References

1. Kinross P, Suetens C, Gomes Dias J, Alexakis L, Wijermans A, Colzani E, et al.; ECDC Public Health Emergency Team. Rapidly increasing cumulative incidence of coronavirus disease (COVID-19) in the European Union/European Economic Area and the United Kingdom, 1 January to 15 March 2020. Euro Surveill. 2020;25. https://doi.org/10.2807/1560-7917.ES.2020.25.11.2000285
2. CDC COVID-19 Response Team. Coronavirus disease 2019 in children — United States, February 12–April 2, 2020. MMWR Morb Mortal Wkly Rep. 2020;69;422–426 [Epub ahead of print]. http://doi.org/10.15585/mmwr.mm6914e4
3. Castagnoli R, Votto M, Licari A, Brambilla I, Bruno R, Perlini S, et al. Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection in children and adolescents: a systematic review. JAMA Pediatr. 2020 Apr 22 [Epub ahead of print]. https://doi.org/10.1001/jamapediatrics.2020.1467

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Severe Acute Respiratory Syndrome Coronavirus 2 among Asymptomatic Workers Screened for Work Resumption, China

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After the outbreak in Wuhan, China, we assessed 29,299 workers screened for severe acute respiratory syndrome coronavirus 2 by reverse transcription PCR. We noted 18 (0.061%) cases of asymptomatic infection; 13 turned negative within 8.0 days, and 41 close contacts tested negative. Among 6 contacts who had serologic tests, none were positive.

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As the population of Wuhan, China, returns to work, asymptomatic cases of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) are being discovered among workers receiving health checkups for work resumption. Previous studies have shown that asymptomatic cases can be a public health threat and might lead to another outbreak (*1*,*2*). However, little is known about the clinical characteristics of asymptomatic infections. We report on cases of asymptomatic SARS-CoV-2 infection among persons during work resumption screening in Wuhan.

At Wuhan Pingan Healthcare Diagnostic Center, we reviewed 29,299 asymptomatic persons who were screened for SARS-CoV-2 by reverse transcription PCR (RT-PCR) and 22,633 asymptomatic persons tested for SARS-CoV-2 antibodies during March 13–April 25, 2020. Throat swab specimens were tested for SARS-CoV-2 by using Real-Time Fluorescent-PCR Kits (DAAN GENE Co., LTD, https://www.en.daangene.com; Appendix, https://wwwnc.cdc.gov/EID/article/28/9/20-1848-App1.pdf). We used colloidal gold-based immunochromatographic strip assay, Novel Coronavirus (SARS-CoV-2) IgM/IgG Antibody Detection Assay (Vazyme Biotech Co. Ltd., http://vazyme.bioon.com.cn) to perform antibody testing (Appendix). We recorded the demographic features, exposure history, RT-PCR and serology results, and imaging reports at the time of testing. We obtained follow-up data from persons screened by telephone.

Among 29,299 persons screened by RT-PCR, we confirmed 18 (0.061%) cases of SARS-CoV-2 infection. Of 22,633 persons tested for SARS-CoV-2 antibodies, 617 (2.7%) cases had positive IgG but negative IgM; 196 (0.87%) cases had positive IgG and IgM; and 40 (0.18%) cases had negative IgG but positive IgM.

The median age of 18 asymptomatic case-patients (10 male, 8 female) was 30.5 years (Table). Six (33.3%) cases had clear contact history with a confirmed case of SARS-CoV-2 infection. The median cycle threshold (C_t) values on the day of first positive RT-PCR were 38.2 (C_t range 37.2–39.3) for ORFa1b gene and 38.1 (C_t range 36.81–38.5) for N gene (Table). All antibody tests were obtained on the day of first positive RT-PCR except in 1 case (obtained 6 days later). Half (7/14) the cases had negative IgM and IgG; the other half had positive IgG but negative IgM results (Table). Among 8 case-patients who had computed tomography imaging of the chest, none had remarkable findings. We closely observed the cases for 3–41 (median 16.5) days; 13 cases had negative RT-PCR within a median of 8 (range 3–14) days (Table), and none had symptoms. Among 41 close contacts, all had 2 consecutive negative RT-PCR tests ≥24 hours apart.

Among 6 contacts who had serologic tests, none had positive results.

According to Wuhan Municipal Health Commission (*3*), 275,400 RT-PCR tests were performed for universal screening during April 9–15, 2020. Among those, 182 (0.066%) asymptomatic persons were identified as SARS-Cov-2–positive, which is consistent with our study. Half the cases in our study showed negative IgM and IgG at the time of positive RT-PCR, suggesting recent infections (≤14 days). Seven (50%) cases in our study had positive IgG but negative IgM, indicating a late stage infection, 4 of which had a long interval of exposure (30–75 days). In addition, 13 cases had negative RT-PCR assays ≤8 (range 3–14) days, suggesting a favorable prognosis for persons with asymptomatic infections.

