Supplementary Tables and Figures.

Supplementary Doc 1 - Search strategy

Pubmed, Scopus and Web of Science Clarivate (Advanced search) (adapted for other database)

#1. (immune OR immuned OR immunes OR immunisation OR vaccination OR vaccination OR immunization OR immunization OR immunisations OR immunizations OR immunise OR immunised OR immuniser OR immunisers OR immunising OR immunities OR immunity OR immunity OR immunizations OR immunize OR immunized OR immunizer OR immunizers OR immunizes OR immunizing OR antibodies OR antibodies OR antibodies OR antibody OR antibody OR immunoglobulins OR immunoglobulins OR antibody OR IgG OR IgM OR “immunoglobulin G” OR “immunoglobulin M” OR “immunoglobulin A” OR IgA OR T cells OR B cells OR “immune memory” OR “immunological memory” OR “memory cells” OR CD4 OR CD8 OR “memory B cells” OR “memory T cells” OR “humoral immunity” OR “cellular immunity” OR “adaptive immunity” OR “memory CD4 T cells” OR “memory CD8 T cells” OR “memory CD4+ T cells” OR “memory CD8+ T cells” OR “memory $CD4^+$ T cells” OR “memory $CD8^+$ T cells” OR reinfect* OR repositive)

#2. (COVID OR COVID19 OR "SARS-CoV-2" OR "SARS-CoV2" OR SARSCoV2 OR"SARSCoV-2" OR "SARS coronavirus 2" OR "2019 nCoV" OR "2019nCoV" OR "2019-novel CoV" OR "nCov 2019" OR "nCov 19" OR "severe acute respiratory syndrome coronavirus 2" OR "novel coronavirus disease" OR "novel corona virus disease" OR "corona virus disease 2019" OR "coronavirus disease 2019" OR "novel coronavirus pneumonia" OR "novel corona virus pneumonia" OR "severe acute respiratory syndrome coronavirus 2") OR AB=(COVID OR COVID19 OR "SARS-CoV-2"

OR "SARS-CoV2" OR SARSCoV2 OR"SARSCoV-2" OR "SARS coronavirus 2" OR "2019 nCoV" OR "2019nCoV" OR "2019-novel CoV" OR "nCov 2019" OR "nCov 19" OR "severe acute respiratory syndrome coronavirus 2" OR "novel coronavirus disease" OR "novel corona virus disease" OR "corona virus disease 2019" OR "coronavirus disease 2019" OR "novel coronavirus pneumonia" OR "novel corona virus pneumonia" OR "severe acute respiratory syndrome coronavirus 2")

#3. #1 AND #2

Filters

Time=2020-2021

Supplementary Table 1 – Characteristics of included studies

Citation (First Author year)	Country	Setting hospital or community based	Study design	Total sample size	Age	Gender	Severity	Timepoints measured	domain
Zhu 2020 (1)	China	Hospital	Cohort	98	52 years (IQR, 37.8 - 59)	67.3% female	Hospitalized and discharged	Median 21 (IQR 17-28)	Reinfection
Zheng 2020 (2)	China	Hospital	Cohort	20	Age range 23-57	70% male	Hospitalized and discharged	2 weeks after recovery	Re-infection
Zhao Y 2020 (3)	China	Hospital	Cohort	55	Mean 47.74 years	41.82% female	Hospitalized and discharged	3 months after recovery	Humoral
Zhao J 2020 (4)	China	Hospital	Cohort	173	Median 48 years (IQR, 35–61 years)	49% male	Hospitalized and discharged	39 days from disease onset	Humoral, Post humoral
Zhang 2020 (5)	China	Hospital	Case series	127	Mean 44.2	50% female	NR	0 - 38 days after recovery	Humoral

Yuan B 2020 (6)	China	Hospital	Cohort	182	Mean 46.4 ± 17.1 years	46.2% males	Hospitalized and discharged	Day 14 after recovery	Re-infection
Yuan J 2020 (7)	China	Hospital	Cross sectional	172	Median 28 yrs	61% female	Hospitalized and discharged	2 weeks after recovery	Re-infection
Ye 2020 (8)	China	Hospital	Cohort	55	Median 37 (range 22 - 67)	65.45% female	Hospitalized and discharged	4-17 days after recovery	Re-infection
Xiao 2020 (9)	China	Hospital	Cross sectional	70	Mean 57 yrs	44.3% male	Moderate	Median 22 days after recovery	Reinfection
Xiang 2020 (10)	China	Hospital	Case series	85	Range 32 – 65 years	63.5% females	Both asymptomatic and symptomatic	≥30 days PSO	Humoral
Wu X 2020 (11)	China	Community	Case series	20280	Median 56 years	46.51% males	Asymptomatic	8 months	Re-infection
Wu J 2020 (12)	China	Hospital	Cross sectional	60	Median 46.5 (IQR 33.5-58.5)	43.3% female	Hospitalized and discharged	Median 21 days PSO	Re-infection
Wong 2020 (13)	Brunei	Hospital	Cross sectional	106	Median age 47	60.3% males	Both asymptomatic and symptomatic	Median 32days (IQR 28.75 - 33.5) PSO	Re-infection
Shu 2020 (14)	China	Hospital	Case series	131	Mean 51.4 years	Male - 68.7%	Hospitalized and discharged	21-40 days PSO	Humoral
Sheehan 2021 (15)	USA	Community	Cohort	33182	Mean 51.7 yrs (SD 22.2)	54.7% female	Both asymptomatic and symptomatic	>9 months	Reinfection and effectiveness
Rydyznski 2020 (16)	USA	Community	Case series	54	Median 55.5	71% Male	Severely ill	3 weeks post blood for convalescent (4 - 37 days)	Cellular and humoral
Qiao 2020 (17)	China	Hospital	Cohort	15	Mean 36.7 years (± 14.91)	53.3% Male	Hospitalized and discharged	2nd and 4th weeks after discharge	Reinfection

Prévost 2020 (18)	Canada	Community	Cross sectional	98	Mean 55 years	50% male	Both asymptomatic and symptomatic	8 - 14days PSO	Post Humoral
Pilz 2021 (19)	Austria	Hospital	Cohort	8900480	Median 39.8 yrs	62.5% female	Both asymptomatic and symptomatic	7 months	Reinfection
Perez 2021 (20)	Israel	Hospital	Case series	149735	Mean 31.5 (SD± 19.7)	61% male	Symptomatic Hospitalized and discharged	3 months	Reinfection
Peng 2021 (21)	China	Community	Cohort	20	Median 51.5 years (range 45–65)	55% Male	Hospitalized and discharged	5 (range 5 – 33 days) and 230 (range 221 – 248 days) days after symptom onset	Post humoral
Olea 2021 (22)	Spain	Hospital	Case series	35	Median age 62.5	66% Male	Hospitalized and discharged	4 months	Post humoral
Ogega 2020 (23)	USA	Hospitalized	Case series	14	Mean 57.6 years	57% male	Hospitalized and discharged	54 days after symptoms	Cellular immunity
Murillo-Zamora 2021 (24)	Mexico	Community	Cohort	100432	81.8% were ≤49	53.9% female	NR	56 days (IQR 40-81)	Reinfection
Liu 2020 (25)	China	Community	Case series	150	Mean 51.5 yrs	49.3% male	Hospitalized and discharged	38-39 days from symptom onset	Re-infection
Li Y 2020 (26)	China	Hospital	Cohort	13	Mean age 52.8 ± 20.2 years	46.1% male	Hospitalized and discharged	Median 32.5 (IQR 30.5-39.25)	Reinfection
Ko 2020 (27)	South Korea	Hospital	Cross sectional	64	Median 32 years	44% male	Asymptomatic, Mild	43 days after symptom onset	Post humoral
Jiang 2020 (28)	China	Hospital	Cross sectional	35	Median 45.2 (IQR 30-56)	100% female	Both asymptomatic and symptomatic	Median 32.5 (IQR 31.25-36)	Reinfection

Jia 2020 (29)	China	Hospital	Case series	19	Mean 9 years (7months-13yrs)	47.3% male	Hospitalized and discharged	11-27 days PSO	Humoral, Post humoral
Huynh 2021 (30)	USA	Hospital	Cohort	153	Mean 49 years (18 – 82)	62.1% female	Hospitalized and discharged	7-211 days post-symptom onset	Humoral
Huang 2020 (31)	China	Hospital	Cohort	414	Range 0-86 yrs	47.1% male	Hospitalized and discharged	Every 3 to 5 days	Reinfection
Havervall 2020 (32)	Sweden	Hospital	Case series	59	Mean 44 years (SD± 12)	69% male	Hospitalized and discharged	4 months	Post humoral
Hansen 2021 (33)	Denmark	Community	Cohort	2434558	NR	NR	NR	>7 months	Re-infection and effectiveness
Hansen 2021 (34)	Denmark	Hospital	Case series	350	Median 52 (41-63 years)	43.1% male	Both asymptomatic and symptomatic	Convalescent 4-11 weeks after symptoms onset	Post humoral
Hamed 2020 (35)	Qatar	Hospital	Case series	63444	Recurrent positive median: 37.3yrs (IQR 11-74)	79% male	Both asymptomatic and symptomatic	mean 29 days, range 21-84 after recovery	Reinfection
Hall 2021 (36)	UK	Healthcare workers	Cohort	25661	Median 46yrs (IQR 18.6-78.4)	82.4% female	Both asymptomatic and symptomatic	≥7 months	Reinfection and effectiveness
Grifoni 2021 (37)	USA	Hospital	Case-control	40	Cases (20–64 (median = 44, IQR = 9)), Controls (20–66 (median = 31, IQR = 21))	40% male	Recovered, symptomatic, Non-hospitalized	20 - 35 days PSO	Cellular immunity
Gudbjartsson 2020 (38)	Iceland	Community	Case series	487	nr	nr	Hospitalized and discharged	4 months	Humoral

