap,j} X_j + \sum_j z_{cap,j} X_j \, , \forall j = 1..114 \quad (8)$$

The loss in real GDP caused by long-COVID is estimated in equation (9). The loss in real GDP is defined as the difference in the GDP with a normal level of labour supply and the GDP with reduced labour supply, given all other factors remaining unchanged.

$$LOSS^{GDP} = GDP(\sum_a POP_a \mu_a T_a \, |z) - GDP(\sum_a P \sum_a POP_a \mu_a T_a - \Delta lab|z) \quad (9)$$

We parameterise equations (1)-(9) using data from various sources. We specify the working age to be in six age groups, noting that labour force participation rate in each cohort is used to determine actual labour supply in paid employment, namely a = [10-19, 20-29, 30-39, 40-49, 50-59, 60-69]

The population and the estimated ranges for the numbers of long COVID cases, and the labour force participation rate and mean number of working weeks per year, are reported by age group in Table 3.

Table 3. The age distribution of model parameters for the calculation of the economic loss*

Age group	Population (millions)†	Labour force participation rate‡	Normal workload (weeks per employee per year)§	Long COVID cases, range (thousands)¶	Long COVID case rate, range (per 100 pop.)**	Labour loss per employed person with normal recovery (weeks)††	Labour loss per employed person with slow recovery (weeks)††	Labour loss per employed person with non-recovery after 6 months (weeks)††
10-19	3.1	21.5%	23.1	9.8-38.4	0.3-1.2	1	2.3	11.6
20-29	3.4	76.3%	40.1	39.4-216.5	1.1-6.3	1	4.0	20.1
30-39	3.8	80.7%	43.1	78.2-220.2	2.1-5.8	1	4.3	21.6
40-49	3.3	81.9%	44.1	51.6-204.7	1.6-6.2	1	4.4	22.1
50-59	3.2	75.5%	43.4	38.2-165.7	1.2-5.2	1	4.3	21.7
60-69	2.7	51.9%	36.7	30.6-186.9	1.1-6.8	1	3.7	18.4

* Numbers are rounded to one decimal place.

† Population data are for 2021 and extracted from the Australian Bureau of Statistics.[61]

‡ Participation rates in the labour force are for 2020-21 financial year and calculated by the number of employed people (full-time and part-time) per 100 population.[62]

§ Annual worked time per employed worker is for the 2020-21 financial year and calculated from total worked hours, assuming 40 hours per working week.[62]

¶ The range of long COVID case numbers is extracted from the epidemiological SEIR compartment model.

** The population rate of long COVID is calculated from the estimated number of cases per 100 people.

†† This approach uses recovery time to derive the loss in labour supply rather than the severity of symptoms. A non-recovery long COVID case would cause a loss of six months (i.e., 50% the normal worked hours in one year in column 4), a slow recovery long COVID case would cause a loss of 20% of a non-recovery case (i.e., work at 80% of full capacity for six months) or 10% of the normal worked hours in one year in column 4, and a normal recovery long COVID case would cause a loss of one working week.

4. Supplementary results

Table 4. Number of people with long COVID symptoms by month and three age groups, 0-4 (unvaccinated), 5-19 (partially vaccinated), and 20+ (mostly vaccinated), for low and high estimated rates