Epidemiologic, virologic, and modeling evidence support the possibility of SARS-CoV-2 transmission from persons who are presymptomatic (SARS-CoV-2 detected before symptoms onset) or asymptomatic (never develop symptoms) (*4*). None of the 18 asymptomatic persons in our study developed symptoms. Recent reports showed that the viral load of SARS-CoV-2 infections in persons with no or mild symptoms was similar to the viral load of symptomatic patients (*5*,*6*), which could contribute to rapid transmissions (*5*). However, other studies demonstrated that asymptomatic patients had a lower viral load than symptomatic and presymptomatic patients (*7*,*8*,*9*), which might indicate less transmissibility from asymptomatic persons. The median cycle threshold values for the 18 cases were 38.2 for ORFa1b gene and 38.1 for the N gene, indicating a relatively low viral load. In addition, all 41 close contacts of the asymptomatic case-patients tested negative by RT-PCR. Possible explanations for this finding include that: the asymptomatic infected persons had relatively low viral load and were less infectious; that asymptomatic persons did not have clinical symptoms, such as sneezing or coughing, that could cause virus spread; and that, due to the strict isolation and preventive measures taken in Wuhan for ≥3 months, the population was generally protected from the spread of infection by mask-wearing and self-quarantine.

Table 1. Clinical characteristics of asymptomatic persons with detected severe acute respiratory syndrome coronavirus 2 infection, Wuhan, China*

Age, y/sex	Occupation	Underlying condition	Interval, d†	Exposure source	RT-PCR	C_t ORFa1b	C_t N	Interval, d‡	IgM	IgG	Chest CT	Interval, d§	Follow-up, d
29/M	Office worker	N	70	Family	+, –, –	37	38	5	–	+	Normal	0	41
32/M	Journalist	N	54	Bus passenger	+, +, –	39	38	9	–	+	Normal	0	41
27/M	Journalist	N	NA	Unclear	+, –	35	32	3	–	–	Normal	0	39
31/F	Researcher	N	61	Family	+, –, –, –, –	36	38	7	–	–	NA	NA	23
27/M	Office worker	N	75	Family	+, –, –, –	33	35	3	–	+	Normal	0	21
32/F	Housewife	N	NA	Unclear	+, –, –	38	37	14	–	–	NA	NA	17
37/F	Office worker	N	22	Family	+, –, –, –	40	39	8	NA	NA	NA	NA	16
57/M	Logistics dispatcher	Asthma	NA	Unclear	+, –, –	39	37	8	NA	NA	Normal	10	16
25/M	Banking	N	NA	Unclear	+, –, –	38	38	8	NA	A	NA	NA	16
26/M	Marketing	N	NA	Unclear	+	39	38	NA	–	–	NA	NA	17
23/M	Marketing	N	NA	Unclear	+, –	38	38	13	–	–	Normal	5	17
26/F	Office worker	N	NA	Unclear	+, –	38	40	14	NA	NA	NA	NA	17
60/F	Cleaner	N	NA	Unclear	+	37	37	NA	–	+	NA	NA	13
65/M	Cleaner	COPD	NA	Unclear	+	39	39	NA	–	–	Normal	0	13
28/F	Office worker	N	NA	Unclear	+	38	39	NA	–	+	NA	NA	8
33/F	Office worker	N	30	Family	+, –	39	37	12	–	+	Normal	0	14
30/F	Office worker	N	NA	Unclear	+, –	39	38	10	–	+	NA	NA	13
62/M	Worker	Hypertension	NA	Unclear	+	39	39	NA	–	–	NA	NA	3

*COPD, chronic obstructive pulmonary disease; CT, computed tomography; C_t ORFa1b, RT-PCR cycle threshold for the ORFa1b gene; C_t N, RT-PCR cycle threshold for the N gene; N, no; NA, not available; +, positive; –, negative.
†Days between last exposure and initial positive RT–PCR.
‡Days between first positive and first negative RT-PCR results
§Days between first positive RT-PCR and CT scan.

Our report has limitations. Our sample size of asymptomatic cases is small, and follow-up was short. Recall bias of exposure history is another limitation; in the absence of clear symptom onset, asymptomatic persons might be less likely to accurately recall exposures than persons with symptoms. Finally, that the study took a place during the post-peak period of the epidemic in Wuhan, so contacts could have been seropositive already; those tested were seronegative, but most contacts did not have serologic testing.

