

COVID-19 Science Update



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 Intended for use by public health professionals responding to the COVID-19 pandemic.

*** Available on-line at <https://www.cdc.gov/library/covid19> ***

Epidemiology

PEER-REVIEWED

[Lockdown contained the spread of 2019 novel coronavirus disease in Huangshi City, China: Early epidemiological findings.](#) Ji *et al.* Clinical Infectious Diseases (April 7, 2020).

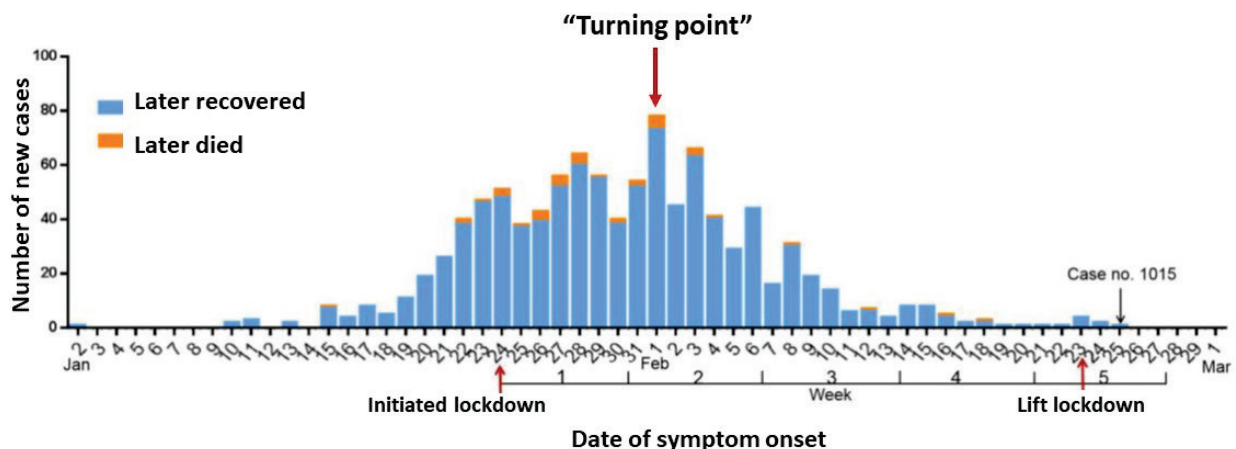
Key findings:

- Containment measures, including travel restrictions and other nonpharmaceutical interventions (NPI), were associated with flattening of the epidemic curve starting 9 days after implementation.
- 82.7% of COVID-19 patients (n = 1,015) had uncomplicated illness or mild pneumonia; 50 (5%) of infected patients remained asymptomatic.
- Percentage of uncomplicated illness increased in patients with symptom onset after containment measures were implemented (23.3% to 46.5%).

Methods: Investigators analyzed publicly available data of reported COVID-19 cases and epidemiological data from local field investigations to assess the effect of a lockdown (cessation of travel to/from Huangshi on January 24, 2020) and additional NPI. On January 25, 2020, Huangshi implemented real-time syndromic surveillance and health screenings, and other NPI (quarantine for incoming travelers, social distancing, face mask use when outdoors, and closure of schools and businesses). **Limitations:** Individual impacts of interventions not evaluated; reasons for increase in uncomplicated cases not explored but possibly related to earlier and broader detection of COVID-19 cases with increased testing.

Implications: Early implementation of travel restrictions and NPI can minimize COVID-19 growth.

Figure:



Note: Adapted from Ji *et al.* Epidemic curve of confirmed COVID-19 cases in Huangshi between January 2 and March 1, 2020, by symptom onset date. Lockdown initiation (January 24) and “turning point” (February 1) are noted with red arrows. Open access journal; all content freely available.

[Contact transmission of COVID-19 in South Korea: novel investigation techniques for tracing contacts.](#) Korea Centers for Disease Control and Prevention. Osong Public Health and Research Perspectives. (February 11, 2020).