	Age group (years)			
Month	**0-4**	**5-19**	**20+**	**Total**
2022				
January	0-0	0-0	5806-26250	5806-26250
February	2246-8729	2554-9925	46369-182060	51169-200714
March	5296-20584	6022-23406	108281-458480	119599-502470
April	8481-32961	9643-37479	167383-722200	185507-792640
May	10543-40980	11975-46606	209436-923350	231954-1010936
June	12517-48658	14201-55348	241133-1066060	267851-1170066
July	12885-50090	14600-56991	243973-1129140	271458-1236221
August	13570-52758	15360-60036	267363-1194150	296293-1306944
September	14142-54988	15991-62587	280208-1257230	310341-1374805
October	13819-53737	15613-61172	272185-1230730	301620-1345639
November	13384-52049	15105-59262	263394-1200710	291880-1312021
December	12898-50166	14539-57131	255374-1174190	282810-1281487
2023				
January	13209-51376	14889-58509	260532-1204260	288630-1314145
February	12959-50348	14617-57162	256607-1205970	284180-1313480
March	12484-48427	14096-54736	247510-1179250	274090-1282413
April	11974-46368	13537-52143	238414-1152550	263930-1251061
May	11491-44411	13008-49669	229062-1124450	253560-1218530
June	10912-42077	12372-46741	219966-1097720	243250-1186538
July	10731-41326	12176-45737	215645-1088220	238550-1175283
August	10489-40332	11915-44432	210926-1076940	233330-1161704
September	10221-39237	11623-43010	206605-1067440	228450-1149687
October	10377-39827	11800-43635	207355-1076140	229530-1159602
November	10541-40450	11989-44295	207354-1081720	229880-1166465
December	10696-41040	12166-44920	205203-1074050	228060-1160010
2024				
January	10248-39285	11657-42879	196845-1028860	218750-1111024
February	9775-37433	11121-40725	189185-986650	210080-1064808
March	9327-35678	10613-38683	182241-949360	202180-1023721
April	9172-35059	10441-37931	178929-932550	198540-1005540
May	9008-34406	10259-37137	175752-916370	195020-987913
June	8852-33786	10087-36385	172438-899570	191380-969741
July	8697-33167	9915-35632	169126-882780	187740-951579
August	8533-32514	9732-34838	165949-866570	184210-933922
September	8377-31894	9560-34086	162635-849780	180570-915760
October	8222-31275	9388-33334	159945-835040	177550-899649
November	8058-30622	9206-32540	157535-821400	174800-884562
December	7902-30002	9034-31787	155590-811010	172530-872799

References

1 Kirby Institute. Serosurveillance for SARS-CoV-2 infection to inform public health responses. Kensington: Kirby Institute, 2022. https://kirby.unsw.edu.au/project/serosurveillance-sars-cov-2-infection-inform-public-health-responses (viewed Nov 2022).

2 Paediatric Active Enhanced Disease Surveillance. Paediatric SARS-CoV-2 serosurvey 2022, Australia - Summary report. Sydney: Paediatric Active Enhanced Disease Surveillance, 2022. https://paeds.org.au/sites/default/files/2022-11/PAEDS%20NCIRS_COVID-19%20Paediatric%20Serosurvey%202022%20Report_3-11-2022_Final_1.pdf (viewed Nov 2022).

3. Department of Health and Aged Care. National Notifiable Disease Surveillance System – National Communicable Disease Surveillance Dashboard. Canberra: Department of Health and Aged Care, 2024. https://nindss.health.gov.au/pbi-dashboard/ (viewed Nov 2022).

4. World Health Organization. Post COVID-19 condition (Long COVID). Geneva: World Health Organization, 2022. https://www.who.int/europe/news-room/fact-sheets/item/post-covid-19-condition#:~:text=It%20is%20defined%20as%20the,months%20with%20no%20other%20explanation (viewed Nov 2023).

5. Centers for Disease Control and Prevention. Long COVID or post-COVID conditions. Atlanta: Centers for Disease Control and Prevention, 2023. https://www.cdc.gov/coronavirus/2019-ncov/long-term-effects/index.html#:~:text=Long%20COVID%20is%20broadly%20defined,after%20acute%20COVID%2D19%20infection (viewed Nov 2023).

6. National Institute for Health and Care Excellence. COVID-19 rapid guideline: managing the longterm effects of COVID-19. London: National Institute for Health and Care Excellence, 2022. https://www.nice.org.uk/guidance/ng188/resources/covid19-rapid-guideline-managing-the-longterm-effects-of-covid19-pdf-66142028400325 (viewed November 2023).

7. Perlis H, Santillana M, Ognyanova K, et al. Prevalence and correlates of long COVID symptoms among US adults. *JAMA Netw. Open* 2022; 5: e2238804-e.

8. Bull-Otterson L, Baca S, Saydah S, et al. Post-COVID conditions among adult COVID-19 survivors aged 18-64 and ≥ 65 years - United States, March 2020-November 2021. *MMWR Morb Mortal Wkly* 2022; 71: 713-717.

