COVID19 - What We Know So Far About.... Infection in Children

Introduction

“What We Know So Far” documents are intended to provide an overview of some of the published and grey-literature reports related to emerging issues with respect to coronavirus disease 2019 (COVID-19). The reports are found through ongoing scanning of the published literature and scientific grey literature (e.g., ProMed, CIDRAP, Johns Hopkins Situation Reports), as well as media reports. It is recognized that there may be additional information not captured in this document. As this is a rapidly evolving outbreak, the information will only be current as of the date the document was written.

Key Points

- Evidence to date suggests that approximately 1-10% of COVID-19 cases are in children. Children of all ages appear to be susceptible and sex has not been identified as a risk factor.

- Children tend to have mild infections, with a substantial portion being asymptomatic. This means the pediatric prevalence of COVID-19 may be difficult to determine, and is likely to be underestimated.

- Although rare, there are reports of severe illness in children with some requiring mechanical ventilation. Deaths have also been reported. Large studies in both China and the United States suggest severe and critical outcomes may be more common in children under the age of one and those with underlying medical conditions.

- Recent media reports have described a number of clusters of Kawasaki Disease-like illness in children. The association between this illness and COVID-19 is at present unclear, but requires further investigation.

Prevalence of Pediatric Infections

Reports to date suggest children account for 1-10% of all confirmed COVID-19 cases:

- **China**: Of 44,672 laboratory-confirmed cases of COVID-19 as of February 11th, 965 (2.2%) were in those aged 0-19 years. This included 416 (0.9%) in children aged 0-9 years and 549 (1.2%) in children aged 10-19 years. In smaller studies that have examined hospitalization, one study reported children under 15 years accounted for 9 (0.9%) out of 1,011 cases, while another study reported children under 17 years accounted for 36 (5.4%) out of 661 cases.

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- **South Korea**: Of 4,212 confirmed cases of COVID-19 as of March 2nd, 201 (4.8%) were in those aged 0-19 years. This included 32 (0.8%) in children aged 0-9 years and 169 (4.0%) in children aged 10-19 years.

- **United States**: Of 149,082 COVID-19 cases as of April 2nd, with complete age information, 2,572 (1.7%) were in children aged 0-17 years.

- **Italy**: Of 212,532 confirmed cases of COVID-19 as of May 6th, an estimated\(^1\) 4,038 (1.9%) were in children aged 0-18 years.

- **Iceland**: Of 1,801 COVID-19 cases as of May 11th, 181 (10.0%) were in children aged 0-17 years.

- **New Zealand**: Of 1,497 COVID-19 cases as of May 12th, 155 (10.4%) were in children aged 0-19 years.

- **Canada**: Of 34,860 COVID-19 cases as of May 11th, with a case report form received by the Public Health Agency of Canada, 1,876 (5.4%) were in children aged 0-19 years.

It is possible that these reports underestimate the true prevalence of COVID-19, as children are more likely to be asymptomatic or mildly symptomatic, and testing is often prioritized for recent travelers, healthcare workers and those with severe symptoms. Therefore, these estimates may increase in countries planning on expanding test capacity and the groups prioritized for testing.

**Clinical Spectrum of Pediatric Infection**

A substantial portion of pediatric cases are identified through contact tracing of family clusters. These cases are initially asymptomatic or mildly symptomatic, although some go on to develop more significant symptoms.

**Asymptomatic Pediatric Infection**

A number of case reports and case series have described asymptomatic COVID-19 infection in children:

- Studies based on pediatric populations have found 22%-28% of COVID-19 cases to be asymptomatic (Qiu et al, Lu et al). A large study reported that 13% of confirmed COVID-19 cases in children were asymptomatic (Dong et al). Since many jurisdictions prioritize testing of symptomatic individuals, it is possible that asymptomatic infection is more prevalent than has been reported.

- Children with asymptomatic and presymptomatic COVID-19 infection have often been identified through cluster investigations involving one or more adult family members (Li et al, Li et al, Pung et al, Qian et al, Wei et al). Asymptomatic infections have been shown to occur at any age (Chan et al, Li et al, Qian et al, Wei et al, Xu et al). Some children continue to be asymptomatic, with no clinical signs of infection (Pan et al, Tang et al), while others may develop symptoms after testing positive (Pung et al).

- Chest CT scans have identified signs of lung infection in some asymptomatic children (e.g., patchy ground-glass opacities) (Li et al, Li et al, Chan et al); while other children with asymptomatic infection have had normal chest CT scans described (Pan et al). A review of 39 asymptomatic pediatric cases of

\(^1\) This number has been estimated based on the percent that was reported.
COVID-19 at Wuhan Children’s Hospital reported that 12 (30.8%) had radiologic features of pneumonia while 27 (69.2%) had no radiologic features (Lu et al).