Key findings and Methods: South Korea public health employed a novel and potentially controversial contact tracing strategy put in place following a 2015 MERS outbreak. The strategy included confirming movement using cell phone GPS records and credit card transactions, closed-circuit television video footage to identify patients’ respiratory symptoms (e.g., cough), and contact exposure risks (e.g., whether patients wore masks, proximity of contact to patient). *Limitations:* No data on effectiveness, acceptability, time, or resources required for each method; privacy safeguards not described.

Implications: Novel technology-based approaches to augment contact tracing and exposure assessments may have contributed to success controlling COVID-19 in South Korea. Assessments of the feasibility, effectiveness, resource utilization, and privacy concerns of these approaches are needed.

PREPRINTS (NOT PEER-REVIEWED)

[COVID-19 testing, hospital admission, and intensive care among 2,026,227 United States veterans aged 54-75 years.](#) Rentsch *et al.* medRxiv. (April 14, 2020).

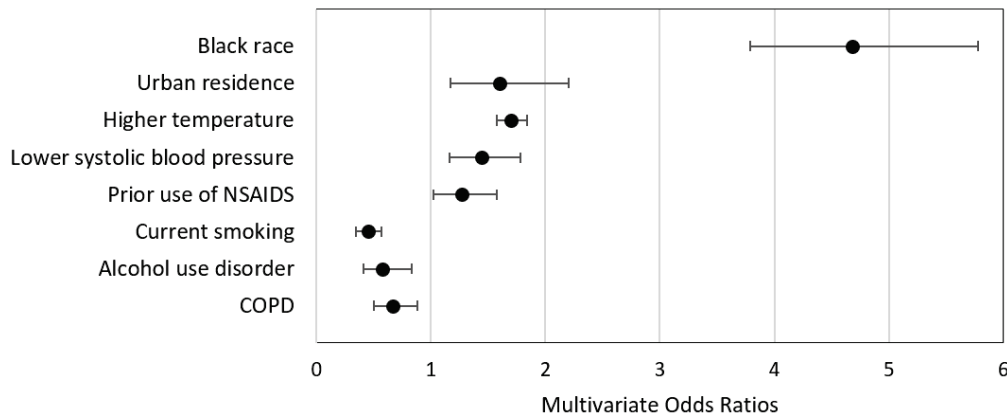
Key findings:

- 15.4% of assessed US veterans aged 54-75 years tested positive for COVID-19.
- Black race was a risk factor for infection (Figure), but not for need for hospitalization or ICU transfer when controlling for underlying medical conditions.
- Neither use of ACE inhibitors/angiotensin receptor blockers (ARBs) nor non-steroidal anti-inflammatory drugs (NSAIDs) was associated with hospitalization or ICU transfer.

Methods: Retrospective cohort study of 3,789 veterans tested for COVID-19 in the Veterans Affairs Birth Cohort (2,026,227 veterans aged 54-75 years and active in care). Electronic health record data from the national Veterans Affairs Healthcare System were used to assess patient characteristics and clinical outcomes. *Limitations:* Most subjects (90%) were male; many patients were still in care at time of analysis, and thus unable to assess outcomes, including death.

Implications: Findings indicate higher risk for COVID-19 among US veterans of black race. ACE/ARBs and NSAIDs did not increase risk for severe disease.

Figure:



Note: Adapted from Rentsch *et al.* Figure shows multivariate odds ratios and 95% confidence intervals for factors associated with testing positive for COVID-19. Licensed under CC-BY-NC-ND 4.0.

Modeling & Transmission

PEER-REVIEWED

[High contagiousness and rapid spread of severe acute respiratory syndrome coronavirus 2](#). Sanche *et al.* Emerging Infectious Diseases. (April 7, 2020).

Key Findings:

- In the early stages of the Wuhan COVID-19 outbreak, the estimated growth rate was 0.2-0.3 cases/day, corresponding to doubling time for cases of 2.3-3.3 days (Figure 1), and the median expected number of cases generated by one case (R_0) was 5.7.
 - These estimates are double those previously reported in the literature.
- One month into the Wuhan epidemic:
 - Time from symptom onset to hospitalization decreased from 5.5 to 1.5 days.
 - Estimated incubation period was 4.2 days.
- To control the Chinese epidemic, herd-immunity must reach >82% to safely reduce robust nonpharmaceutical interventions and surveillance (Figure 2).

