Supplementary Online Content

Wu F, Liu M, Wang A, et al. Evaluating the association of clinical characteristics with neutralizing antibody levels in patients who have recovered from mild COVID-19 in Shanghai, China. *JAMA Intern Med.* Published online August 18, 2020. doi:10.1001/jamainternmed.2020.4616

eTable 1. Clinical Characteristics of Patients Who Recovered From COVID-19

eTable 2. Clinical Characteristics of COVID-19 Recovered Patients With Low, Medium-Low, Medium-High, and High Titers of SARS-CoV-2–Specific NAbs on Day of Discharge and Revisit

eTable 3. Clinical Characteristics and SARS-CoV-2–Specific NAb Titers of Younger, Middle-Aged, and Older COVID-19 Recovered Patients

eFigure 1. Plasma From Patients Who Recovered From COVID-19 Specifically Inhibited SARS-CoV-2 Infection but not SARS-CoV

eFigure 2. Correlation between SARS-CoV-2 NAb titers and Spike-Binding Antibodies

eFigure 3. Male Patients Who Recovered From COVID-19 Developed Significantly Higher NAb Titers Than Females

eFigure 4. Older and Middle-Aged Patients Who Recovered From COVID-19 Developed Higher Levels of SARS-CoV-2–Specific NAbs Than Younger Recovered Patients

eFigure 5. Correlation Between SARS-CoV-2–Specific NAb Titers at Discharge and Lymphocyte Count and CRP Levels at Admission

This supplementary material has been provided by the authors to give readers additional information about their work.
### eTable 1. Clinical Characteristics of Patients Who Recovered From COVID-19

| Patient | Sex | Age, y | Temperature, °C | Symptoms | TLC, /μL | CRP level, mg/dL | Duration, d | NAb titer, ID50 | Binding, OD 405d |
|---------|-----|--------|-----------------|----------|---------|----------------|-------------|-----------------|-----------------|
| 1       | F   | 30s    | 37.8            | Fever, nasal congestion | 2020    | <0.050         | 22          | 31              | NA              | 1.07 1.02 1.13  |
| 2       | F   | 30s    | 37.6            | Cough, muscle aches, nasal congestion | 1020    | 0.616          | 17          | 22              | 40              | 0.22 0.23 0.29  |
| 3       | M   | 10s    | 37.7            | Nasal congestion, cough | 2450    | 0.630          | 9           | 12              | 40              | 2.96 2.45 2.81  |
| 4       | F   | 30s    | 38.1            | Cough | 1300    | 0.560          | 8           | 12              | 40              | 0.55 0.46 0.42  |
| 5       | M   | 40s    | 37.9            | Cough, chest pain | 1590    | <0.050         | 13          | 14              | 40              | 1.16 0.87 1.04  |
| 6       | F   | 30s    | 37.4            | Fatigue | 1420   | <0.050         | 13          | 15              | 40              | 0.70 0.67 0.63  |
| 7       | F   | 60s    | 37.2            | Chills | 1830    | 0.251          | 18          | 22              | 40              | 0.35 0.57 0.42  |
| 8       | F   | 30s    | 38.1            | Sore throat, cough, chest tightness | 1350    | 0.398          | 21          | 23              | 40              | 3.46 2.37 3.28  |
| 9       | F   | 20s    | 38              | Cough | 2690    | <0.050         | 8           | 9               | 40              | 0.53 0.45 0.52  |
| 10      | F   | 30s    | 38.4            | Cough, dizziness | 2560    | <0.050         | 12          | 23              | 40              | 0.36 0.47 0.65  |
| 11      | M   | 30s    | 37              | Fever | 1750    | <0.050         | 8           | 9               | 89              | 232 2.08 3.06  |
| 12      | F   | 20s    | 37.6            | Fever | 2860    | <0.050         | 12          | 16              | 130             | 0.31 0.21 0.28  |
| 13      | M   | 40s    | 37.8            | Cough | 1420    | 0.088          | 9           | 20              | 186             | 0.51 0.54 1.36  |
| 14      | F   | 40s    | 37.2            | Cough, nasal congestion, fatigue | 1060    | 0.225          | 15          | 26              | 196             | 0.51 0.35 0.75  |
| 15      | F   | 30s    | 37              | Fever, sore throat | 1960    | <0.050         | 15          | 24              | 206             | 0.89 0.80 0.81  |
| 16      | M   | 30s    | 37.6            | Fever, sore throat | 1170    | <0.050         | 15          | 30              | 230             | 1.48 1.22 1.81  |
| 17      | F   | 60s    | 37.5            | Cough, nasal congestion | 1460    | 0.354          | 16          | 24              | 235             | 81 2.69 1.78 2.69 |
| 18      | F   | 30s    | 38.5            | Chills, headache | 630     | <0.050         | 18          | 22              | 239             | 105 0.43 0.26 1.59 |
| 19      | F   | 20s    | 37.9            | Fever, cough | 1270    | 0.344          | 16          | 21              | 242             | NA 1.34 1.11 1.30 |