García-Abellán 2021 (39)	Spain	Hospital	Case series	116	Median 64 yrs	60% male	Hospitalized and discharged	6 months	Reinfection, Post humoral
Fischer 2021 (40)	Germany	Hospital	Case series	41	Mean 54 years (± 8.4)	57% Male	Mild to moderate	Convalescent 28 - 288 days after recovery	Post humoral and cellular immunity
Fendler 2020 (41)	UK	Hospital	Case-Control	144	Median 59.4 years	49% Male	Hospitalized and discharged	8 - 202 days after recovery	Cellular immunity
De Giorgi 2021 (42)	USA	Community	Case series	202	Mean 47 years (19-79)	45% Males	Asymptomatic (3%), moderate 90%	5 months	Post humoral
Dan 2021	USA	Hospital	Case series	188	Median 40 years	43% male	93% mild – never hospitalized	8 months	Cellular, Humoral
Chirathaworn 2020 (43)	Thailand	Hospital	Case series	217	Median 33yrs (IQR 25–47)	Male 42.4%; Female 57.6%	Both asymptomatic and symptomatic	Days 28 – 142 PSO	Reinfection, Post humoral
Chen 2020 (44)	China	Hospital	Cohort	1067	Median 60 years (IQR 49-69)	41.6% male	Hospitalized and discharged	50 Days (IQR 36.5 - 59.5) PSO	Reinfection
Cao S 2020 (45)	China	Population-based census	Cross sectional	34420	NR	52.2% males	Both asymptomatic and symptomatic	Not reported but measured after recovery	Reinfection
Cao H 2020 (46)	China	Hospital	Case series	8	Mean 54 (26 -72 years)	37.5% males	Hospitalized and discharged	Day 28 - 50	Reinfection, Post humoral
Breathnach 2021 (47)	UK	Community	Cohort	66001	Mean 50 yrs	60% female	NR	> 7 months	Re -infection and effectiveness

An 2020 (48)	China	Hospital	Cohort	262	NR	47.9% males	Mild to moderate, Discharged	28 days (14 days isolation and 2 additional weeks post isolation)	Reinfection
Ali 2020 (49)	Iraq	Hospital	Case series	829	NR	NR	Hospitalized and discharged	5 months	Reinfection, Post-humoral
Adrielle dos Santos 2021 (50)	Brazil	Community	Case series	33	Mean 39.2 yrs (SD ±8.53)	79% female	Symptomatic	18-134 days between first and second qRT-PCR	Reinfection
Abu-Raddad 2020 (51)	Qatar	Community	Case series	133266	NR	NR	All hospitalized and discharged Symptomatic - Mild	Median 64.5 (Range 45-129) after negative PCR	Reinfection
Abdullah 2020 (52)	Brunei Darussalam	Hospital	Case series	138	mean age 41.3 ± 17.0 years)	59.4% male	All hospitalized and discharged	Day 11 after recovery	Reinfection
Abu-Raddad 2021 (53)	Qatar	Community	Cohort	43044	Median for females - 35yrs, and for males- 38 yrs	79% male	All hospitalized and discharged	Median 16.3 weeks, range 0 days - 34.6 weeks	Reinfection

Supplementary Table 2 – Hoy risk of bias

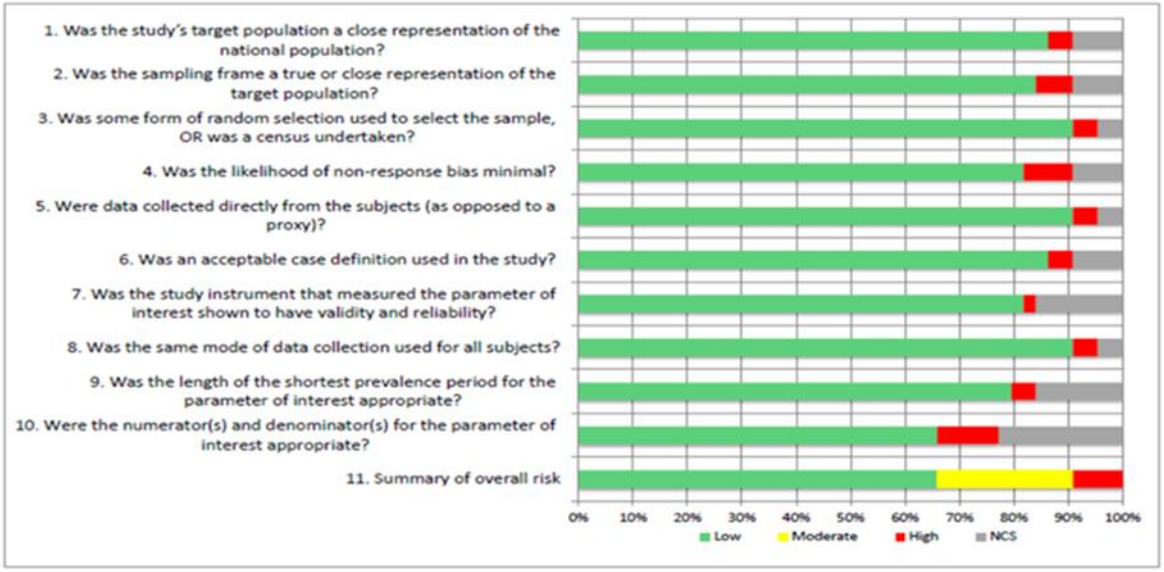
STUDY	1	2	3	4	5	6	7	8	9	10	OVERALL RISK OF BIAS	ROB CLASS
Abdullah 2020	0	0	0	0	1	1	1	1	1	1	6	Moderate risk
Abu-Raddad 2020	0	0	0	0	1	1	1	1	1	1	6	Moderate risk
Abu-Raddad 2021	0	0	0	0	1	1	1	1	1	1	6	Moderate risk
Adrielle dos Santos 2021	0	0	0	0	1	1	1	1	0	1	5	High risk
Ali 2020	0	0	0	0	1	1	1	1	1	1	6	Moderate risk

An 2020	0	0	0	0	1	1	1	1	1	1	6	Moderate risk
Breathnach 2021	0	0	0	0	1	1	1	1	1	1	6	Moderate risk
Cao H 2020	0	0	0	0	1	1	1	1	1	1	6	Moderate risk
Cao S 2020	1	1	1	1	1	1	1	1	0	1	9	Moderate risk
Chen 2020	0	0	0	0	1	1	1	1	1	0	5	High risk
Chirathaworn 2020	0	0	0	0	1	1	1	1	0	1	5	High risk
Dan 2021	0	0	0	0	1	1	1	1	1	1	6	Moderate risk
De Giorgi 2021	0	0	0	0	1	1	1	1	0	1	5	High risk
Fendler 2020	0	0	0	0	1	1	1	1	1	1	6	Moderate risk
Fischer 2021	0	0	0	0	1	1	1	1	1	1	6	Moderate risk
García-Abellán 2021	0	0	0	0	1	1	1	1	1	1	6	Moderate risk
Grifoni 2021	0	0	0	0	1	1	1	1	1	1	6	Moderate risk
Gudbjartsson 2020	0	0	0	0	1	1	1	1	1	1	6	Moderate risk
Hall 2021	0	0	0	0	1	1	1	1	1	1	5	Moderate risk
Hamed 2020	0	0	0	0	1	1	1	1	1	1	6	Moderate risk
Hansen B 2021	0	0	0	0	1	1	1	1	1	1	6	Moderate risk
Hansen H 2021	1	1	1	1	1	1	1	1	1	1	10	Low risk
Havervall 2020	0	0	0	0	1	1	1	1	1	1	6	High risk
Huang 2020	0	0	0	1	1	1	1	1	1	1	7	Moderate risk
Huynh 2021	0	0	0	0	1	1	1	1	1	1	6	Moderate risk
Jia 2020	0	0	0	0	1	1	0	1	1	1	5	High risk
Jiang 2020	0	0	0	1	1	1	1	1	1	1	7	Moderate risk
Ko 2020	0	0	0	1	1	1	1	1	1	1	7	Moderate risk

Li Y 2020	0	0	0	1	1	1	1	1	1	1	7	Moderate risk
Liu 2020	0	0	0	0	1	1	1	1	1	1	5	Moderate risk
Murillo-Zamora 2021	0	0	0	1	1	1	1	1	0	1	5	Moderate risk
Ogega 2020	0	0	0	0	1	1	1	1	1	1	6	Moderate risk
Olea 2021	0	0	0	1	1	1	1	1	1	1	7	Moderate risk
Peng 2021	0	0	0	0	1	1	1	1	1	1	5	Moderate risk
Perez 2021	0	1	1	0	1	1	1	1	1	1	8	Moderate risk
Pilz 2021	1	1	1	1	1	1	1	1	1	1	10	Low risk
Prévost 2020	0	0	0	0	1	1	1	1	1	1	6	Moderate risk
Qiao 2020	0	0	0	1	1	1	1	1	1	1	7	Moderate risk
Rydyznski 2020	0	0	0	0	1	1	1	1	1	1	6	Moderate risk
Sheehan 2021	0	1	0	0	0	1	1	1	1	1	6	Moderate risk
Shu 2020	0	0	0	0	1	1	1	1	1	1	6	Moderate risk
Wong 2020	0	0	0	1	1	1	1	1	1	1	7	Moderate risk
Wu J 2020	0	0	0	1	1	1	1	1	1	1	6	Moderate risk
Wu X 2020	0	1	0	1	1	1	1	0	0	1	5	Moderate risk
Xiang 2020	0	0	0	0	1	1	1	1	1	1	6	Moderate risk
Xiao 2020	0	0	0	1	1	1	1	1	1	1	7	Moderate risk
Ye 2020	0	0	0	1	1	1	1	1	1	1	7	Moderate risk
Yuan B 2020	0	0	0	0	1	1	1	1	1	1	6	Moderate risk
Yuan J 2020	0	0	0	1	1	1	1	1	0	1	6	Moderate risk
Zhang 2020	0	0	0	1	1	1	1	1	1	1	7	Moderate risk
Zhao J 2020	0	0	0	1	1	1	1	1	1	1	7	Moderate risk

Zhao Y 2020	0	0	0	0	1	1	1	1	1	1	6	Moderate risk
Zheng 2020	0	0	0	1	1	1	1	1	1	1	7	Moderate risk
Zhu 2020	0	0	0	0	1	0	1	1	1	1	5	High risk

Risk of bias using the tool by Hoy et al 2012. High risk, and unclear scored as zero "0", while low risk was scored as one "1" for each item. Total score out of 10 where 10 depicts low overall risk and 0 high overall risk. Scores 0-5 (high risk), 6-8 (moderate risk) and 9-10 (low risk)