In conclusion, as the population returns to the workplace, asymptomatic SARS-CoV-2–infected persons could be among workers. Although we did not detect transmission among 41 contacts of persons who were SARS-CoV-2–positive, such transmission cannot be excluded. Therefore, continued testing, self-quarantine, and mask-wearing should be encouraged to reduce the risk for additional outbreaks.

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References

1. Qiu J. Covert coronavirus infections could be seeding new outbreaks. Nature. 2020 Mar 20 [Epub ahead of print]. https://doi.org/10.1038/d41586-020-00822-x
2. Pan A, Liu L, Wang C, Guo H, Hao X, Wang Q, et al. Association of public health interventions with the epidemiology of the COVID-19 outbreak in Wuhan, China. JAMA. 2020;323:1–9. https://doi.org/10.1001/jama.2020.6130
3. Wuhan Municipal Health Commission. CN-HEALTHCARE: Hubei health, 2020 April 19 [in Chinese] [cited 2020 May 25]. https://www.cn-healthcare.com/articlewm/20200419/content-1105403.html
4. Furukawa NW, Brooks JT, Sobel J. Evidence supporting transmission of severe acute respiratory syndrome coronavirus 2 while presymptomatic or asymptomatic. Emerg Infect Dis. 2020 May 4 [Epub ahead of print]. https://doi.org10.3201/eid2607.201595
5. Arons MM, Hatfield KM, Reddy SC, Kimball A, James A, Jacobs JR, et al. Presymptomatic SARS-CoV-2 infections and transmission in a skilled nursing facility. N Engl J Med. 2020;382:2081–90. https://doi.org/10.1056/NEJMoa2008457
6. Zou L, Ruan F, Huang M, Liang L, Huang H, Hong Z, et al. SARS-CoV-2 viral load in upper respiratory specimens of infected patients. N Engl J Med. 2020;382:1177–9. https://doi.org/10.1056/NEJMc2001737
7. Kim SE, Jeong HS, Yu Y, Shin SU, Kim S, Oh TH, et al. Viral kinetics of SARS-CoV-2 in asymptomatic carriers and presymptomatic patients. Int J Infect Dis. 2020;95:441–3. https://doi.org/10.1016/j.ijid.2020.04.083
8. He D, Zhao S, Lin Q, Zhuang Z, Cao P, Wang MH, et al. The relative transmissibility of asymptomatic COVID-19 infections among close contacts. Int J Infect Dis. 2020;94:145–7. https://doi.org/10.1016/j.ijid.2020.04.034
9. Zhou R, Li F, Chen F, Liu H, Zheng J, Lei C, et al. Viral dynamics in asymptomatic patients with COVID-19. Int J Infect Dis. 2020;96:288–290. https://doi.org/10.1016/j.ijid.2020.05.03

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Effects of Proactive Social Distancing on COVID-19 Outbreaks in 58 Cities, China

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Cities across China implemented stringent social distancing measures in early 2020 to curb coronavirus disease outbreaks. We estimated the speed with which these measures contained transmission in cities. A 1-day delay in implementing social distancing resulted in a containment delay of 2.41 (95% CI 0.97–3.86) days.

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Appendix

Reverse Transcription-PCR (RT-PCR) for Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2)

We performed real-time fluorescent PCR analysis on ABI 7500 (Thermo Fisher Scientific, https://www.thermofisher.com). The throat swab specimens were tested for SARS-CoV-2 by using Real-Time Fluorescent-PCR Kits (DAAN GENE Co., LTD, https://www.en.daangene.com). The coincidence rate of negative reference products (–/–) is 10/10 and all are negative; the coincidence rate of positive reference products (+/+) is 5/5.

The coefficient of variation (CV, %) of the precision cycle threshold (C_t) value is $\leq$5.0%. The minimum detection amount is $\leq$1 × 103 copies/mL. We did not detect cross reaction with human coronavirus (HKU1, OC43, NL63 and 229E), SARS coronavirus, MERS coronavirus (HKU1, OC43), other viruses, or human genomic DNA.

Method for SARS-CoV-2 Antibody Assays

We tested for SARS-CoV-2 IgM/IgG antibodies by using colloidal gold-based immunochromatographic strip assay, Novel Coronavirus (SARS-CoV-2) IgM/IgG Antibody Detection Assay (Vazyme Biotech Co. Ltd., http://vazyme.bioon.com.cn). The tested specimen (serum/plasma) diffuses upward by capillary force at the loading end and passes

through the marker pad. The SARS-CoV-2 IgM antibody and IgG antibody in the sample combine with the recombinant antigen colloidal gold to form a colloidal gold-labeled antigen-test IgM complex and a colloidal gold-labeled antigen-test IgG complex diffusing into nitrocellulose membrane. The strip includes 3 indicator lines, T1 for IgM, T2 for IgG, and C indicating control.