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| # | Sex | Age | Temperature | Symptoms | Temperature | White Blood Count | Platelet Count | Neutrophil Count | Lymphocyte Count | Monocyte Count | Erythrocyte Count | Hemoglobin | Neutrophil Percentage | Lymphocyte Percentage | Monocyte Percentage | Erythrocyte Percentage |
|---|-----|-----|-------------|----------|-------------|------------------|----------------|-----------------|----------------|----------------|----------------|-------------------|-------------|---------------------|---------------------|---------------------|---------------------|
| 20 | F   | 40s | 36.8        | Fever    | 1750        | 1.490            | 17            | 18              | 264            | NA             | 0.78            | 0.74              | 0.99       |                     |                     |                     |                     |
| 21 | M   | 50s | 38.3        | Cough    | 980         | 1.028           | 13            | 17              | 273            | 464            | 0.82            | 0.76              | 1.56      |                     |                     |                     |                     |
| 22 | M   | 30s | 36          | Fever, cough | 1890      | 0.120           | 8             | 17              | 294            | NA             | 2.29            | 1.37              | 1.94      |                     |                     |                     |                     |
| 23 | F   | 40s | 39.2        | Fever, cough, sputum | 520     | 1.268           | 29            | 31              | 297            | NA             | 2.87            | 1.94              | 4.61      |                     |                     |                     |                     |
| 24 | M   | 20s | 38.1        | Fever    | 1420        | 1.773           | 13            | 16              | 322            | NA             | 0.82            | 0.59              | 0.98      |                     |                     |                     |                     |
| 25 | F   | 30s | 38.1        | Fever, cough | 730     | <0.050          | 23            | 25              | 324            | 220            | 1.68            | 0.63              | 1.63      |                     |                     |                     |                     |
| 26 | M   | 30s | 38.2        | Fever, cough | 2560     | <0.050          | 17            | 23              | 326            | 200            | 0.79            | 0.78              | 0.81      |                     |                     |                     |                     |
| 27 | M   | 30s | 38.4        | Fever, cough | 2350     | 0.697           | 13            | 21              | 327            | 292            | 0.94            | 0.65              | 0.86      |                     |                     |                     |                     |
| 28 | F   | 20s | 39.7        | Fever    | 1080        | 0.746           | 14            | 18              | 330            | NA             | 2.28            | 0.98              | 2.26      |                     |                     |                     |                     |
| 29 | F   | 50s | 38          | Chills, nasal congestion, cough | 650   | 1.117           | 9             | 15              | 333            | 453            | 0.91            | 1.06              | 1.11      |                     |                     |                     |                     |
| 30 | F   | 60s | 38.1        | Fever, cough, sputum | 900    | 3.461           | 15            | 17              | 343            | 435            | 1.52            | 0.93              | 2.70      |                     |                     |                     |                     |
| 31 | M   | 30s | 37.7        | Soreness, headache, nasal congestion | 1030  | 0.064           | 14            | 20              | 344            | NA             | 0.77            | 0.71              | 0.92      |                     |                     |                     |                     |
| 32 | M   | 30s | 38          | Fever    | 650         | 0.239           | 15            | 20              | 346            | 822            | 0.99            | 0.37              | 1.48      |                     |                     |                     |                     |
| 33 | F   | 50s | 37.6        | Fever, cough, sputum | 1720  | 2.859           | 14            | 19              | 350            | 116            | 1.64            | 0.86              | 2.01      |                     |                     |                     |                     |
| 34 | M   | 20s | 37.2        | Nasal congestion, itchy throat, headache | 1550  | 0.102           | 20            | 21              | 356            | NA             | 0.57            | 0.65              | 1.07      |                     |                     |                     |                     |
| 35 | F   | 60s | 37.8        | Fever, sputum, headache | 1400  | <0.050          | 24            | 29              | 357            | 377            | 2.15            | 1.53              | 2.56      |                     |                     |                     |                     |
| 36 | F   | 60s | 37.5        | Fever, cough | 750     | 0.460           | 18            | 23              | 369            | 462            | 1.45            | 1.05              | 1.14      |                     |                     |                     |                     |
| 37 | F   | 20s | 37.6        | Fever, cough | 1790  | 0.058           | 14            | 18              | 373            | 141            | 1.72            | 1.18              | 1.04      |                     |                     |                     |                     |
| 38 | F   | 30s | 38          | Fever, cough | 1900    | 0.249           | 14            | 20              | 378            | 115            | 1.84            | 0.79              | 2.06      |                     |                     |                     |                     |
| 39 | F   | 30s | 38          | Fever, headache, cough, nasal congestion | 1040  | 1.600           | 17            | 19              | 403            | 213            | 0.83            | 1.00              | 1.47      |                     |                     |                     |                     |
| 40 | M   | 30s | 36.4        | Cough    | 1390        | 0.875           | 9             | 13              | 404            | 404            | 1.07            | 0.66              | 1.32      |                     |                     |                     |                     |
| 41 | F   | 60s | 37.4        | Fever    | 1070        | 0.407           | 22            | 29              | 404            | 404            | 1.35            | 0.96              | 0.62      |                     |                     |                     |                     |
| 42 | F   | 50s | 38.5        | Fever    | 1880        | <0.050          | 27            | 29              | 405            | NA             | 1.24            | 0.88              | 2.25      |                     |                     |                     |                     |
| 43 | F   | 40s | 38          | Dizziness, fatigue | 640   | 0.135           | 11            | 13              | 446            | 142            | 1.22            | 1.07              | 1.30      |                     |                     |                     |                     |
| 44 | M   | 30s | 37.7        | Fever, fatigue | 1490    | 0.947           | 12            | 14              | 448            | 138            | 0.52            | 0.25              | 1.52      |                     |                     |                     |                     |