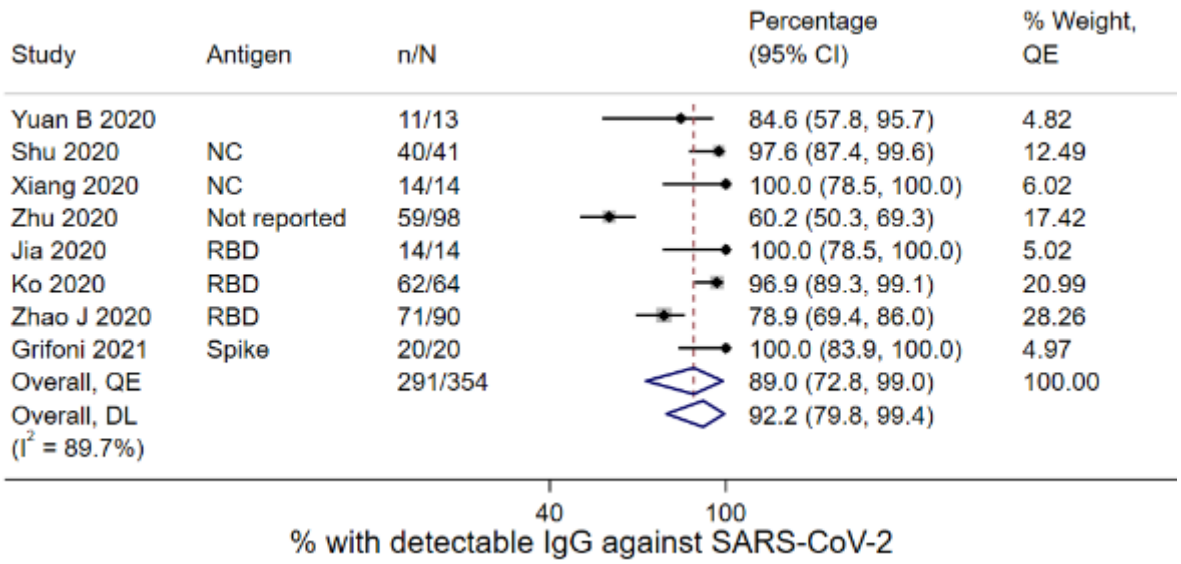
Supplementary Table 3 – MASTER assessment for comparative studies

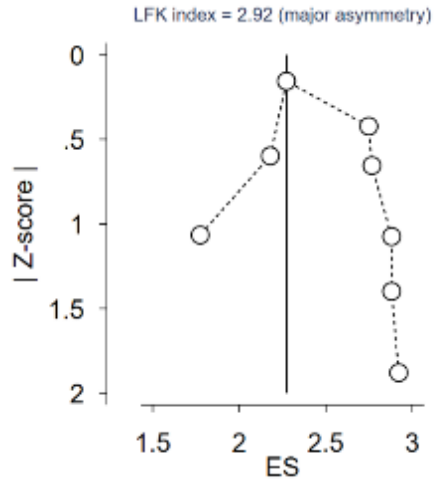
Safeguard item	Pilz 2021	Sheehan 2021	Hansen 2021	Breathnach 2021	Hall 2021
1. Data collected after the start of the study was not used to exclude participants or to select them into the analysis	1	1	1	1	1

2. Participants in all comparison groups met the same eligibility requirements and were from the same population and timeframe	0	0	0	0	0
3. Determination of eligibility and assignment to treatment group/exposure strategy was synchronized	0	0	0	0	0
4. None of the eligibility criteria were common effects of exposure and outcome	1	1	1	0	1
5. Any attrition (or exclusions after entry) is less than 20% of total participant numbers	0	0	0	0	0
6. Missing data is less than 20%	0	0	1	0	1
7. Analysis accounted for missing data	0	0	1	0	1
8. Exposure variations/treatment deviations were less than 20%	0	1	1	1	1
9. Variations in exposure or withdrawals after the start of the study were addressed by analysis	0	1	1	1	1
10. Procedures for data collection of covariates were reliable and the same for all participants	0	0	1	0	0
11. The outcome was objectively defined and/or reliably measured	1	1	1	1	1
12. Exposures/ interventions were objectively defined and/ or reliably measured	1	0	1	0	0
13. Outcome assessor(s) were blinded	0	0	0	0	0
14. Participants were blinded	0	0	0	0	0
15. Caregivers were blinded	0	0	0	0	0
16. Analyst was blinded	0	0	0	0	0
17. Care was delivered equally to all participants	0	0	0	0	0
18. Cointerventions that could impact the outcome were comparable between groups or avoided	0	0	0	0	0
19. Control and active interventions/ exposures are sufficiently distinct	0	0	0	0	0
20. Exposure/intervention definition consistently applied to all participants	1	1	1	1	0
21. Outcome definition consistently applied to all participants	1	1	1	1	1
22. The time period between exposure and outcome is similar across patients and between groups or the analyses adjust for different lengths of follow-up of patients	1	1	1	1	0
23. Design and/or analytic strategies were in place that addressed potential confounding	0	0	1	0	1

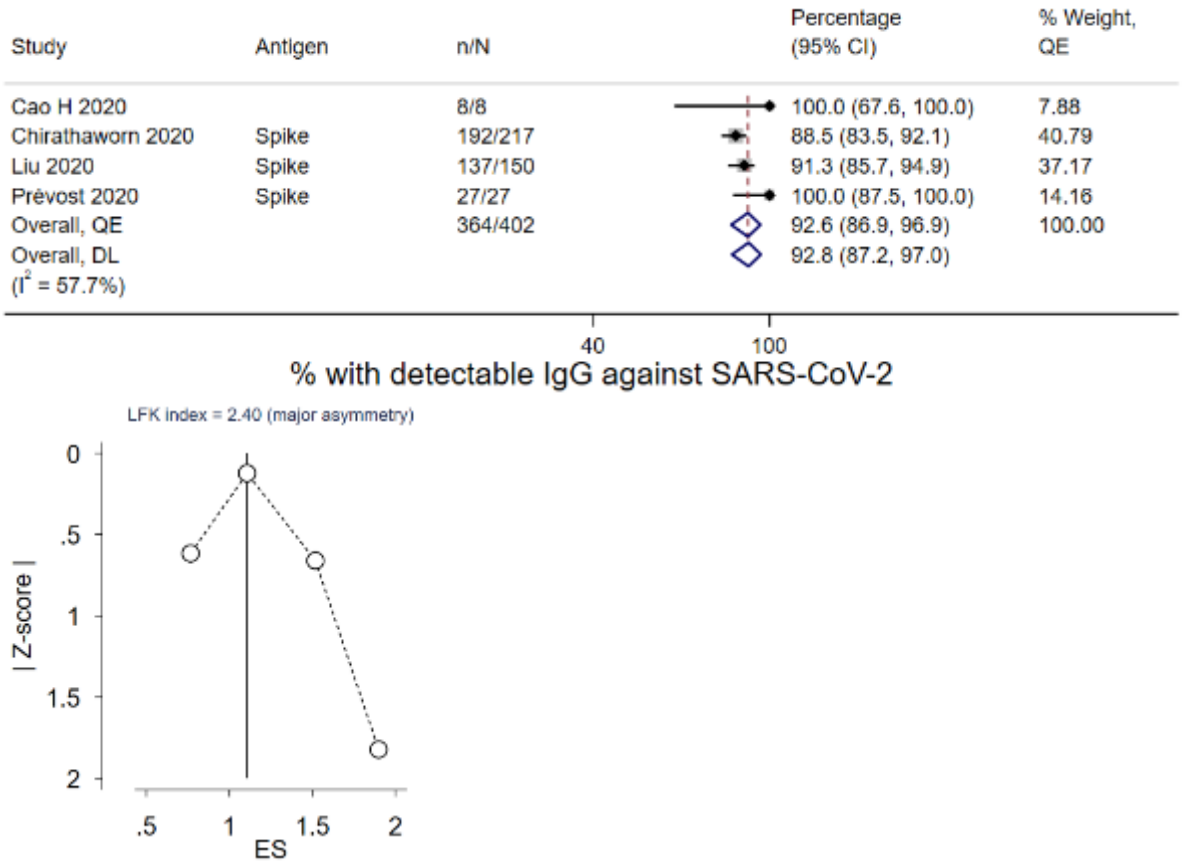
24. Key confounders addressed through design or analysis were not common effects of exposure and outcome	0	0	0	0	0
25. Key baseline characteristics / prognostic indicators for the study were comparable across groups	0	1	0	0	0
26. Participants were randomly allocated to groups with adequate randomisation process	0	0	0	0	0
27. Allocation procedure was adequately concealed	0	0	0	0	0
28. Conflict of interests were declared and absent	1	1	1	1	1
29. Analytic method was justified by study design or data requirements	0	0	1	0	1
30. Computation errors or contradictions were absent	1	1	1	1	1
31. There was no discernible data dredging or selective reporting of the outcome	1	1	1	1	1
32. All subjects were selected prior to intervention/exposure and evaluated prospectively	0	0	0	0	0
33. Carry-over or refractory effects were avoided or considered in the design of the study or were not relevant	1	1	1	1	1
34. The intervention/ exposure period was long enough to have influenced the study outcome	1	1	1	1	1
35. Dose of intervention/ exposure was sufficient to influence the outcome	1	1	1	1	1
36. Length of follow-up was not too long or too short in relation to the outcome assessment	1	1	1	1	1
Summary count of safeguard items	14	16	21	14	17

Supplementary Figure 1 – Proportion with detectable IgG after within 1 month after recovery from COVID-19