9. Ayoubkhani D, Khunti K, Nafilyan V, et al. Post-covid syndrome in individuals admitted to hospital with covid-19: retrospective cohort study. *BMJ* 2021; 372: n693.

10. Donnelly JP, Wang XQ, Iwashyna TJ, Prescott HC. Readmission and death after initial hospital discharge among patients with COVID-19 in a large multihospital system. *JAMA* 2021; 325: 304-306.

11. Hastie CE, Lowe DJ, McAuley A, et al. Outcomes among confirmed cases and a matched comparison group in the Long-COVID in Scotland study. *Nat Commun* 2022; 13: 5663.

12. Biddle N, Korda R. The experience of COVID-19 in Australia, including long-COVID: evidence from the COVID-19 Impact Monitoring Survey Series, August 2022. Canberra: Centre for Social Research and Methods, 2022. https://apo.org.au/node/319910 (accessed Nov 2023).

13. Subramanian A, Nirantharakumar K, Hughes S, et al. Symptoms and risk factors for long COVID in non-hospitalized adults. *Nat Med* 2022; 28: 1706-1714.

14. Thompson EJ, Williams DM, Walker Alex J, et al. Long COVID burden and risk factors in 10 UK longitudinal studies and electronic health records. *Nat Commun* 2022; 13: 3528.

15. Rigoni Marta, Torri E, Nollo G, et al. "Long COVID" results after hospitalization for SARS-CoV-2 infection. *Sci Rep* 2022; 12: 9581.

16. Carvalho-Schneider C, Laurent E, Lemaignen A, Beaufils E, et al. Follow-up of adults with noncritical COVID-19 two months after symptom onset. *Clin Microbiol Infect* 2021; 27: 258-263.

17. Carfì A, Bernabei R, Landi F. Persistent symptoms in patients after acute COVID-19. *JAMA* 2020; 324: 603-605.

18. Huang C, Huang L, Wang Y, Li X, et al. 6-month consequences of COVID-19 in patients discharged from hospital: A cohort study. *Lancet* 2021; 397: 220-232.

19. Goërtz YMJ, Van Herck M, Delbressine JM, Vaes AW, et al. Persistent symptoms 3 months after a SARS-CoV-2 infection: the post-COVID-19 syndrome? *ERJ Open Res* 2020; 6: 00542-2020.

20. Blomberg B, Mohn KG-I, Brokstad KA, Zhou F, et al. Long COVID in a prospective cohort of home-isolated patients. *Nat Med* 2021; 27: 1607-1613.

21. Huang Y, Pinto MD, Borelli JL, Asgari Mehrabadi M, et al. COVID symptoms, symptom clusters, and predictors for becoming a long-hauler looking for clarity in the haze of the pandemic. *Clin Nurs Res* 2022; 31: 1390-1408.

22. Global Burden of Disease Long COVID Collaborators. Estimated global proportions of individuals with persistent fatigue, cognitive, and respiratory symptom clusters following symptomatic COVID-19 in 2020 and 2021. *JAMA* 2022; 328: 1604-1615.

23. Ayoubkhani D, Bermingham C, Pouwels KB, Glickman M, et al. Trajectory of long covid symptoms after covid-19 vaccination: community based cohort study. *B*MJ 2022; 377: e069676.