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| No. | Age | Sex  | Temperature | Symptoms                          | RR | 95% CI   | P-Value | Body Temperature | RR  | 95% CI   | P-Value |
|-----|-----|------|-------------|-----------------------------------|----|----------|---------|-----------------|----|----------|---------|
| 45  | 40s | F    | 38          | Nasal congestion, headache       | 1530 | 0.606    | 11      | 14              | 448 | 1054     | 1.00    |
| 46  | 60s | F    | 38.3        | Fever, fatigue, cough            | 1280 | 3.693    | 29      | 33              | 457 | 1557     | 2.02    |
| 47  | 30s | F    | 38.2        | Fever, fatigue, chest tightness  | 1080 | 0.794    | 30      | 33              | 471 | NA       | 2.38    |
| 48  | 30s | M    | 38.3        | Fever, cough                     | 870  | 1.226    | 24      | 27              | 473 | 379      | 2.38    |
| 49  | 50s | M    | 37.6        | Fever, cough                     | 1000 | 1.046    | 8       | 19              | 480 | 519      | 0.58    |
| 50  | 50s | F    | 37.2        | Chest tightness                  | 1070 | <0.050   | 13      | 15              | 481 | 262      | 0.75    |
| 51  | 50s | M    | 38.5        | Fever                            | 1570 | 6.257    | 25      | 29              | 484 | NA       | 2.38    |
| 52  | 50s | M    | 37.7        | Fever, cough                     | 910  | 1.877    | 11      | 21              | 488 | NA       | 2.71    |
| 53  | 40s | F    | 38          | Fever                            | 1500 | <0.050   | 16      | 27              | 504 | 270      | 0.72    |
| 54  | 70s | F    | 37.4        | Abdominal distention, nausea     | 720  | 2.768    | 25      | 31              | 507 | 1233     | 2.81    |
| 55  | 30s | M    | 37.4        | Cough                            | 1190 | 0.080    | 12      | 15              | 512 | 453      | 0.21    |
| 56  | 60s | F    | 37.8        | Fever, cough                     | 2510 | 1.351    | 17      | 21              | 513 | 181      | 1.41    |
| 57  | 50s | M    | 37.4        | Cough                            | 980  | <0.050   | 11      | 18              | 551 | 1453     | 1.58    |
| 58  | 60s | F    | 36.8        | Cough                            | 1320 | 0.487    | 17      | 22              | 562 | NA       | 1.14    |
| 59  | 40s | M    | 37.1        | Chest tightness, fatigue         | 1750 | 0.959    | 21      | 23              | 568 | 266      | 0.44    |
| 60  | 60s | F    | 37.8        | Fever, cough                     | 1830 | <0.050   | 14      | 17              | 574 | 186      | 0.57    |
| 61  | 20s | M    | 38.2        | Fever, dizziness                 | 2260 | <0.050   | 24      | 27              | 576 | NA       | 0.82    |
| 62  | 40s | M    | 37.2        | Fever                            | 1430 | 0.786    | 15      | 16              | 607 | 837      | 0.52    |
| 63  | 50s | F    | 38.5        | Fever                            | 1570 | 0.746    | 28      | 31              | 623 | NA       | 0.91    |
| 64  | 60s | M    | 37.2        | Cough                            | 1070 | 0.624    | 27      | 29              | 689 | NA       | 0.57    |