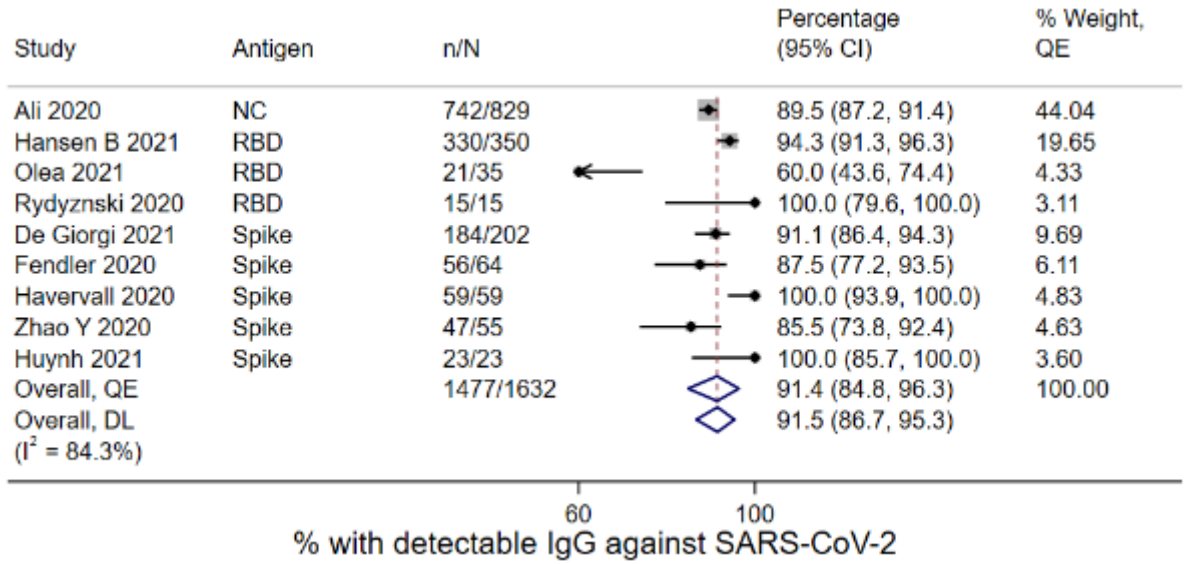


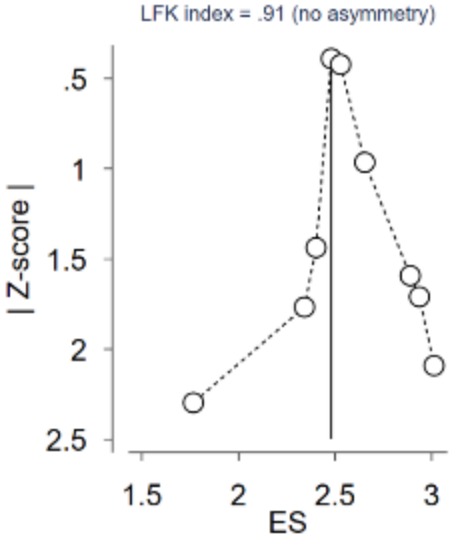


Supplementary Figure 2 – Proportion with detectable IgG after 1-<3 months after recovery from COVID-19

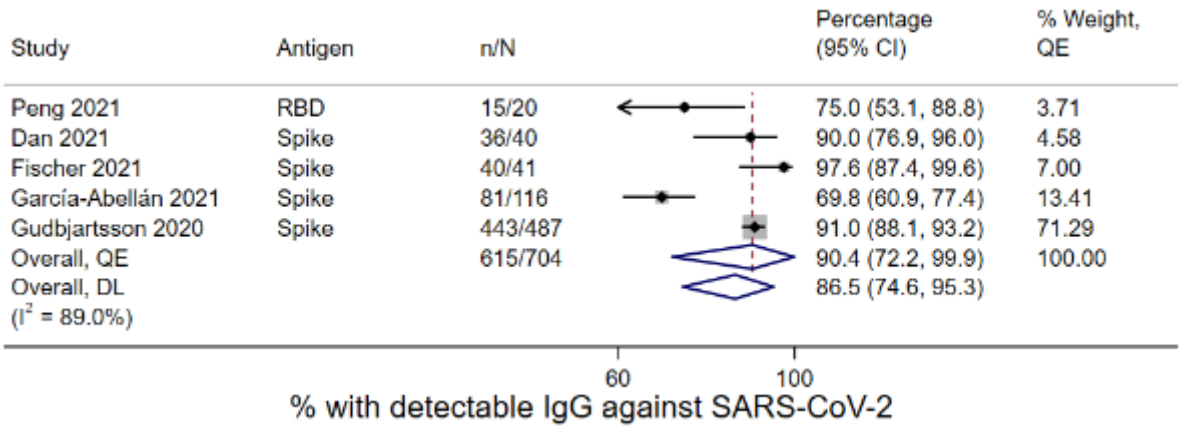


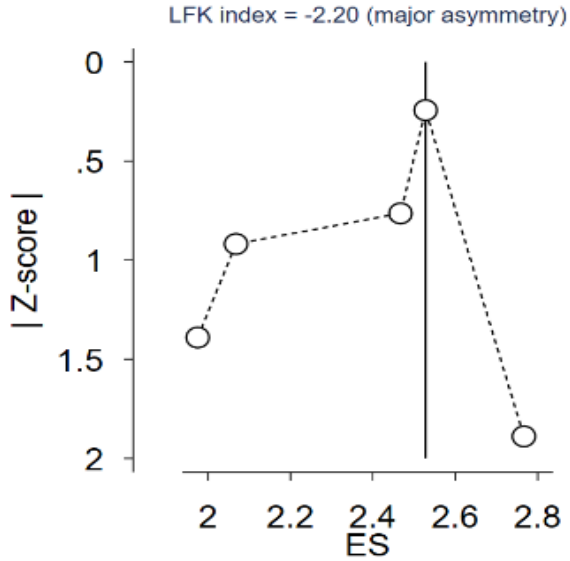
Supplementary Figure 3 – Proportion with detectable IgG after 3-<6 months after recovery from COVID-19



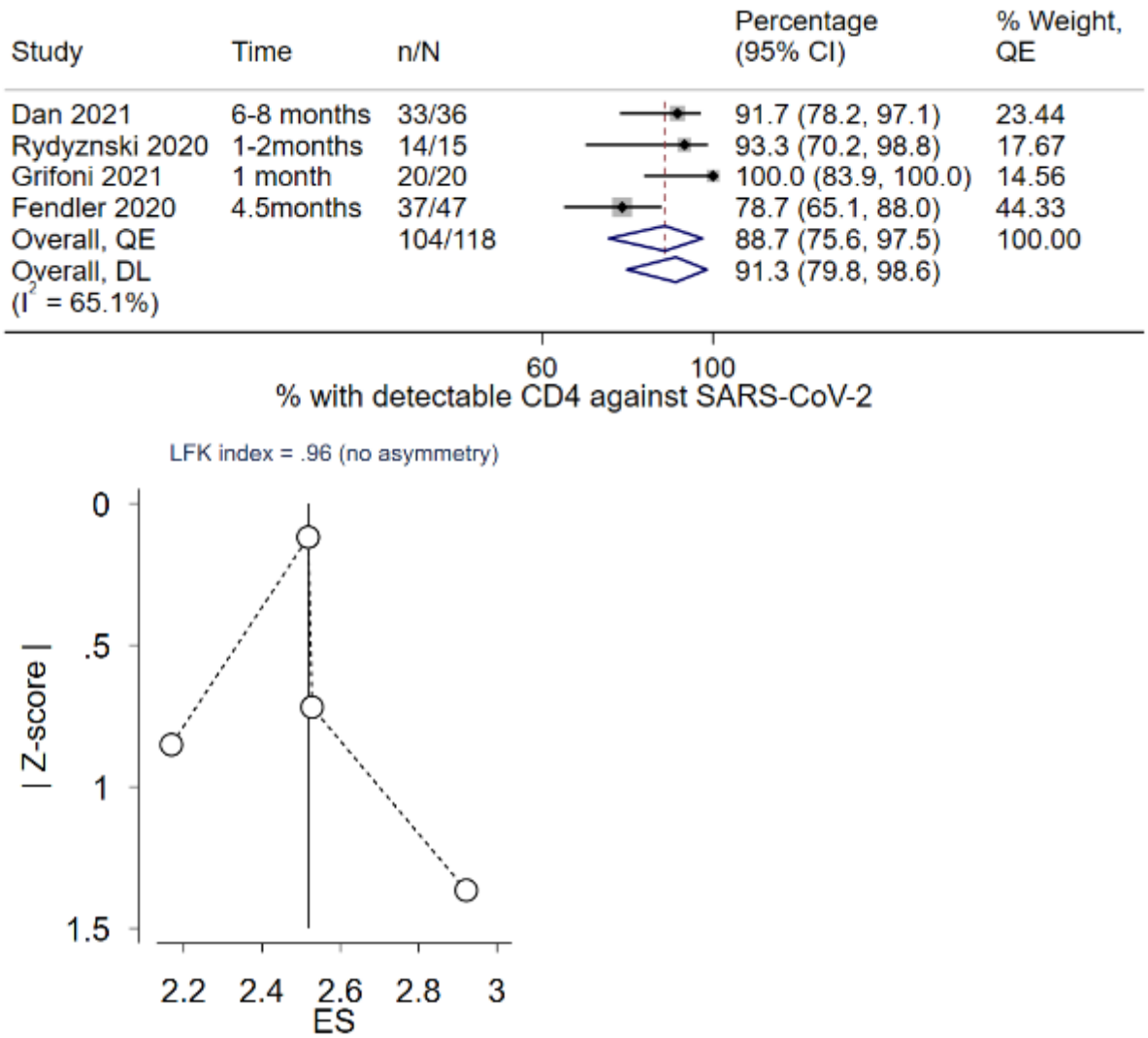


Supplementary Figure 4 – Proportion with detectable IgG after ≥6 months after recovery from COVID-19