24. Chudzik M, Lewek J, Kapusta J, Banach M, et al. Predictors of long COVID in patients without comorbidities: data from the Polish long-COVID cardiovascular (PoLoCOV-CVD) study. *J Clin Med* 2022; 11: 4980.
25. Cabrera Martimbianco AL, Pacheco RL, Bagattini Â M, Riera R. Frequency, signs and symptoms, and criteria adopted for long COVID-19: a systematic review. *Int J Clin Pract* 2021; 75: e14357.
26. Nasserie T, Hittle M, Goodman SN. Assessment of the frequency and variety of persistent symptoms among patients with COVID-19: a Systematic Review. *JAMA Netw. Open* 2021; 4: e2111417-e.
27. Rass V, Beer R, Schiefecker AJ, Kofler M, et al. Neurological outcome and quality of life 3 months after COVID-19: A prospective observational cohort study. *Eur J Neurol* 2021; 28: 3348-3359.
28. Petersen MS, Kristiansen MF, Hanusson KD, Danielsen ME, et al. Long COVID in the Faroe Islands: a longitudinal study among nonhospitalized patients. *Clin Infect Dis* 2021; 73: e4058-e63.
29. Logue JK, Franko NM, McCulloch DJ, McDonald D, et al. Sequelae in adults at 6 months after COVID-19 infection. *JAMA Netw. Open* 2021; 4: e210830-e.
30. Xiong Q, Xu M, Li J, Liu Y, et al. Clinical sequelae of COVID-19 survivors in Wuhan, China: a single-centre longitudinal study. *Clin Microbiol Infect* 2021; 27: 89-95.
31. Zayet S, Zahra H, Royer PY, Tipirdamaz C, et al. Post-COVID-19 syndrome: nine months after SARS-CoV-2 infection in a cohort of 354 patients: data from the first wave of COVID-19 in Nord Franche-Comté Hospital, France. *Microorganisms* 2021; 9: 1719.
32. Al-Aly Z, Bowe B, Xie Y. Long COVID after breakthrough SARS-CoV-2 infection. *Nat Med* 2022; 28: 1461-1467.
33. Bowe B, Xie Y, Al-Aly Z. Acute and postacute sequelae associated with SARS-CoV-2 reinfection. *Nat Med* 2022; 28: 2398–2405.
34. Peter RS, Nieters A, Kräusslich HG, et al. Post-acute sequelae of covid-19 six to 12 months after infection: population based study. *BMJ* 2022; 379: e071050.
35. Bek LM, Berentschot JC, Heijenbrok-Kal MH, Huijts S, et al. Symptoms persisting after hospitalisation for COVID-19: 12 months interim results of the CO-FLOW study. *ERJ Open Res* 2022; 8: 00355-2022.
36. Whitaker M, Elliott J, Chadeau-Hyam M, Riley S, et al. Persistent COVID-19 symptoms in a community study of 606,434 people in England. *Nat Commun* 2022; 13: 1957.
37. Dryden M, Mudara C, Vika C, Blumberg L, et al. Post-COVID-19 condition 3 months after hospitalisation with SARS-CoV-2 in South Africa: a prospective cohort study. *Lancet Glob Health* 2022; 10: e1247-e56.
38. Chen C, Haupert SR, Zimmermann L, Shi X, et al. Global prevalence of post-Coronavirus Disease 2019 (COVID-19) condition or long COVID: a meta-analysis and systematic review. *J Infect Dis* 2022; 226: 1593-1607.
39. Robineau O, Zins M, Touvier M, Wiernik E, et al. Long-lasting symptoms after an acute COVID-19 infection and factors associated with their resolution. *JAMA Netw. Open* 2022; 5: e2240985-e.
40. Miller F, Nguyen DV, Navaratnam AMD, Shrotri M, et al. Prevalence and characteristics of persistent symptoms in children during the COVID-19 pandemic: evidence from a household cohort study in England and Wales. *Pediatr Infect Dis J* 2022; 42: 438-439.
41. Osmanov IM, Spiridonova E, Bobkova P, Gamirova A, et al. Risk factors for post-COVID-19 condition in previously hospitalised children using the ISARIC global follow-up protocol: a prospective cohort study. *Eur Respir J* 2022; 59: 2101341.
42. Say D, Crawford N, McNab S, Wurzel D, et al. Post-acute COVID-19 outcomes in children with mild and asymptomatic disease. *Lancet Child & Adolesc Health* 2021; 5: e22-e3.
43. Smane L, Stars I, Pucuka Z, Roge I, et al. Persistent clinical features in paediatric patients after SARS-CoV-2 virological recovery: a retrospective population-based cohort study from a single centre in Latvia. *BMJ Paediatr Open* 2020; 4: e000905
44. Buonsenso D, Munblit D, De Rose C, Sinatti D, et al. Preliminary evidence on long COVID in children. *Acta Paediatr* 2021; 110: 2208-2211
45. Molteni E, Sudre CH, Canas LS, Bhopal SS, et al. Illness duration and symptom profile in symptomatic UK school-aged children tested for SARS-CoV-2. *Lancet Child & Adolesc Health* 2021; 5: 708-718.
46. Stephenson T, Stephenson T, Pereira SP, Shafran R, et al. Long COVID-the physical and mental health of children and non-hospitalised young people 3 months after SARS-CoV-2 infection; a national matched cohort study (The CLoCk) Study. *Lancet Child & Adolesc Health* 2022; 6: e21.
47. Sterky E, Olsson-Åkefeldt S, Hertting O, Herlenius E, et al. Persistent symptoms in Swedish children after hospitalisation due to COVID-19. *Acta paediatr* 2021; 110: 2578-2580.
48. Lopez-Leon S, Wegman-Ostrosky T, Ayuzo del Valle NC, et al. Long-COVID in children and adolescents: a systematic review and meta-analyses. *Sci Rep* 2022; 12: 9950.
49. Behnood SA, Shafran R, Bennett SD, Zhang AXD, et al. Persistent symptoms following SARS-CoV-2 infection amongst children and young people: A meta-analysis of controlled and uncontrolled studies. *J Infect* 2022; 84: 158-170.
50. Borch L, Holm M, Knudsen M, Ellermann-Eriksen S, et al. Long COVID symptoms and duration in SARS-CoV-2 positive children — a nationwide cohort study. *Eur J of Pediatr* 2022; 181: 1597-1607.