| 65  | 30s | M    | 37.6        | Fever                            | 1590 | 0.867    | 16      | 23              | 697 | 803      | 1.78    |
| 66  | 30s | F    | 37          | Fever                            | 2000 | 0.329    | 15      | 16              | 710 | NA       | 1.81    |
| 67  | 50s | M    | 37.2        | Cough, expectoration             | 750  | 1.238    | 7       | 14              | 715 | 285      | 1.52    |
| 68  | 30s | F    | 38.5        | Nasal congestion, cough          | 1870 | <0.050   | 20      | 26              | 718 | NA       | 2.42    |
| 69  | 20s | F    | 36.8        | Dizziness, nasal congestion      | 1470 | <0.050   | 12      | 14              | 725 | NA       | 1.66    |
|    |    |    |    |    |    |    |
|----|----|----|----|----|----|----|
| 70 | F  | 60s| 36.8|Fever | 740 | 1.139 | 13 | 15 | 765 | 408 | 0.75 | 0.42 | 1.00 |
| 71 | F  | 30s| 37.8|Fever | 1350| 1.387 | 22 | 31 | 768 | NA | 2.21 | 1.52 | 4.01 |
| 72 | F  | 30s| 37.3|Fever | 1250| 0.693 | 13 | 24 | 827 | NA | 1.58 | 0.86 | 2.19 |
| 73 | F  | 70s| 38  |Fever | 1450| 2.144 | 14 | 19 | 868 | NA | 2.45 | 1.69 | 4.72 |
| 74 | M  | 40s| 37.4|Cough | 590 | 7.635 | 8  | 17 | 870 | 1075| 1.61 | 1.25 | 2.74 |
| 75 | M  | 20s| 37.3|Chills, fatigue, cough, expectoration | 1810| <0.050 | 13 | 15 | 892 | 1732| 1.06 | 0.89 | 2.62 |
| 76 | F  | 60s| 37.5|Cough, chills, fever, muscle ache | 610 | 2.211 | 14 | 19 | 905 | NA | 1.47 | 0.63 | 3.97 |
| 77 | M  | 30s| 37.7|Fever, muscle ache | 1680| 0.792 | 16 | 19 | 964 | 938 | 0.78 | 0.52 | 2.00 |
| 78 | M  | 60s| 37.3|Fever, cough | 1520| <0.050 | 22 | 26 | 972 | NA | 1.86 | 1.86 | 3.09 |
| 79 | F  | 30s| 37.7|Fever, sore throat, fatigue | 2490| 0.442 | 14 | 18 | 979 | 219 | 1.23 | 0.92 | 2.11 |
| 80 | M  | 30s| 37.4|Chills, cough | 1790| <0.050 | 17 | 29 | 979 | NA | 0.87 | 0.60 | 3.26 |
| 81 | F  | 60s| 38.3|Cough, chills, nausea | 1140| 0.625 | 12 | 24 | 989 | 1137| 1.49 | 1.03 | 3.30 |
| 82 | M  | 30s| 38.9|Fever | 1090| 0.819 | 8  | 16 | 1004| 727 | 1.06 | 0.81 | 1.86 |
| 83 | F  | 30s| 37.7|Fever | 1230| 0.186 | 14 | 24 | 1022| 532 | 0.80 | 0.60 | 2.14 |
| 84 | F  | 40s| 38.1|Headache, muscle ache, fatigue | 720 | 0.777 | 23 | 27 | 1046| 1982| 0.79 | 0.57 | 2.50 |
| 85 | M  | 60s| 36.5|Fever | 1370| <0.050 | 20 | 20 | 1066| NA | 1.01 | 0.59 | 1.41 |
| 86 | F  | 50s| 37.4|Shortness of breath | 1640| 0.161 | 16 | 18 | 1070| NA | 1.04 | 0.46 | 1.58 |
| 87 | F  | 50s| 39 |Fever, fatigue, dizziness | 1200| 0.357 | 18 | 22 | 1075| 834 | 1.46 | 1.20 | 2.37 |
| 88 | F  | 50s| 38.3|Fever, cough | 690 | 1.150 | 25 | 26 | 1076| 1373| 2.48 | 2.24 | 2.64 |
| 89 | M  | 40s| 37.5|Fever | 1110| <0.050 | 18 | 20 | 1081| 1044| 0.50 | 0.31 | 1.33 |
| 90 | F  | 40s| 38.5|Fever, headache, chest tightness | 510 | 2.920 | 21 | 25 | 1088| 728 | 1.66 | 1.07 | 2.68 |
| 91 | F  | 60s| 38.4|Fever, fatigue, muscle ache | 1050| 1.094 | 10 | 16 | 1110| 509 | 2.76 | 2.14 | 2.02 |
| 92 | M  | 50s| 38.4|Chills, dry cough, poor appetite | 920 | 3.575 | 15 | 16 | 1158| 1045| 3.29 | 2.33 | 4.32 |
| 93 | F  | 60s| 37.3|Fever, chills, nausea | 850 | 1.898 | 12 | 17 | 1163| 424 | 1.08 | 0.86 | 1.89 |
| 94 | M  | 60s| 38.3|Cough | 1740| 5.475 | 15 | 17 | 1171| NA | 1.44 | 0.96 | 1.49 |