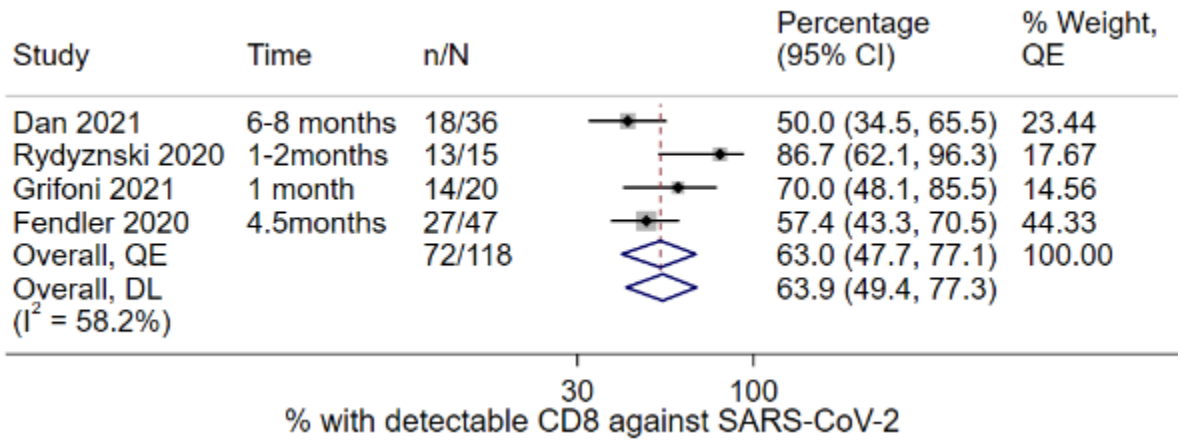


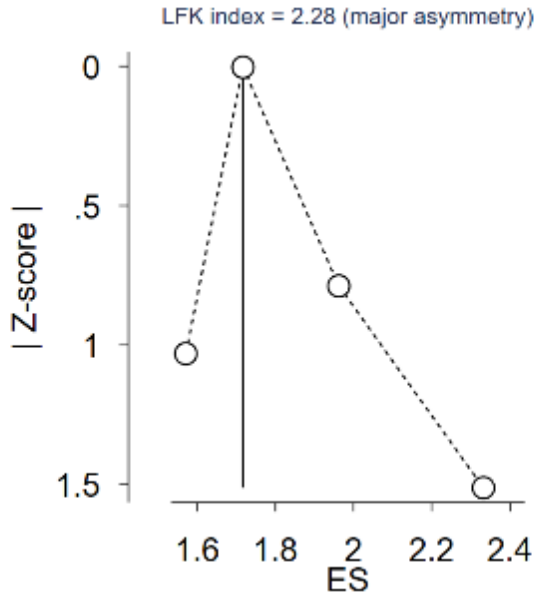


Supplementary Figure 5 – Proportion with detectable memory CD4+ T cells after recovery from COVID-19

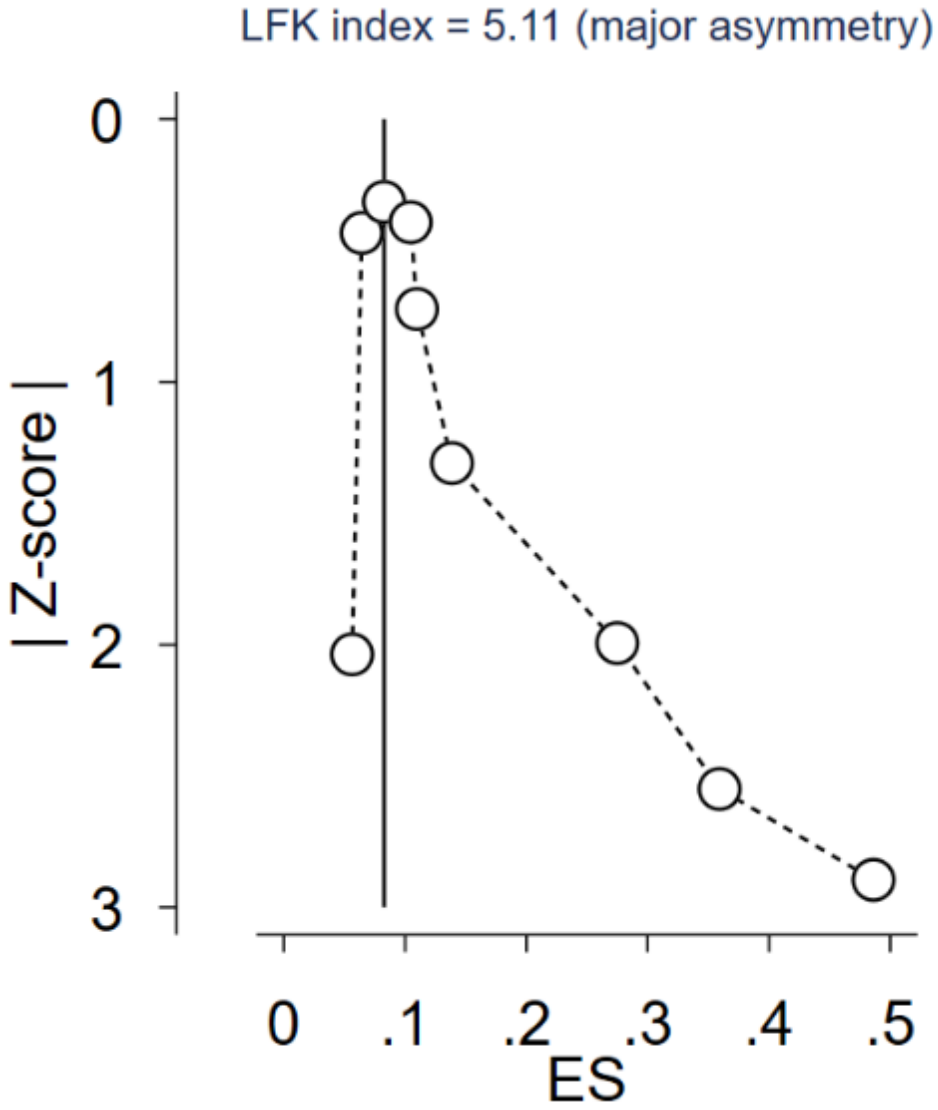


Supplementary Figure 6 – Proportion with detectable memory CD8+ T cells after recovery from COVID-19