Methods: Using key epidemiologic parameters derived from a first-arrival model (based on high-resolution domestic travel data) and a case-count model (based on 140 case reports from within and outside Hubei province), the authors assessed R_0 early in the Wuhan epidemic and the impact of non-pharmaceutical interventions (NPI).

Limitations: Likely underestimated time from symptom onset to hospitalization given that most cases had severe symptoms.

Implications: COVID-19 appears to have spread much faster in Wuhan than initially estimated.

Figure 1:

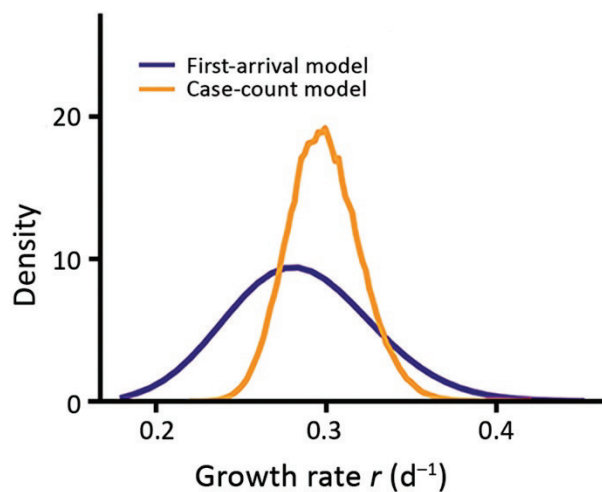
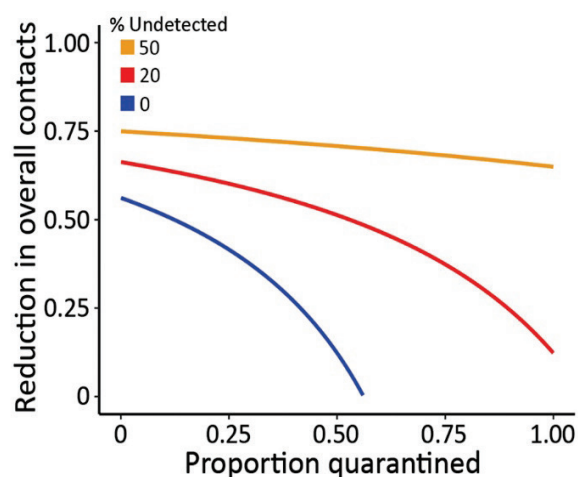


Figure 2:



Note: Adapted from Sanche *et al.* **Figure 1** shows the similarly estimated growth rates (r) for the **first-arrival model** (dark purple line, model derived from travel data to estimate the arrival time of the first case in a province) and **case-count model** (yellow line, model derived from cases diagnosed outside of Hubei but had recent travel history to Hubei) which represent the doubling time for cases per day. The peak of each curve indicates the most likely growth rate for each model. **Figure 2.** The lines in this figure represent the minimum levels of intervention strategies needed to control the epidemic (defined as $R_0 < 1$), at **100% case detection (blue line)**, **80% case detection (red line)** and **50% case detection (yellow line)**. The intervention strategies are on the y-axis (reducing case contact rates) and x-axis (proportion of people quarantined). Open access journal; all content freely available.

First-wave COVID-19 transmissibility and severity in China outside Hubei after control measures, and second-wave scenario planning: A modelling impact assessment. Leung *et al.* Lancet (April 8, 2020).