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|   |   |   |   |   |   |
|---|---|---|---|---|---|
| 95 | M | 40s | 38.1 | Fever | 920 | 4.410 | 18 | 22 | 1186 | 1268 | 2.03 | 1.33 | 1.57 |
| 96 | F | 40s | 38.2 | Fever, chest tightness | 1380 | 0.794 | 15 | 19 | 1219 | NA | 2.06 | 1.57 | 4.13 |
| 97 | F | 60s | 37.8 | Fever, fatigue | 1110 | 3.138 | 16 | 24 | 1232 | 886 | 1.63 | 1.49 | 1.26 |
| 98 | F | 60s | 37.9 | Fever, cough, chest tightness | 840 | 0.156 | 7 | 26 | 1272 | 996 | 3.08 | 2.12 | 4.50 |
| 99 | M | 40s | 37.5 | Fever, chest tightness | 770 | 1.646 | 16 | 24 | 1291 | 629 | 2.20 | 1.27 | 3.15 |
| 100 | F | 60s | 36.5 | Fever | 1250 | 0.254 | 16 | 26 | 1303 | NA | 1.31 | 0.78 | 3.29 |
| 101 | M | 60s | 38.6 | Fever, fatigue, muscle ache | 1110 | 0.457 | 14 | 20 | 1323 | 532 | 0.99 | 0.50 | 1.25 |
| 102 | F | 30s | 38.1 | Fever, cough | 620 | 1.314 | 25 | 30 | 1348 | NA | 1.21 | 1.28 | 0.74 |
| 103 | F | 40s | 38.7 | Fever, cough, chills | 990 | 5.214 | 10 | 20 | 1359 | 1026 | 3.29 | 2.17 | 1.31 |
| 104 | M | 50s | 37.5 | Fever, body aches | 1490 | 1.332 | 17 | 21 | 1401 | 1487 | 1.70 | 1.52 | 2.93 |
| 105 | F | 70s | 38 | Fever, cough | 1010 | 0.467 | 12 | 20 | 1411 | 2004 | 0.57 | 0.34 | 0.76 |
| 106 | M | 70s | 39 | Fever, muscle ache | 940 | 7.904 | 12 | 16 | 1433 | 866 | 2.41 | 1.42 | 4.63 |
| 107 | F | 30s | 38.3 | Cough, expectoration, fatigue, chills | 1660 | 1.708 | 23 | 32 | 1435 | NA | 2.73 | 2.91 | 3.28 |
| 108 | F | 60s | 37.2 | Fever, cough | 1320 | <0.050 | 22 | 23 | 1462 | 539 | 1.23 | 0.86 | 1.03 |
| 109 | M | 40s | 39 | Fever, cough | 940 | 0.986 | 29 | 34 | 1482 | NA | 1.42 | 1.00 | 0.85 |
| 110 | M | 30s | 37.5 | Nasal congestion, fever | 2060 | 1.416 | 13 | 17 | 1496 | NA | 0.88 | 0.67 | 1.80 |
| 111 | M | 30s | 37.6 | Fever, fatigue | 960 | 0.518 | 17 | 23 | 1522 | 955 | 0.70 | 0.46 | 1.05 |
| 112 | F | 50s | 38.7 | Fever, fatigue, cough | 570 | 0.195 | 13 | 18 | 1531 | 1368 | 4.15 | 2.52 | 4.52 |
| 113 | M | 50s | 39.1 | Fever, fatigue, cough | 510 | 2.518 | 19 | 22 | 1531 | 2278 | 1.96 | 1.49 | 2.38 |
| 114 | F | 50s | 37.6 | Fever | 1300 | 0.103 | 7 | 21 | 1605 | 1177 | 1.46 | 0.87 | 1.35 |
| 115 | F | 60s | 36.8 | Fever, nausea | 910 | <0.050 | 28 | 29 | 1611 | NA | 1.41 | 1.59 | 0.81 |
| 116 | F | 50s | 39 | Fever, dry cough | 2200 | 3.015 | 30 | 32 | 1642 | 3922 | 2.16 | 2.24 | 1.95 |
| 117 | M | 50s | 37.5 | Fatigue, chest tightness, muscle ache | 1480 | 1.384 | 22 | 23 | 1715 | NA | 1.76 | 1.60 | 1.53 |
| 118 | F | 40s | 37.1 | Cough | 1130 | 0.702 | 14 | 17 | 1731 | 1599 | 1.42 | 1.28 | 1.40 |
| 119 | F | 60s | 38.5 | Fever, cough | 670 | 2.581 | 17 | 24 | 1732 | 1773 | 3.57 | 3.06 | 4.11 |
| Patient | Sex | Age | Temperature | Symptoms | Heart Rate | Respiration | Blood Pressure | Oxygen Saturation |
|---------|-----|-----|-------------|----------|------------|-------------|---------------|------------------|
| 120     | M   | 50s | 38.6        | Fever, dry cough, sore throat | 930        | 2.491       | 27            | 31               |
| 121     | M   | 50s | 38.6        | Fever    | 900        | 2.656       | 27            | 29               |
| 122     | F   | 60s | 38.6        | Fever    | 1140       | 4.222       | 14            | 17               |
| 123     | F   | 70s | 37          | Cough    | 930        | 2.265       | 12            | 15               |
| 124     | M   | 50s | 38.4        | Fever, cough | 870        | 2.358       | 13            | 18               |
| 125     | M   | 60s | 38          | Fever    | 1600       | 7.010       | 17            | 22               |
| 126     | M   | 70s | 38          | Fever    | 520        | 7.615       | 20            | 22               |
| 127     | M   | 60s | 37.2        | Fever, cough | 132        | 0.271       | 26            | 29               |
| 128     | M   | 50s | 36.9        | Intermittent fever | 1160       | 1.489       | 16            | 23               |
| 129     | M   | 70s | 37.8        | Fever, cough | 800        | 0.664       | 14            | 24               |
| 130     | F   | 20s | 37.6        | Fever, cough | 720        | 0.058       | 14            | 17               |
| 131     | F   | 30s | 38.5        | Fever    | 790        | 0.262       | 20            | 21               |
| 132     | F   | 70s | 37.5        | Fever, chills, cough | 1390       | 0.672       | 25            | 28               |
| 133     | F   | 50s | 37.6        | Cough    | 910        | 3.133       | 13            | 15               |
| 134     | M   | 40s | 37.5        | Fever, chills, cough | 1810       | 0.865       | 8             | 11               |
| 135     | M   | 70s | 38.4        | Fever    | 1120       | 1.790       | 17            | 19               |
| 136     | M   | 40s | 38.1        | Fever, cough | 710        | 4.175       | 10            | 16               |
| 137     | M   | 60s | 37.3        | Cough, expectoration | 950        | 7.603       | 11            | 18               |
| 138     | M   | 40s | 38          | Chest tightness, shortness of breath | 910        | 3.467       | 8             | 22               |
| 139     | F   | 60s | 38          | Fever, muscle ache | 1790       | 1.088       | 17            | 22               |
| 140     | F   | 70s | 36.8        | Sore throat, poor appetite | 1470       | 0.322       | 29            | 31               |
| 141     | M   | 30s | 38.1        | Fever    | 1720       | 1.622       | 17            | 19               |
| 142     | M   | 60s | 38          | Fever, fatigue, poor appetite, cough | 440        | 3.196       | 10            | 19               |
| 143     | M   | 60s | 38          | Fever    | 910        | 4.646       | 16            | 18               |
| 144     | M   | 50s | 37.8        | Headache, cough, arthralgia | 700        | 4.181       | 11            | 16               |