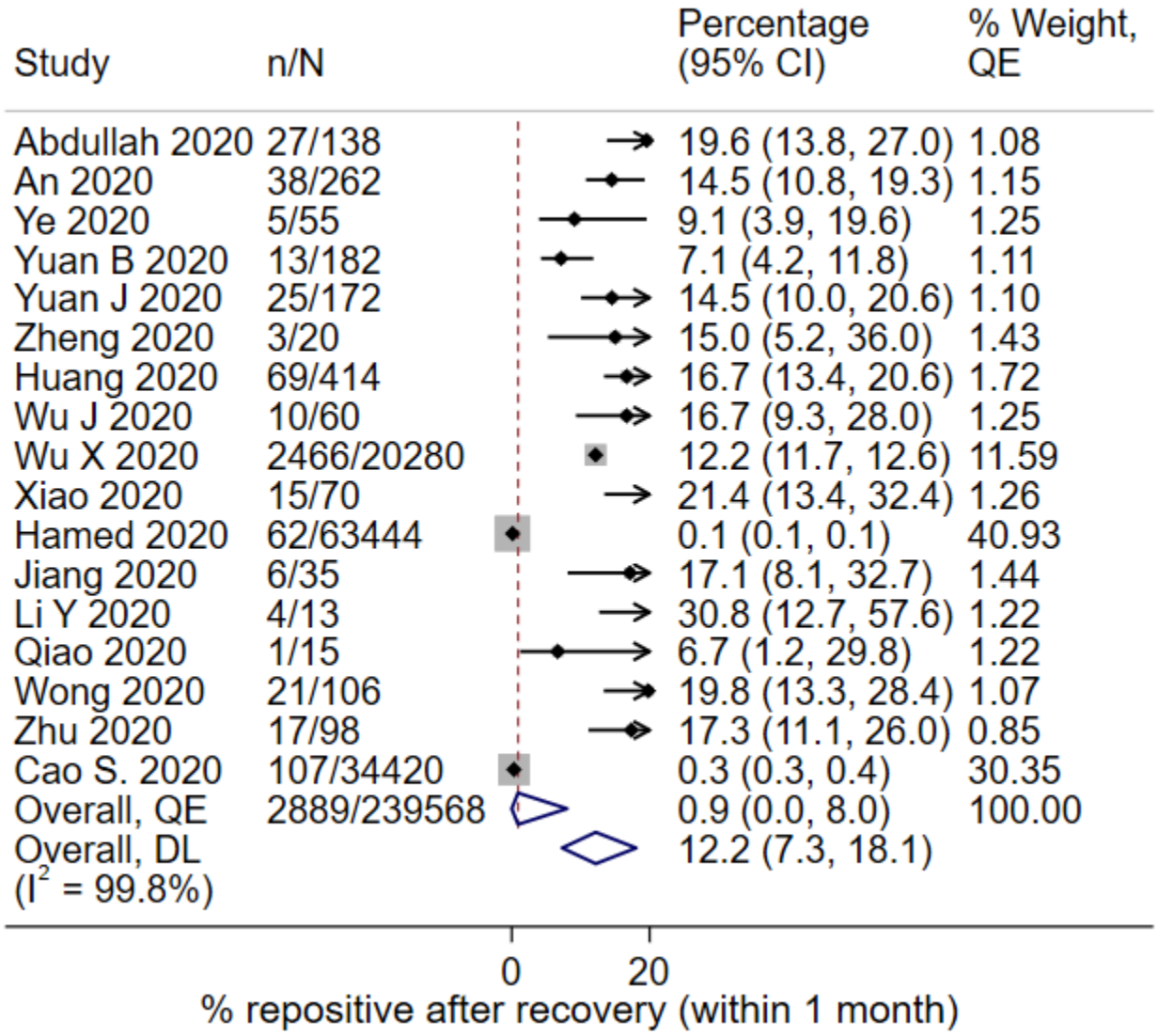


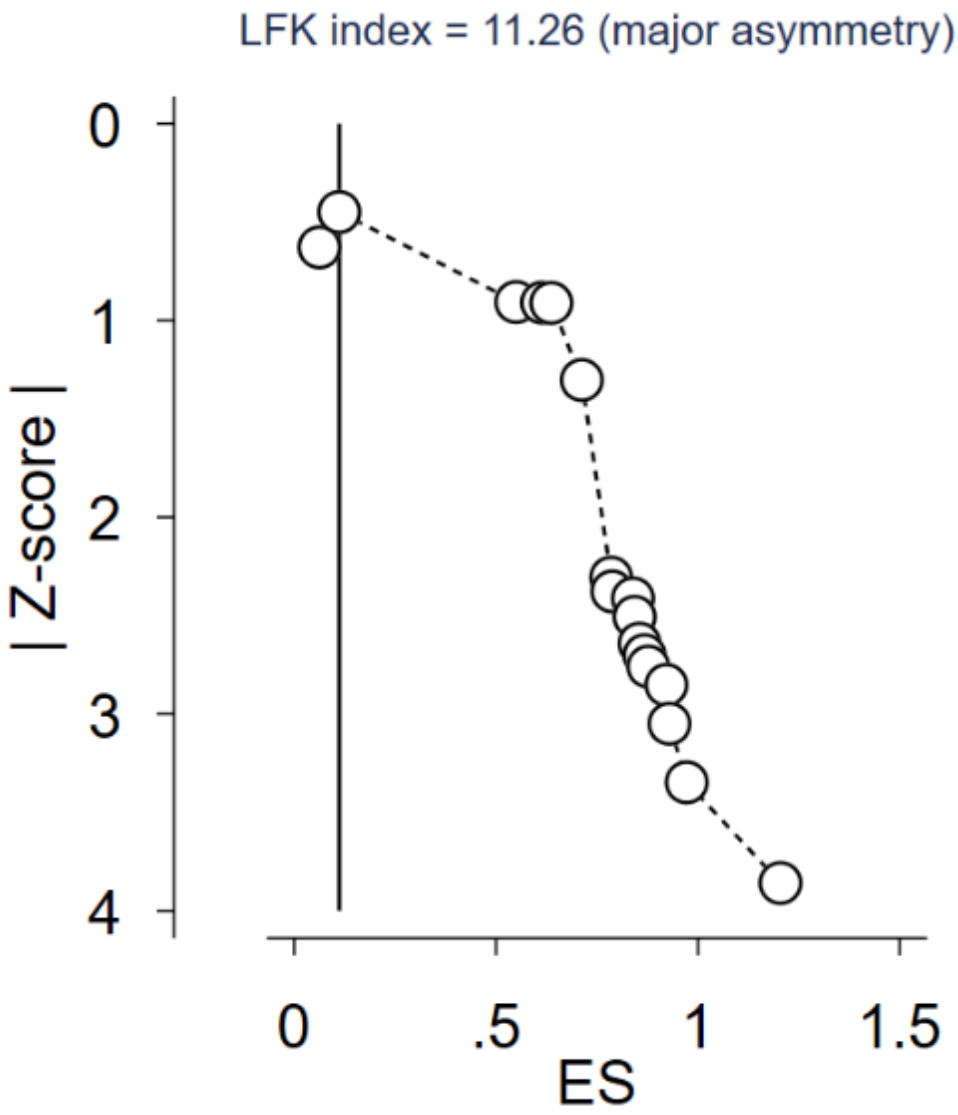


Supplementary Figure 7 – Doi plot for proportion with possible reinfection ≥3months after recovery from COVID-19

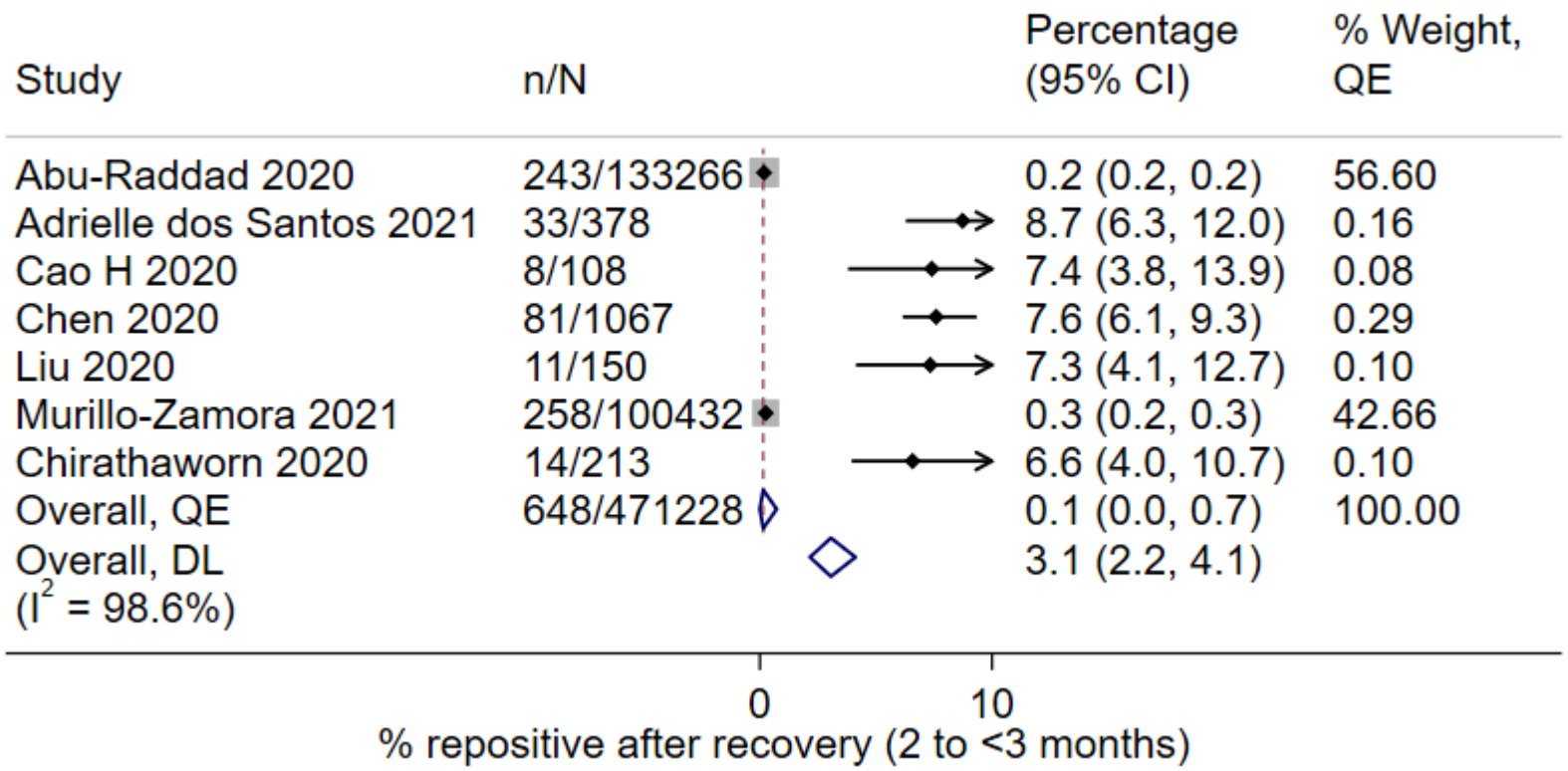


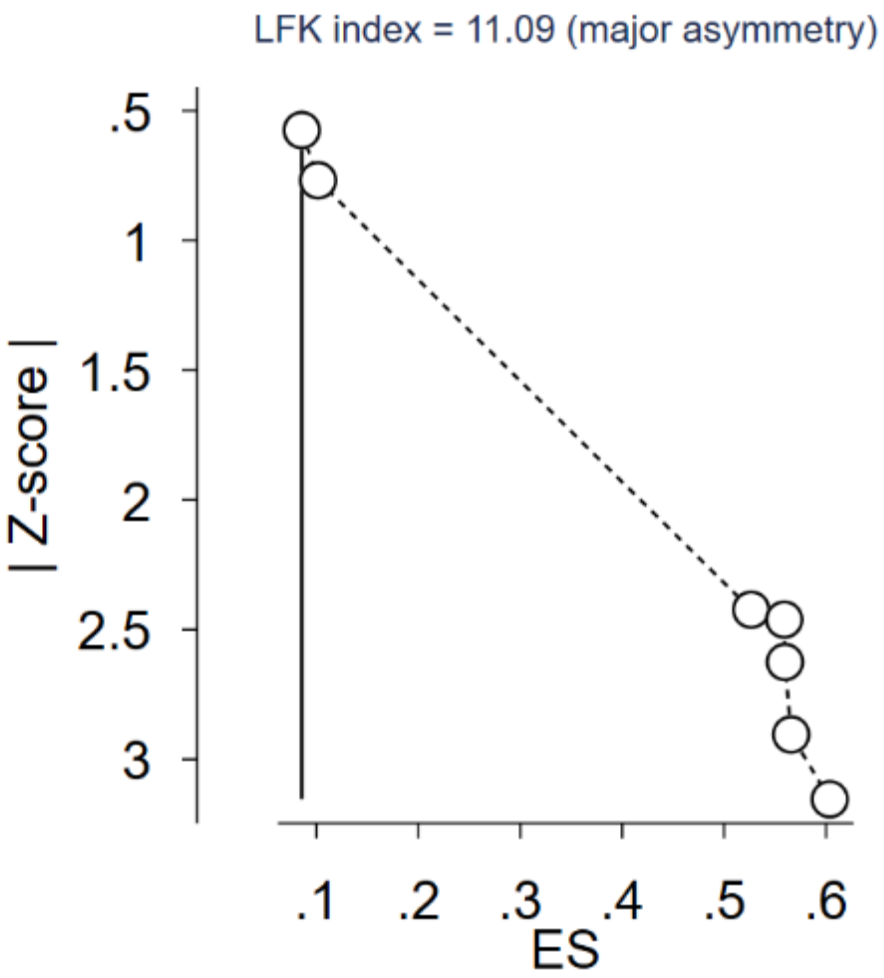
Supplementary Figure 8 – Proportion testing positive within 1 month after recovery from COVID-19