51. Roge I, Smane L, Kivite-Urtane A, Pucuka Z, et al. Comparison of persistent symptoms after COVID-19 and other non-SARS-CoV-2 infections in children. *Front in Pediatr* 2021; 9; 752385.
52. Asadi-Pooya AA, Nemati H, Shahisavandi M, Akbari A, et al. Long COVID in children and adolescents. *World J Pediatr* 2021; 17: 495-499.
53. Fainardi V, Meoli A, Chiopris G, Motta M, et al. Long COVID in children and adolescents. *Life* 2022; 12: 285.
54. Berg SP, Palm P, Nygaard U, et al. Long COVID symptoms in SARS-CoV-2-positive children aged 0–14 years and matched controls in Denmark (LongCOVIDKidsDK): a national, cross-sectional study. *Lancet Child & Adolesc Health* 2022; 6: 240-248.
55. Adler L, Gazit S, Pinto Y, et al. Long-COVID in patients with a history of mild or asymptomatic SARS-CoV-2 infection: a Nationwide Cohort Study. *Scand J Prim Health Care* 2022; 40: 342-349.
56. World Health Organization. At least 17 million people in the WHO European Region experienced long COVID in the first two years of the pandemic; millions may have to live with it for years to come. Geneva: World Health Organization, 2022. https://www.who.int/europe/news/item/13-09-2022-at-least-17-million-people-in-the-who-european-region-experienced-long-covid-in-the-first-two-years-of-the-pandemic--millions-may-have-to-live-with-it-for-years-to-come (viewed Nov 2022).
57. Peter RS, Nieters A, Kräusslich HG, et al. Post-acute sequelae of covid-19 six to 12 months after infection: population based study. *BMJ* 2022; 379: e071050.
58. Bach K. Is ‘long Covid’ worsening the labor shortage? Washington D.C: Brookings Institute, 2022. https://www.brookings.edu/articles/is-long-covid-worsening-the-labor-shortage/ (viewed Jan 2023).
59. Gualano MR, Rossi MF, Borrelli I, Santoro PE, et al. Returning to work and the impact of post COVID-19 condition: a systematic review. *Work* 2022; 73: 405-413.
60. Australian Bureau of Statistics. Population clock and pyramid. Canberra: Australian Bureau of Statistics, 2024. https://www.abs.gov.au/statistics/people/population/population-clock-pyramid (viewed Jun 2023).
61. Australian Bureau of Statistics. Population. Canberra: Australian Bureau of Statistics, 2022. https://www.abs.gov.au/statistics/people/population/national-state-and-territory-population/jun-2022/31010do002_202206.xlsx (viewed Jun 2023).
62. Australian Bureau of Statistics. Employment and Hours Worked. Canberra: Australian Bureau of Statistics, 2023. https://www.abs.gov.au/statistics/labour/employment-and-unemployment/labour-force-australia-detailed/mar-2023/EM1a.xlsx (viewed Jun 2023).