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| Case | Gender | Age | Temperature | Symptoms | White Blood Cell Count | Neutrophils | Lymphocytes | Platelets | Creatinine | C-reactive Protein | Total Serum Proteins |
|------|--------|-----|-------------|----------|------------------------|-------------|-------------|-----------|------------|-------------------|----------------------|
| 145  | M      | 20s | 38          | Fever    | 2250                   | 0.358       | 10          | 22        | 2324       | NA                | 1.82                 |
| 146  | M      | 40s | 38.3        | Fever    | 1370                   | 1.436       | 22          | 26        | 2389       | 1370              | 2.05                 |
| 147  | M      | 20s | 38.2        | Fever, nausea | 770                | 0.526       | 23          | 27        | 2454       | 2513              | 1.30                 |
| 148  | F      | 40s | 38.8        | Fever, cough, nausea | 900            | 0.512       | 16          | 23        | 2466       | 751               | 1.58                 |
| 149  | F      | 50s | 38.7        | Cough, chest tightness, fatigue | 850            | 4.132       | 21          | 25        | 2474       | 1868              | 2.32                 |
| 150  | M      | 60s | 37.8        | Fever, cough | 580              | 4.333       | 10          | 15        | 2482       | NA                | 1.65                 |
| 151  | F      | 30s | 38          | Chills, fatigue | 890            | 2.582       | 13          | 22        | 2560       | 852               | 3.39                 |
| 152  | F      | 40s | 37.8        | Body aches | 970              | 1.981       | 20          | 22        | 2664       | 1397              | 1.98                 |
| 153  | M      | 70s | 39.3        | Chest tightness | 780            | 8.72        | 13          | 22        | 2984       | NA                | 2.30                 |
| 154  | F      | 60s | 37.7        | Cough, body aches | 920            | 1.451       | 18          | 22        | 3002       | 947               | 2.43                 |
| 155  | M      | 40s | 38.5        | Cough, fatigue | 790            | 5.419       | 10          | 13        | 3112       | 2970              | 1.44                 |
| 156  | M      | 70s | 37.5        | Arthralgia, fatigue | 720            | 3.830       | 18          | 28        | 3260       | 6900              | 1.50                 |
| 157  | M      | 50s | 38.1        | Cough, sputum | 1510           | 1.309       | 19          | 23        | 3372       | 3168              | 4.28                 |
| 158  | F      | 50s | 38          | Chills     | 1000          | 0.933       | 21          | 33        | 3476       | 1133              | 2.62                 |
| 159  | F      | 60s | 38          | Cough      | 540           | 4.257       | 22          | 31        | 3502       | NA                | 2.77                 |
| 160  | M      | 70s | 38.5        | Fatigue, muscle pain | 730            | 0.476       | 16          | 22        | 3567       | 1900              | 2.88                 |
| 161  | M      | 50s | 39.1        | Cough, sore throat | 750            | 0.675       | 26          | 32        | 3574       | NA                | 3.14                 |
| 162  | M      | 30s | 40          | Cough, headache | 680            | 6.347       | 25          | 29        | 3717       | 1835              | 3.56                 |
| 163  | F      | 80s | 38.1        | Cough, sore throat | 560            | 1.712       | 17          | 26        | 3800       | NA                | 1.92                 |
| 164  | F      | 50s | 38          | Fever      | 760           | 0.944       | 24          | 27        | 3830       | NA                | 1.75                 |
| 165  | F      | 40s | 37.6        | Cough      | 1140          | 0.156       | 11          | 18        | 3831       | 5379              | 0.78                 |
| 166  | M      | 60s | 39          | Cough, fatigue | 520            | 4.614       | 29          | 32        | 3977       | 6999              | 1.62                 |
| 167  | M      | 40s | 37.6        | Sore throat, fever, cough | 760            | 3.628       | 22          | 30        | 4353       | 3592              | 3.14                 |
| 168  | F      | 50s | 37.3        | Fever      | 800           | 0.190       | 16          | 21        | 4534       | 5615              | 1.74                 |
| 169  | M      | 60s | 38.6        | Fever      | 870           | 1.057       | 10          | 24        | 4818       | 2972              | 0.74                 |
|   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 170 | M | 60s | 37.7 | Fever | 820 | 6.170 | 23 | 23 | 5121 | 5014 | 4.33 | 3.53 | 1.66|
| 171 | F | 60s | 39 | Fever | 590 | 4.460 | 17 | 18 | 6389 | 2560 | 2.86 | 1.31 | 3.68|
| 172 | F | 60s | 38 | Fever, chills | 1260 | 4.859 | 14 | 18 | 6552 | 4937 | 3.69 | 1.78 | 1.33|
| 173 | M | 40s | 38.5 | Fever, muscle ache | 1330 | 0.990 | 17 | 21 | 6888 | 5622 | 2.71 | 2.32 | 2.72|
| 174 | M | 60s | 38.5 | Cough, shortness of breath, nausea | 540 | 8.305 | 14 | 18 | 15989 | NA | 4.33 | 3.53 | 4.13|
| 175 | M | 60s | 37.8 | Cough, shortness of breath | 960 | 2.329 | 19 | 21 | 21567 | 38995 | 3.80 | 1.84 | 2.97|