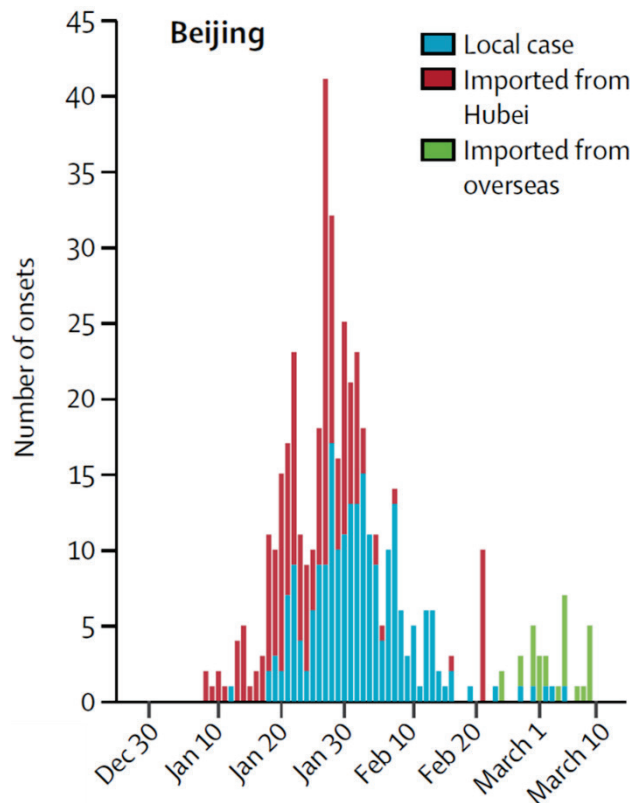
Key Findings:

- In four Chinese cities and 10 provinces outside of Hubei province, COVID-19 transmission decreased after implementing strict containment measures; the effect was stronger when implemented earlier.
- The estimated confirmed case fatality rate (cCFR) outside Hubei was 0.98% (Hubei estimate was 5.9%).
- In the absence of herd immunity, modeling predicts that containment measures in China are still necessary to prevent an increase in COVID-19 case incidence or case importation (Figure).

Methods: Epidemiologic data from 4 large Chinese cities were modeled while accounting for delays between symptom onset and reporting to estimate the instantaneous reproduction number (R_t) and cCFR in 10 provinces outside Hubei (results for Beijing shown in Figure). These parameters were used in models to simulate the potential impact of relaxing containment measures after the first wave of the epidemic. **Limitations:** Reporting delay was extrapolated for half of cases for which onset date was unavailable.

Implications: Modeling suggests that in regions outside Hubei, the reproductive rate of COVID-19 substantially decreased after implementing strict containment measures. However, escalating case importation or local transmission are likely to lead to a second wave of COVID-19 if there is no herd immunity or non-pharmaceutical interventions are relaxed too soon.

Figure:



Note: Adapted from Leung *et al.* The daily number of people with COVID-19 symptom onset for Beijing, China, colored by **Hubei imports**, **local transmission** and **overseas imports** – between December 30, 2019 and March 10, 2020. As the local epidemic wanes, new cases are almost all imported from overseas. This article was published in Lancet, Vol 395, Leung *et al.*, First-wave COVID-19 transmissibility and severity in China outside Hubei after control measures, and second-wave scenario planning: A modelling impact assessment, Pages 1382-1393, Copyright Elsevier 2020. This article is currently available at the Elsevier COVID-19 resource center: <https://www.elsevier.com/connect/coronavirus-information-center>.

PREPRINTS (NOT PEER-REVIEWED)