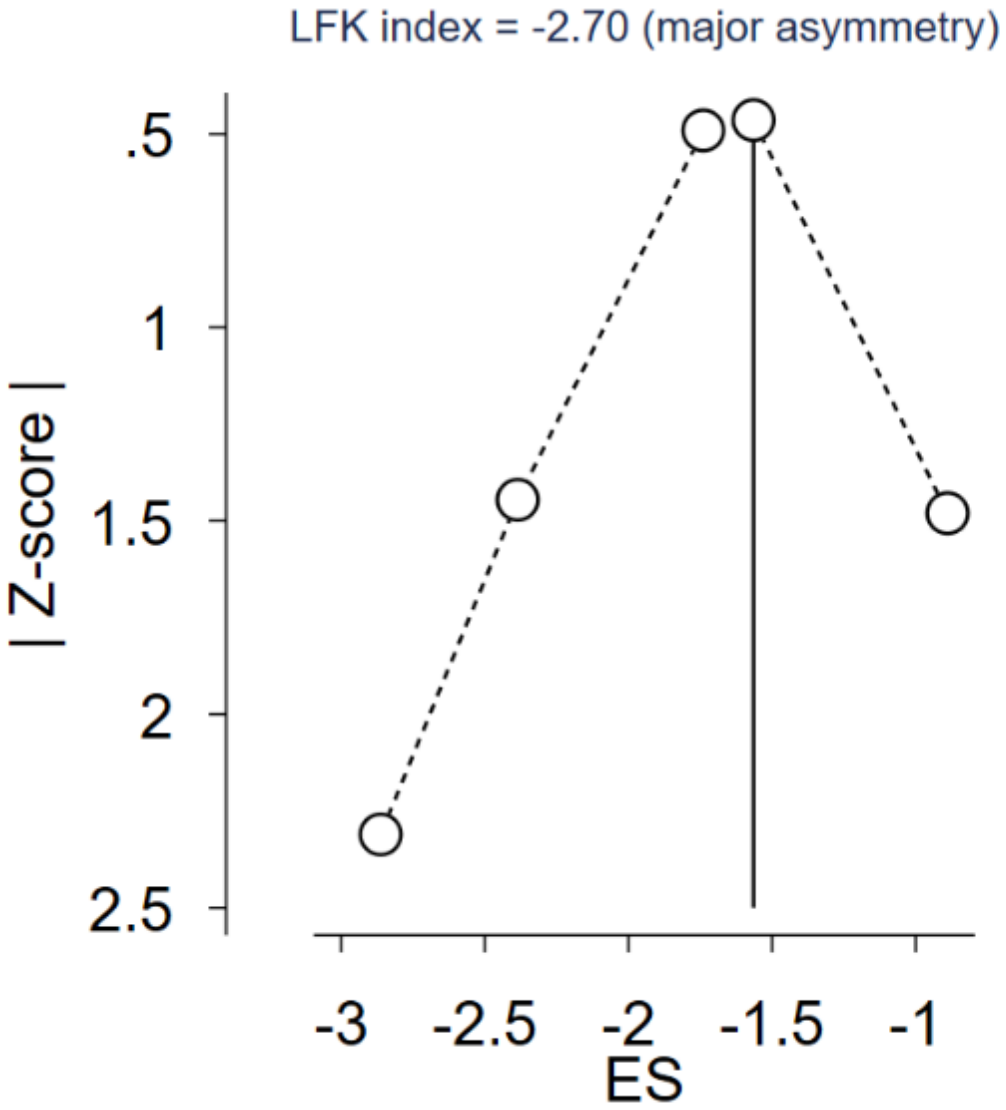

LFK index = 11.26 (major asymmetry)
| Z-score |
0
1
2
3
4
0
.5
1
1.5
ES

Supplementary Figure 9 – Proportion testing positive at 2-3months after recovery from COVID-19




LFK index = 11.09 (major asymmetry)
| Z-score |
.5
1
1.5
2
2.5
3
.1
.2
.3
.4
.5
.6
ES

Supplementary Figure 10 – Doi plot for proportion for efficacy of previous COVID-19 in preventing future infection



Supplementary Table 4 – Findings from previous systematic reviews

Author, year	Design	N# of studies	N# of prtcpnts	Longest length of follow up	IgG prevalence at follow up	IgM	T cell CD4	T cell CD8	Memory B	Reinfection / repositive	Comments
Váncsa (2021) (54)	Systematic review	56	123	>60 days	IgG positive in 86.1% (n = 31/36) at first episode and 94.2% (n = 49/52) at second episode	NR	NR	NR	NR	96 (78%) at ≤60 days and 27 (22%) at >60 days	Included case reports.
Wu Yan (2021) (55)	Network meta-analysis	71	8, 647		NR	NR	2216 patients from 14 studies reported the differences in CD4+ T cells counts	12 studies involved 2091 patients reported about CD8+ T cells levels	NR	NR	Length of follow up not reported but the reported studies were conducted between January 2020 and March, ranging between 7 days and 2months.

Choudhary (2021) (56)	Systematic review	16	20	44 days to 282 days	NR	NR	NR	NR	NR	25% (5/20) at 2 months	
Piri (2021) (57)	Systematic review	66	1128	1 – 140 days	Ranged between 58.8 – 100%	Ranged between 11 – 95%	NR	NR	NR	NR	
Arafkas (2021) (58)	Systematic review	15 including an in vivo study	215	39 ± 9 days	NR	NR	NR	NR	NR	4% (8/215) at 1 month	Reinfection rate calculated while extracting
Farrukh (2020) (59)	Systematic review	27	1616	>1 month	166 (10%) at >1 month	165 (10%) at >1 month	NR	NR	NR	253 (16%) tested positive the second time after an average period of 11.5 days from the last negative RT-PCR test	1. Data recalculated. 2. article mixing up repositivity and reinfection

Bwire (2020) (60)	Systematic review	6	11	NR	9/11 (82%) at birth	8/11 (73%) at birth	NR	NR	NR	NR	Studied children.
Shrotri (2021) (61)	Narrative review										
Iwamura et al (2021) (62)	Narrative review										

NR – Not reported

References

1. Zhu H, Fu L, Jin Y, Shao J, Zhang S, Zheng N, et al. Clinical features of COVID-19 convalescent patients with re-positive nucleic acid detection. Journal of Clinical Laboratory Analysis. 2020;34(7):e23392.
2. Zheng KI, Wang X-B, Jin X-H, Liu W-Y, Gao F, Chen Y-P, et al. A Case Series of Recurrent Viral RNA Positivity in Recovered COVID-19 Chinese Patients. Journal of General Internal Medicine. 2020;35(7):2205-6.
3. Zhao Y-m, Shang Y-m, Song W-b, Li Q-q, Xie H, Xu Q-f, et al. Follow-up study of the pulmonary function and related physiological characteristics of COVID-19 survivors three months after recovery. EClinicalMedicine. 2020;25.
4. Zhao J, Yuan Q, Wang H, Liu W, Liao X, Su Y, et al. Antibody Responses to SARS-CoV-2 in Patients With Novel Coronavirus Disease 2019. Clinical Infectious Diseases. 2020;71(16):2027-34.
5. Zhang G, Nie S, Zhang Z, Zhang Z. Longitudinal Change of Severe Acute Respiratory Syndrome Coronavirus 2 Antibodies in Patients with Coronavirus Disease 2019. J Infect Dis. 2020;222(2):183-8.
6. Yuan B, Liu H-Q, Yang Z-R, Chen Y-X, Liu Z-Y, Zhang K, et al. Recurrence of positive SARS-CoV-2 viral RNA in recovered COVID-19 patients during medical isolation observation. Scientific Reports. 2020;10(1):11887.

7. Yuan J, Kou S, Liang Y, Zeng J, Pan Y, Liu L. Polymerase Chain Reaction Assays Reverted to Positive in 25 Discharged Patients With COVID-19. Clin Infect Dis. 2020;71(16):2230-2.
8. Ye G, Pan Z, Pan Y, Deng Q, Chen L, Li J, et al. Clinical characteristics of severe acute respiratory syndrome coronavirus 2 reactivation. The Journal of infection. 2020;80(5):e14-e7.
9. Xiao AT, Tong YX, Zhang S. False negative of RT-PCR and prolonged nucleic acid conversion in COVID-19: Rather than recurrence. Journal of medical virology. 2020;92(10):1755-6.
10. Xiang F, Wang X, He X, Peng Z, Yang B, Zhang J, et al. Antibody Detection and Dynamic Characteristics in Patients With Coronavirus Disease 2019. Clinical Infectious Diseases. 2020;71(8):1930-4.
11. Wu X, Wang Z, He Z, Li Y, Wu Y, Wang H, et al. A follow-up study shows no new infections caused by patients with repeat positive of COVID-19 in Wuhan. medRxiv. 2020:2020.11.18.20232892.
12. Wu J, Liu X, Liu J, Liao H, Long S, Zhou N, et al. Coronavirus Disease 2019 Test Results After Clinical Recovery and Hospital Discharge Among Patients in China. JAMA network open. 2020;3(5):e209759-e.
13. Wong J, Koh WC, Momin RN, Alikhan MF, Fadillah N, Naing L. Probable causes and risk factors for positive SARS-CoV-2 test in recovered patients: Evidence from Brunei Darussalam. Journal of Medical Virology. 2020;92(11):2847-51.
14. Shu H, Wang S, Ruan S, Wang Y, Zhang J, Yuan Y, et al. Dynamic Changes of Antibodies to SARS-CoV-2 in COVID-19 Patients at Early Stage of Outbreak. Virologica Sinica. 2020;35(6):744-51.
15. Sheehan MM, Reddy AJ, Rothberg MB. Reinfection Rates Among Patients Who Previously Tested Positive for Coronavirus Disease 2019: A Retrospective Cohort Study. Clinical Infectious Diseases. 2021.
16. Rydyznski Moderbacher C, Ramirez SI, Dan JM, Grifoni A, Hastie KM, Weiskopf D, et al. Antigen-Specific Adaptive Immunity to SARS-CoV-2 in Acute COVID-19 and Associations with Age and Disease Severity. Cell. 2020;183(4):996-1012.e19.
17. Qiao X-M, Xu X-F, Zi H, Liu G-X, Li B-H, Du X, et al. Re-positive Cases of Nucleic Acid Tests in Discharged Patients With COVID-19: A Follow-Up Study. Frontiers in medicine. 2020;7:349-.
18. Prévost J, Gasser R, Beaudoin-Bussières G, Richard J, Duerr R, Laumaea A, et al. Cross-Sectional Evaluation of Humoral Responses against SARS-CoV-2 Spike. Cell Reports Medicine. 2020;1(7).
19. Pilz S, Chakeri A, Ioannidis JPA, Richter L, Theiler-Schwetz V, Trummer C, et al. SARS-CoV-2 re-infection risk in Austria. European Journal of Clinical Investigation. 2021;51(4):e13520.