Abbreviations: CRP, C-reactive protein; ID50, 50% inhibitory dose; NA, not available; NAb, neutralizing antibody; OD 405, optical density at 405 nm; RBD, receptor-binding domain; S1, S2, spike proteins 1 and 2; TLC, total lymphocyte count.

SI conversion factors: To convert CRP to milligrams per liter, multiply by 10; and lymphocytes to $\times 10^9$ per liter, multiply by 0.001.

*The reference range for TLC is 1100/μL to 3200/μL.

*The reference range for blood CRP level is 0 to 1 mg/dL.

*Disease duration was defined as from the day of symptom onset to the day of discharge.

*Binding antibodies were tested at discharge.
**eTable 2. Clinical characteristics of COVID-19 recovered patients with low, medium-low, medium-high, and high titers of SARS-CoV-2-specific NAbs on day of discharge and revisit**

| Time Point | Patient Information | Low          | Medium-low | Medium-high | High          |
|------------|---------------------|--------------|------------|-------------|---------------|
|            |                     | <500         | 500-999    | 1000-2500   | >2500         |
| Discharge  | Recovered Patient No. (%) | 52 (30%)    | 29 (17%)   | 69 (39%)    | 25 (14%)      |
|            | Male (%)             | 19 (23%)     | 13 (16%)   | 36 (44%)    | 14 (17%)      |
|            | Female (%)           | 33 (35%)     | 16 (17%)   | 33 (35%)    | 11 (12%)      |
|            | Median Age (Years) [IQR] | 38 [31-53]  | 42 [35-66.5] | 56 [42-63.5] | 63 [44-68]    |
|            | Hosp. Stay (Days) [IQR] | 14.5 [12-19.5] | 15 [13-20.5] | 16 [12.5-21] | 18 [15-22]    |
|            | Dx duration (Days) [IQR] | 20 [16-24]  | 21 [16.5-26.5] | 22 [18-25]  | 23 [21-29.5]  |
|            | Median NT (ID50) [IQR] | 327 [189-404] | 715 [571-881] | 1642 [1282-2090] | 3800 [3316-4970] |
| Revisit    | Recovered Patient No. (%) | 39 (33%)    | 24 (21%)   | 35 (30%)    | 19 (16%)      |
|            | Male (%)             | 13 (23%)     | 13 (23%)   | 16 (28%)    | 14 (25%)      |
|            | Female (%)           | 26 (42%)     | 11 (18%)   | 19 (31%)    | 5 (8%)        |
|            | Median Age (Years) [IQR] | 40 [34-58]  | 42.5 [35.5-62]      | 52 [42-66]  | 58 [46-66]    |
|            | Hosp. stay (Days) [IQR] | 14 [12-17]   | 16 [13-17]  | 16 [12-21]  | 17 [11-23]    |
|            | Dx duration (Days) [IQR] | 19 [15-23]  | 22 [19-24]  | 21 [17-26]  | 21 [18-28]    |
|            | Median NT (ID50) [IQR] | 212 [114-379] | 766 [638-862] | 1373 [1133-1732] | 3922 [2972-5615] |

Abbreviations: IQR, interquartile range; Hosp., hospital; Dx, disease; NT, Neutralizing titer.
eTable 3. Clinical characteristics and SARS-CoV-2–specific NAb titers of younger, middle-aged, and older COVID-19 recovered patients.

| Patient Information | Age Distribution (Years) |
|---------------------|--------------------------|
|                     | 15-39 | 40-59 | 60-85 |
| Recovered Patient No. (%) | 55 (31) | 64 (37) | 56 (32) |
| Male (%)            | 27 (33) | 33 (40) | 22 (27) |
| Female (%)          | 28 (30) | 31 (33) | 34 (37) |
| Hosp. stay (days) [IQR] | 14.5 [13-20] | 16 [11-21] | 17 [14-22] |
| Disease duration (days) [IQR] | 21 [16-24] | 21 [17-26] | 22 [18-26] |
| Median NT (ID50) [IQR] | 459 [255-998] | 1291 [504-2126] | 1537 [877-2427] |