Mild Pediatric Infection

Children with COVID-19 often present with mild, sometimes nonspecific symptoms. A number of case reports and case series have described symptomatic COVID-19 in children:

- Similar to asymptomatic cases, children at any age may present with mild infection (Ji et al, Liu et al, Wei et al, Xia et al).
- Fever has been reported in about half of all cases (4 out of 9 cases in Wei et al, 12 out of 20 cases in Xia et al) and cough is frequently reported (Chang et al, Fang et al, Lou et al, Xia et al, Xu et al), but it may not develop until after children are tested (Zhang et al). Symptoms such as nausea, vomiting (Fang et al, Liu et al), and diarrhea (Fang et al, Xu et al) have also been reported. Based on data from China and the United States, the following symptoms are most common in children: cough (48-54%), fever (41-56%), sore throat (24-46%) diarrhea (8-13%), dyspnea (13%), vomiting (6-11%), nasal congestion (5-8%), and abdominal pain (8%). In one case, a child was hospitalized due to diarrhea and no other symptoms were present (Ji et al). Symptoms observed in adult populations, such as lethargy, dyspnea, muscle ache, and headache, do not appear to be common in children (Xu et al).
- Several studies suggest that children, as compared to adults, may be less likely to present with traditional COVID-19 symptoms. Of 291 pediatric cases in the United States, at least one symptom of COVID-19 (fever, cough or shortness of breath) was observed in 73% of children versus 93% of adult cases. Qiu et al examined 36 pediatric cases and found that, when compared to adult cases, children had a significantly lower prevalence of: fever (36% for children versus 86% for adults) and cough (19% versus 62%) (p<0.0001 for each).

Radiologic Features

- The most common radiologic finding in a hospital-based study of 171 pediatric infections was bilateral ground-glass opacities (32.7%) (Lu et al). Case reports and case series also describe shadows and ground-glass opacities identified in one or both lungs (Liu et al, Xu et al, Zhang et al). In smaller hospital based studies (Xia et al, Zheng et al), chest CT scans indicated bilateral involvement of the lungs in approximately half of all cases (48%-50%) and unilateral involvement in approximately one-quarter of all cases (20%-30%).

Severe Pediatric Infection

Case series and surveillance reports have also described severe pediatric infections due to COVID-19, particularly in young children and those with underlying conditions:

- Of 745 pediatric cases of laboratory-confirmed COVID-19 in the United States, 147 resulted in hospitalization, including 15 ICU admissions. Infants aged less than 1 year accounted for 13% (95) of total pediatric cases and 33% (5) of the ICU admissions. Among a subset of 295 children with complete information, 77% (28 out of 37) of those hospitalized and 12% (30 out of 258) of those not hospitalized had at least one underlying medical condition (ie. chronic lung disease, cardiovascular disease, immunosuppression). Three deaths were reported (ages not provided and cause of death not yet determined).
- Dong et al described 2,143 cases of laboratory-confirmed (731, 34.1%) or suspected (1,412, 65.9%) COVID-19 in children. The median age was 7 years (ranging from 1 day to 18 years). Cases were grouped
by severity based on clinical features, laboratory testing and chest imaging: 94 (4.4%) asymptomatic, 1,088 (51.0%) mild, 826 (38.7%) moderate, 112 (5.3%) severe, and 13 (0.6%) critical. Although infants aged less than 1 year accounted for 17.6% of overall cases (85 laboratory-confirmed cases and 291 suspected cases), they made up 32.0% of the severe and critical cases (33 out of 112 severe cases and 7 out of 13 critical cases). No additional information, such as underlying medical condition or age in months, was presented for infants. There was no statistically significant difference in case severity by sex. There was one death in a 14-year-old male.

- Eight COVID-19 pediatric patients (three critical and five severe; age range: 2 months - 15 years) at Wuhan Children’s Hospital presented with symptoms of: rapid breathing, fever and cough. Chest imaging showed multiple patch-like shadows in seven patients and ground-glass opacity in six patients. Laboratory findings revealed normal or increased whole blood counts, increased C-reactive protein, procalcitonin and lactate dehydrogenase, and abnormal liver function. Six children required oxygen therapy, with two also requiring mechanical ventilation; one recovered and was discharged (male, 13 months) and the other remained in ICU at the time of follow-up (male, 8 years, with acute lymphoblastic leukemia who also tested positive for influenza) (Sun et al).

- One previously healthy three-year-old female was admitted to the ICU with fever lasting 11 days (Liu et al). Two males, aged 8 and 12 months with pre-existing congenital heart disease, required mechanical ventilation, corticosteroids, and immunoglobulin (Zheng et al). Three children were treated in the ICU and required mechanical ventilation (Lu et al); all had previous conditions (hydronephrosis, leukemia, intussusception) and one child, a 10-month-old infant with an intestinal obstruction [intussusception], died of organ failure.

- A cluster of eight children presenting with atypical Kawasaki Disease or toxic shock syndrome was reported in the United Kingdom in mid-April (Riphagen et al). Although these children were previously healthy and tested negative for COVID-19, subsequent testing confirmed they all had COVID-19 antibodies. Similar reports of Kawasaki Disease-like illness in children have been recently reported in Europe and North America, but the potential association with COVID-19 is unclear and requires further investigation.

**Neonatal Infection**

A small number of studies have described COVID-19 infection during the first month of life in children born to mothers infected during pregnancy:

- Three neonates tested positive for COVID-19 shortly after birth via caesarean section at Wuhan Children's Hospital in a case series of 33 pregnant women who tested positive for COVID-19 (Zeng et al). The first newborn developed lethargy and fever on day 2 and a chest CT confirmed pneumonia. The second newborn presented with lethargy, vomiting, and fever, with pneumonia confirmed by chest CT imaging. Laboratory tests also showed leukocytosis, lymphocytopenia, and elevated creatine kinase-MB fraction. The third newborn was delivered preterm (31 weeks + 2 days) due to fetal distress. Resuscitation was required. Neonatal respiratory distress syndrome and pneumonia were confirmed and treated with noninvasive ventilation.

- A neonate tested positive for COVID-19 approximately 36 hours after birth via caesarean section (Yu et al). The newborn had mild shortness of breath, no fever or cough, and recovered quickly.
References


Citation

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