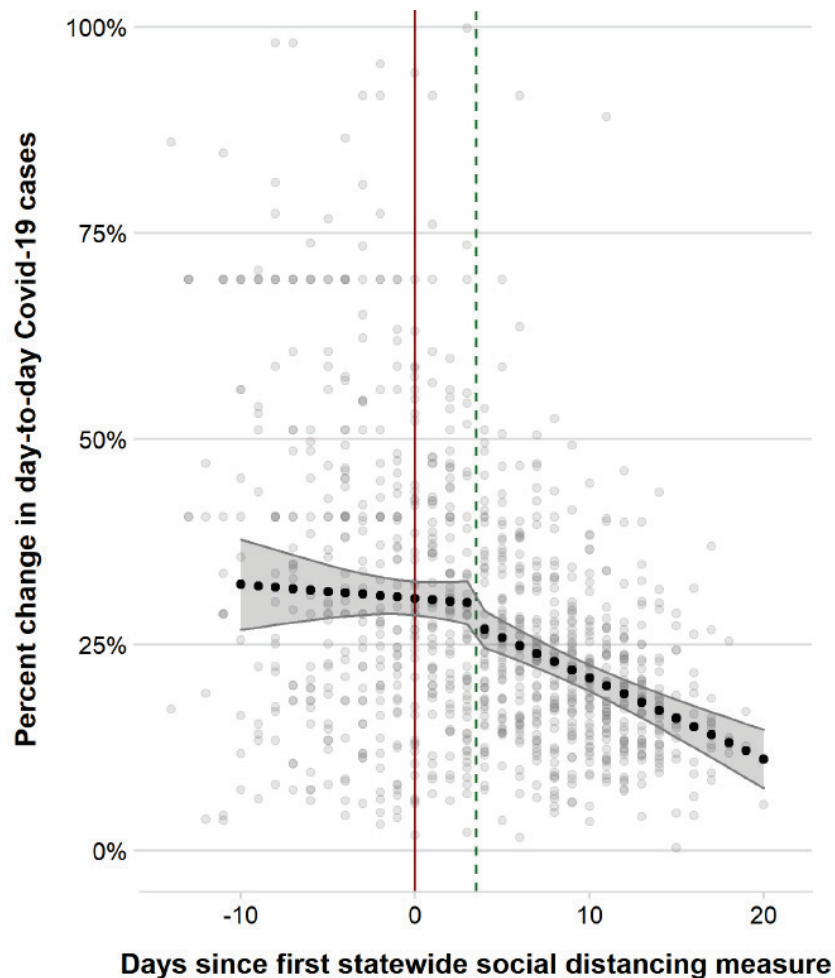
[Social distancing to slow the U.S. COVID-19 epidemic: Interrupted time-series analysis.](#) Siedner *et al.* medRxiv (April 8, 2020). [Updated analysis](#) published in PLoS Medicine (August 11, 2020).

Key findings:

- Social distancing measures decreased the daily COVID-19 case count by 0.8% (Figure).
- Using the dates that social distancing measures started by state, nationwide COVID-19 cases fell by ~3,000 after 7 days and by ~68,000 after 14 days.
- 14 days of social distancing slowed the doubling time for cases from 3.3 to 5.0 days.

Methods: Within each US state, the change in daily COVID-19 cases was compared for two periods: pre- and post-implementation of social distancing. **Limitations:** Ecological study using data from the New York Times COVID-19 database; possible confounding by changes in SARS-CoV-2 testing; pre-implementation period included the first 3 days after measures were emplaced (note that COVID-19 incubation period presently averages 5 days).

Implications: Modeling suggests social distancing reduced the daily growth rate of US COVID-19 cases.

Figure:

Note: Adapted from Siedner *et al.* Scatter plots and predictive margins with 95% confidence interval of the daily COVID-19 growth rate pre- vs. post-implementation of the first statewide social distancing measures. The **red line** indicates the date of implementation in each state. The **green dashed line** is 4 days after implementation of the social distancing measure. Licensed under CC-BY-NC-ND 4.0.

Real-time detection of COVID-19 epicenters within the United States using a network of smart thermometers. Chamberlain *et al.* medRxiv (April 10, 2020).

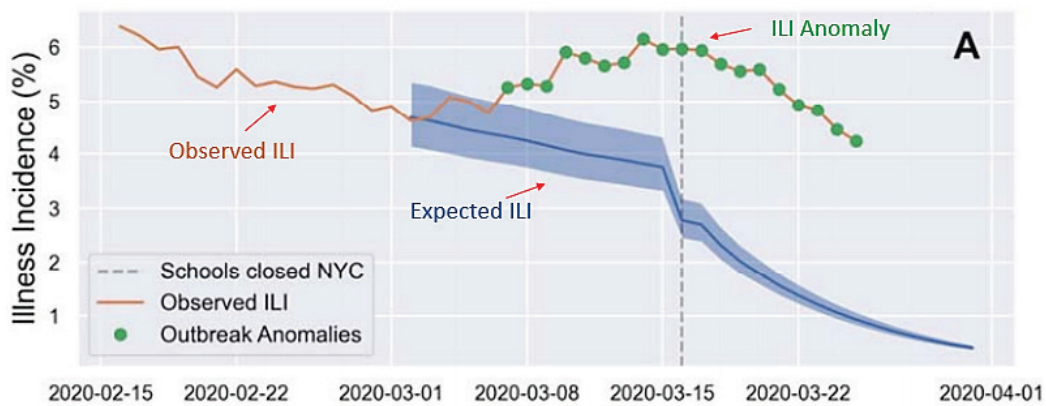
Key findings:

- Data from a geospatial network of home thermometers (www.kinsahealth.co/) identified unusual levels of influenza-like illness (ILI) that correlated with COVID-19 case counts at county and state levels.