Abbreviations: IQR, interquartile range; Hosp., hospital; Dx, disease; NT, Neutralizing titer.
eFigure 1. Plasma from patients who recovered from COVID-19 specifically inhibited SARS-CoV-2 infection but not SARS-CoV. (A) Plasma from five patients who recovered from COVID-19 inhibited infection of SARS-CoV-2. Plasma from a healthy donor was used as a negative control. The assay was performed in duplicate and the median percentage of neutralization is shown. (B) Inhibition of live SARS-CoV-2 infection by serial-diluted plasma of patient 3, 170 and 174. Vero-E6 cell was used as a negative control and cells infected by the live SARS-CoV-2 was used as a positive control. The viral cytopathology is indicated by arrows. (C) Binding of plasma from patients who recovered from COVID-19 to SARS-CoV-2 RBD, S1, and S2 proteins and (D) SARS-CoV RBD and S1 proteins. (E) NAb titers (ID50) of 26 plasma samples from patients who recovered from COVID-19 against VSV, SARS-CoV, and SARS-CoV-2 pseudovirus are shown as boxplots and scatter plots. Median NAb titer against SARS-CoV-2 (2685 [1826-4060]) is significantly higher than those against SARS-CoV (40 [40-69], median difference 2645 [95% CI 2132-3245], P<.001) and VSV-G negative control (40 [40-58], median difference 2645 [95% CI 2137-3236], P<.001). No significant difference is observed between NAb titers against SARS-CoV and VSV-G control (median difference 0 [95% CI 0-0], P=.96)
eFigure 2. Correlation between SARS-CoV-2 NAb titers and spike-binding antibodies. (A) The alignment of kinetics between SARS-CoV-2 NAb titers and binding antibodies to S1, RBD, and S2 for individual patient. (B) The correlations between SARS-CoV-2 NAb titers and binding antibodies to S1, RBD, and S2 in 175 patients at the time of discharge are shown. NAb titers among these patients positively correlate with the spike-binding antibodies targeting S1 (r=0.451 [95% CI 0.320-0.564], P<.001), RBD (r=0.484 [95% CI 0.358-0.592], P<.001), and S2 regions (r=0.346 [95% CI 0.204-0.473], P<.001). Plasma from patient 3 and 8, which could not neutralize pseudovirus infection (ID50: <40) but developed high titers of spike-binding antibodies, are in red circle.
SARS-CoV-2 NAb Titer (ID50)

Discharge (N=175)

Revisit (N=117)

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eFigure 3. Male patients who recovered from COVID-19 developed significantly higher NAb titers than females. SARS-CoV-2-specific NAb titers in male (blue) and female (red) recovered patients on the day of discharge (A) or revisit after two weeks (B) are shown as boxplots and scatter plots. NAb titers are significantly higher in male patients (1417 [541-2253], \( N=82 \)) than those in females at the time of discharge (905 [371-1687], \( N=93 \), median difference 512 [95% CI 82-688], \( P=.011 \)) and at follow-up (1049 [552-2454, \( N=56 \) vs 751 [216-1301, \( N=61 \), median difference 298 [95% CI 86-732], \( P=.009 \)).
eFigure 4. Older and middle-aged patients who recovered from COVID-19 developed higher levels of SARS-CoV-2–specific NAbs than younger recovered patients. (A) NAb titers of younger (15-39 years, N=56), middle-aged (40-59 years, N=63), and older (60-85 years, N=56) patients at time of discharge are shown as boxplots and scatter plots. Older (1537 [877-2427]) and middle-aged patients (1291 [504-2126]) had significantly higher plasma NAb titers than younger patients (459 [225-998] median difference 1078 [95% CI 548-1287], P<.001 and median difference 832 [95% CI 284-1013], P<.001). (B) Correlation between ages of patients and SARS-CoV-2-specific NAb titers at time of discharge (r=0.414 [95% CI 0.279-0.533], P<.001). (C) RBD, S1, or S2 binding antibodies levels of older (blue, N=56), middle-aged (red, N=63), and younger patients (black, N=56) who recovered from COVID-19 were compared. RBD: older OD 405 [IQR], 1.995 [1.365-2.8], median difference 0.885 [95% CI 0.31-1.01], p<.001 and middle-aged 1.66 [1.04-2.32], median difference 0.52 [95% CI 0.03-0.7], P=.03, vs younger 1.14 [0.783-2.05]); S1: older (1.44 [0.872-1.92], median difference 0.645 [95% CI 0.23-0.75], p<.001 and middle-aged 1.2 [0.87-1.77], median difference 0.405 [95% CI 0.13-0.58], P=.002 vs younger 0.795 [0.592-1.258]); S2 older (2.44 [1.278-3.473], median difference 0.93 [95% CI 0.23-1.21], p=.002 and middle-aged 2.01 [1.4-2.72], median difference 0.5 [95% CI 0.12-0.82], P=.006 vs younger 1.51 [1.008-2.178]). (D) Length of hospital stay of younger 14.5 [13-20], middle-aged 16 [11-21], and older patients 17 [14-21.75]. No statistically significant difference was observed among the groups, P=.299, Kruskal-Wallis test)
A

B

C

D

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eFigure 5. Correlation between SARS-CoV-2-specific NAb titers at discharge and lymphocyte count and CRP levels at admission. (A) Correlation between patient age and lymphocyte counts at admission ($r= -0.355$ [95% CI -0.482 - -0.214], p<.001). (B) Correlation between patient age and C-reactive protein (CRP) level at admission ($r= 0.439$ [95% CI 0.307-0.554], p<.001). (C) Correlation between SARS-CoV-2-specific NAb titers at discharge and lymphocyte counts at admission ($r= -0.427$ [95% CI -0.544 - -0.293], P<.001). (D) Correlation between SARS-CoV-2-specific NAb titers at discharge and CRP levels at admission ($r=0.508$ [95% CI 0.386-0.614], P<.001). Correlations were calculated by Spearman correlation test, N=175. The reference normal ranges are 1100-3200 /μL for lymphocyte counts and 0-1 mg/dL for blood CRP level.