20. Perez G, Banon T, Gazit S, Moshe SB, Wortsman J, Grupel D, et al. A 1 to 1000 SARS-CoV-2 reinfection proportion in members of a large healthcare provider in Israel: a preliminary report. medRxiv. 2021:2021.03.06.21253051.
21. Peng P, Hu J, Deng H-j, Liu B-z, Fang L, Wang K, et al. Changes in the humoral immunity response in SARS-CoV-2 convalescent patients over 8 months. Cellular & Molecular Immunology. 2021;18(2):490-1.
22. Olea B, Albert E, Torres I, Amat P, Remigia MJ, Gozalbo-Rovira R, et al. Adaptive immune responses to SARS-CoV-2 in recovered severe COVID-19 patients. medRxiv. 2021:2021.01.05.20249027.
23. Ogega CO, Skinner NE, Blair PW, Park H-S, Littlefield K, Ganesan A, et al. Durable SARS-CoV-2 B cell immunity after mild or severe disease. The Journal of Clinical Investigation. 2021;131(7).
24. Murillo-Zamora E, Mendoza-Cano O, Delgado-Enciso I, Hernandez-Suarez CM. Predictors of severe symptomatic laboratory-confirmed SARS-CoV-2 reinfection. Public Health. 2021;193:113-5.
25. Liu T, Wu S, Zeng G, Zhou F, Li Y, Guo F, et al. Recurrent positive SARS-CoV-2: Immune certificate may not be valid. Journal of Medical Virology. 2020;92(11):2384-6.
26. Li Y, Hu Y, Yu Y, Zhang X, Li B, Wu J, et al. Positive result of Sars-Cov-2 in faeces and sputum from discharged patients with COVID-19 in Yiwu, China. Journal of medical virology. 2020;92(10):1938-47.
27. Ko J-H, Joo E-J, Park S-J, Baek JY, Kim WD, Jee J, et al. Neutralizing Antibody Production in Asymptomatic and Mild COVID-19 Patients, in Comparison with Pneumonic COVID-19 Patients. Journal of clinical medicine. 2020;9(7):2268.
28. Jiang M, Li Y, Han M, Wang Z, Zhang Y, Du X. Recurrent PCR positivity after hospital discharge of people with coronavirus disease 2019 (COVID-19). The Journal of infection. 2020;81(1):147-78.
29. Jia R, Wang X, Liu P, Liang X, Ge Y, Tian H, et al. Mild Cytokine Elevation, Moderate CD4+ T Cell Response and Abundant Antibody Production in Children with COVID-19. Virologica Sinica. 2020;35(6):734-43.
30. Huynh A, Arnold DM, Smith JW, Moore JC, Zhang A, Chagla Z, et al. Characteristics of Anti-SARS-CoV-2 Antibodies in Recovered COVID-19 Subjects. Viruses. 2021;13(4).
31. Huang J, Zheng L, Li Z, Hao S, Ye F, Chen J, et al. Recurrence of SARS-CoV-2 PCR positivity in COVID-19 patients: a single center experience and potential implications. medRxiv. 2020:2020.05.06.20089573.
32. Havervall S, Falk AJ, Klingström J, Ng H, Greilert-Norin N, Gabrielsson L, et al. SARS-CoV-2 induces a durable and antigen specific humoral immunity after asymptomatic to mild COVID-19 infection. medRxiv. 2021:2021.01.03.21249162.

33. Hansen CH, Michlmayr D, Gubbels SM, Mølbak K, Ethelberg S. Assessment of protection against reinfection with SARS-CoV-2 among 4 million PCR-tested individuals in Denmark in 2020: a population-level observational study. The Lancet. 2021;397(10280):1204-12.
34. Hansen CB, Jarlhelt I, Pérez-Alós L, Hummelshøj Landsy L, Loftager M, Rosbjerg A, et al. SARS-CoV-2 Antibody Responses Are Correlated to Disease Severity in COVID-19 Convalescent Individuals. The Journal of Immunology. 2021;206(1):109.
35. Hamed E, Sedeeq S, Alnuaimi AS, Syed M, ElHamid MA, Alemrayat B, et al. Rates of recurrent positive SARS-CoV-2 swab results among patients attending primary care in Qatar. The Journal of infection. 2021;82(4):84-123.
36. Hall VJ, Foulkes S, Charlett A, Atti A, Monk EJM, Simmons R, et al. SARS-CoV-2 infection rates of antibody-positive compared with antibody-negative health-care workers in England: a large, multicentre, prospective cohort study (SIREN). The Lancet. 2021;397(10283):1459-69.
37. Grifoni A, Weiskopf D, Ramirez SI, Mateus J, Dan JM, Moderbacher CR, et al. Targets of T Cell Responses to SARS-CoV-2 Coronavirus in Humans with COVID-19 Disease and Unexposed Individuals. Cell. 2020;181(7):1489-501.e15.
38. Gudbjartsson DF, Norddahl GL, Melsted P, Gunnarsdottir K, Holm H, Eythorsson E, et al. Humoral Immune Response to SARS-CoV-2 in Iceland. The New England journal of medicine. 2020;383(18):1724-34.
39. García-Abellán J, Padilla S, Fernández-González M, García JA, Agulló V, Andreo M, et al. Long-term clinical, virological and immunological outcomes in patients hospitalized for COVID-19: antibody response predicts long COVID. medRxiv. 2021:2021.03.08.21253124.
40. Fischer B, Lindenkamp C, Lichtenberg C, Birschmann I, Knabbe C, Hendig D. Evidence of long-lasting humoral and cellular immunity against SARS-CoV-2 even in elderly COVID-19 convalescents showing a mild to moderate disease progression. medRxiv. 2021:2021.02.23.21251891.
41. Fendler A, Au L, Boos LA, Byrne F, Shepherd STC, Shum B, et al. Adaptive immunity to SARS-CoV-2 in cancer patients: The CAPTURE study. medRxiv. 2020:2020.12.21.20248608.
42. De Giorgi V, West KA, Henning AN, Chen L, Holbrook MR, Gross R, et al. Anti-SARS-CoV-2 Serology persistence over time in COVID-19 Convalescent Plasma Donors. medRxiv. 2021:2021.03.08.21253093.
43. Chirathaworn C, Sripramote M, Chalongviriyalert P, Jirajariyavej S, Kiatpanabhikul P, Saiyarin J, et al. SARS-CoV-2 RNA shedding in recovered COVID-19 cases and the presence of antibodies against SARS-CoV-2 in recovered COVID-19 cases and close contacts, Thailand, April-June 2020. PloS one. 2020;15(10):e0236905.

44. Chen J, Xu X, Hu J, Chen Q, Xu F, Liang H, et al. Clinical course and risk factors for recurrence of positive SARS-CoV-2 RNA: a retrospective cohort study from Wuhan, China. Aging. 2020;12(17):16675-89.
45. Cao S, Gan Y, Wang C, Bachmann M, Wei S, Gong J, et al. Post-lockdown SARS-CoV-2 nucleic acid screening in nearly ten million residents of Wuhan, China. Nature Communications. 2020;11(1):5917.
46. Cao H, Ruan L, Liu J, Liao W. The clinical characteristic of eight patients of COVID-19 with positive RT-PCR test after discharge. Journal of medical virology. 2020;92(10):2159-64.
47. Breathnach AS, Riley PA, Cotter MP, Houston AC, Habibi MS, Planche TD. Prior COVID-19 significantly reduces the risk of subsequent infection, but reinfections are seen after eight months. J Infect. 2021;82(4):e11-e2.
48. An J, Liao X, Xiao T, Qian S, Yuan J, Ye H, et al. Clinical characteristics of recovered COVID-19 patients with re-detectable positive RNA test. Annals of Translational Medicine. 2020;8(17):1084.
49. Ali AM, Ali KM, Fatah MH, Tawfeeq HM, Rostam HM. SARS-CoV-2 Reinfection in Patients Negative for Immunoglobulin G Following Recovery from COVID-19. medRxiv. 2020:2020.11.20.20234385.
50. Adrielle dos Santos L, Filho PGdG, Silva AMF, Santos JVG, Santos DS, Aquino MM, et al. Recurrent COVID-19 including evidence of reinfection and enhanced severity in thirty Brazilian healthcare workers. Journal of Infection. 2021;82(3):399-406.
51. Abu-Raddad LJ, Chemaitelly H, Malek JA, Ahmed AA, Mohamoud YA, Younuskunju S, et al. Assessment of the risk of SARS-CoV-2 reinfection in an intense re-exposure setting. Clin Infect Dis. 2020.
52. Abdullah MS, Chong PL, Asli R, Momin RN, Mani BI, Metussin D, et al. Post discharge positive re-tests in COVID-19: common but clinically non-significant. Infectious Diseases. 2020;52(10):743-5.
53. Abu-Raddad LJ, Chemaitelly H, Coyle P, Malek JA, Ahmed AA, Mohamoud YA, et al. SARS-CoV-2 reinfection in a cohort of 43,000 antibody-positive individuals followed for up to 35 weeks. medRxiv. 2021:2021.01.15.21249731.
54. Váncsa S, Dembrovszky F, Farkas N, Szakó L, Teutsch B, Bunduc S, et al. Repeated SARS-CoV-2 Positivity: Analysis of 123 Cases. 2021;13(3):512.
55. Yan W, Chen D, Bigambo FM, Wei H, Wang X, Xia Y. Differences of blood cells, lymphocyte subsets and cytokines in COVID-19 patients with different clinical stages: a network meta-analysis. BMC Infectious Diseases. 2021;21(1):156.
56. Choudhary MC, Crain CR, Qiu X, Hanage W, Li JZ. Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) Sequence Characteristics of Coronavirus Disease 2019 (COVID-19) Persistence and Reinfection. Clinical Infectious Diseases. 2021.

57. Piri SM, Edalatfar M, Shool S, Jalalian MN, Tavakolpour S. A systematic review on the recurrence of SARS-CoV-2 virus: frequency, risk factors, and possible explanations. Infectious Diseases. 2021;53(5):315-24.
58. Arafkas M, Khosrawipour T, Kocbach P, Zielinski K, Schubert J, Mikolajczyk A, et al. Current meta-analysis does not support the possibility of COVID-19 reinfections. 2021;93(3):1599-604.
59. Farrukh L, Mumtaz A, Sana MK. How strong is the evidence that it is possible to get SARS-CoV-2 twice? A systematic review.n/a(n/a):e2203.
60. Bwire GM, Njiro BJ. A systematic review on the levels of antibodies in COVID-19 virus exposed but negative newborns: a possible vertical transmission of IgG/ IgM. medRxiv. 2020:2020.06.09.20127118.
61. Shrotri M, van Schalkwyk MC, Post N, Eddy D, Huntley C, Leeman D, et al. T cell response to SARS-CoV-2 infection in humans: A systematic review. 2021;16(1):e0245532.
62. Iwamura APD, Tavares da Silva MR, Hümmelgen AL, Soeiro Pereira PV, Falcai A, Grumach AS, et al. Immunity and inflammatory biomarkers in COVID-19: A systematic review. 2021;31(4):e2199.