Methods: Investigators compared county and state level forecasts of ILI with real-time measures of ILI using temperature readings captured from smartphone-connected home-use thermometers. Rates of ILI higher than expected seasonal influenza rates were flagged as anomalies. **Assumptions:** Social distancing reduces influenza transmission by 25%. **Limitations:** Number of users not described; investigators did not observe anomalous pattern of fevers in three states with confirmed COVID-19 cases; cost and feasibility of large-scale implementation not discussed.

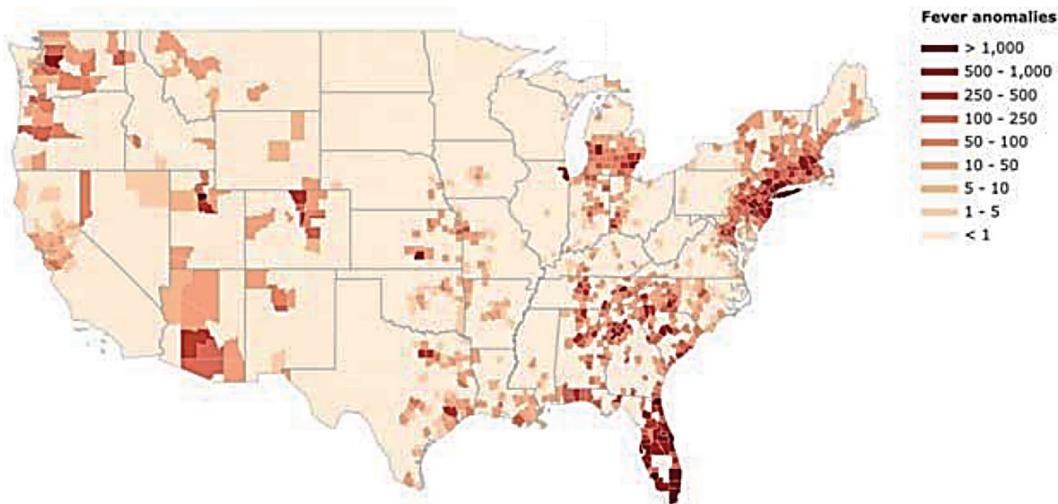
Implications: Real-time identification of ILI anomalies using home-based thermometers could provide an early-warning system for identifying COVID-19 hot spots, potentially reducing disease burden and slowing transmission.

Figure 1



Note: Adapted from Chamberlain *et al.* **Blue line and shaded area** are the median expected influenza forecast and 2.5-97.5th percentile of the forecast, respectively, over time for Brooklyn, NY. Investigators estimated 25% reduction after NYC schools closed (dashed grey line) on March 16, 2020. Observed ILI anomalies illustrated with **orange line** and **green dots**. Licensed under CC-BY-NC 4.0

Figure 2



Note: Adapted from Chamberlain *et al.* Figure shows national map of estimated cumulative ILI anomalies between March 1 and 24, 2020 (larger anomalies shown in darker **red**). Licensed under CC-BY-NC 4.0.

Clinical Treatment & Management

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Maternal and neonatal outcomes of pregnant women with COVID-19 pneumonia: A case-control study. Li *et al.* Clinical Infectious Diseases (March 30, 2020).

Key findings:

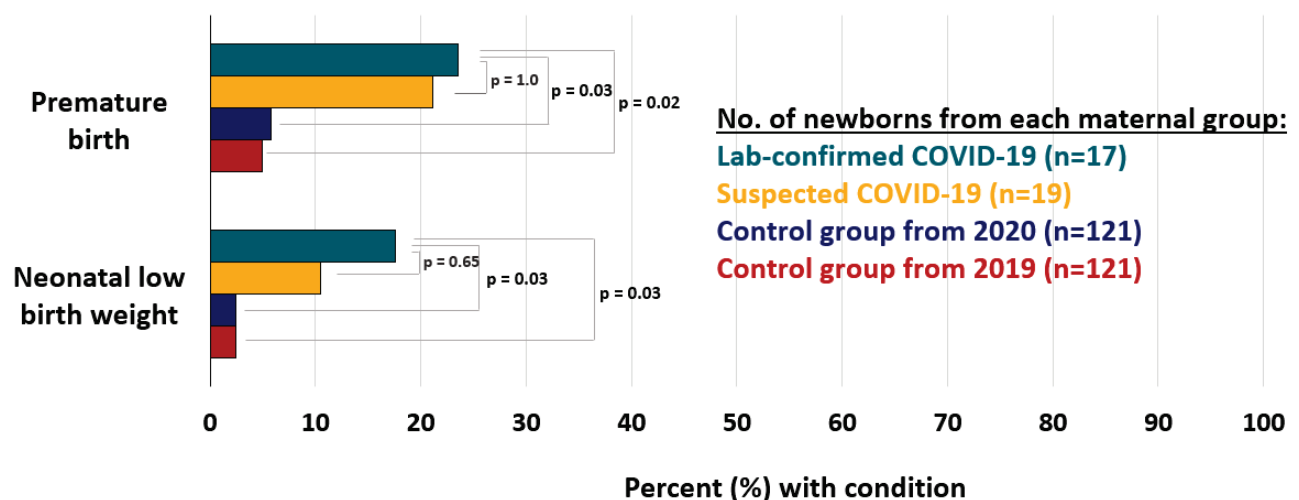
- Among 34 pregnant women with *confirmed or suspected* COVID-19 at hospital admission, most had chest CT images indicative of COVID-19 pneumonia but had no fever or cough.
- Among 16 *confirmed* cases, 69% (n = 11) had gestational complications on admission, including pre-eclampsia (n = 1), premature rupture of membranes (n = 1), and gestational hypertension (n = 1). None required admission to the ICU.
- Premature delivery and low birth weight of the neonates were more common in women with COVID-19 than in women in 2 control groups (Figure).
- No newborns developed COVID-19 or experienced severe neonatal complications.

Methods: Medical chart abstraction case-control study of pregnant women with confirmed (n = 16) and suspected (n = 18) COVID-19 pneumonia. Confirmed cases: CT showed typical COVID-19 findings and positive SARS-CoV-2 RT-PCR. Suspected cases: same CT criteria but negative RT-PCR tests. Controls were randomly selected from among pregnant women in similar age range (n = 121) in 2020 and (n = 121) in 2019 from the same maternity center.

Limitations: Small sample; no control group of women with other infections.

Implications: Compared to control groups of healthy women, pre-term delivery and low birth weight were common among women with suspected or confirmed COVID-19. About half of lab-confirmed cases had no signs or symptoms of illness, suggesting that CT scans might be useful for COVID-19 diagnosis at presentation for delivery; however, this must be weighed against potential late third-term radiation exposure (see first piece in the “In the news” section below).

Figure:



Note: Adapted from Li *et al.* Newborns of mothers with COVID-19 were more often born prematurely and more often had low birth weight than newborns of mothers who did not have COVID-19. Available via Oxford University Press Public Health Emergency Collection through PubMed Central.

In Brief

- Hope *et al.* [Chest computed tomography for detection of coronavirus disease 2019 \(COVID-19\): Don't rush the science](#). *Annals of Internal Medicine*. Drawing on publications describing the use of chest CT for diagnosing COVID-19, authors discuss the importance of not rushing the science, even during the COVID-19 pandemic.
- Keesara *et al.* [COVID-19 and health care's digital revolution](#). *NEJM*. Call to unleash the “power of digital technologies” for the COVID-19 response.
- Studdert *et al.* [Disease control, civil liberties, and mass testing — Calibrating restrictions during the Covid-19 pandemic](#). *NEJM*. On the intersection of disease control, civil liberties, and mass testing in the United States, focused on asking: “When & how will restrictions be unwound?”
- Gostin *et al.* [Governmental public health powers during the COVID-19 pandemic: Stay-at-home orders, business closures, and travel restrictions](#). *JAMA*. Discusses the balance between public health objectives and individual rights in implementation of COVID-19 response activities in the United States.

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