

Brief Report



Epidemiology and Prognosis of COVID-19 Among Children in Northwest Iran

Farinaz Amirikar^{1*}, Nemat Bilan¹, Amir Hossein Jafari-Rouhi¹, Shahram Abdoli Oskouie¹, Babak Abdinia¹, Mirhadi Mousavi¹, Mehri Rasekhi¹, Roghayye Nasiri¹, Sina Hamzehzadeh²¹Pediatric Health Research Center, Tabriz University of Medical Sciences, Tabriz, Iran²Student Research Committee, Tabriz University of Medical Sciences, Tabriz, Iran

Article info

Article History:

Received: September 17, 2024

Revised: December 29, 2024

Accepted: January 17, 2025

ePublished: July 8, 2026

Keywords:

SARS-CoV-2, Epidemiology,
COVID-19, Pediatric,
Coronavirus

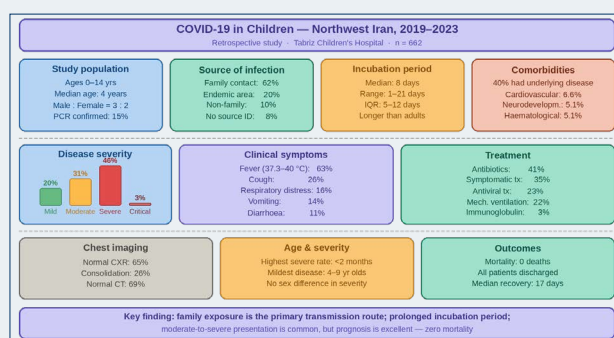
Abstract

Introduction: Individuals across all age are susceptible to COVID-19, and this disease has spread globally, it may continue to pose a long-term threat to public health. For this reason, a complete understanding of the epidemiological and clinical characteristics of COVID-19 can help control the disease's spread and improve patients' recovery rate during this pandemic. The death rate is crucial in turning an infection into a public concern and pandemic risk. We aimed to evaluate the epidemiological profile and prognosis of pediatric patients with COVID-19 at Tabriz Children's Hospital, Iran.

Methods: We conducted a retrospective study of children with suspicious COVID-19 diagnoses in northwest Iran between 2019 and 2023. Six hundred sixty-two children who are suspected of having COVID-19 due to respiratory and other clinical symptoms according to the national protocol, as well as MISC patients (multi-System inflammatory following COVID-19, including patients with gastrointestinal, pulmonary, cardiovascular symptoms, and increased IgM and IgG levels) admitted to the COVID ward, were included in the study.

Results: The average age of the patients was 48 months, with a male-to-female ratio of 3:2. 62.3% of patients had a history of contact with infected family members. Most of the patients were delivered by cesarean section. The average incubation period of the disease was eight days. The disease was confirmed positive in 15% of patients by the PCR test. 46.5% of patients had severe disease. The most common clinical symptoms of the patients were fever and cough. 40.3% of patients with COVID-19 had an underlying developmental disease. The most common treatments for patients involved antibiotic and antiviral therapies.

Conclusion: We conclude that in most children with COVID-19, the origin of the infection was typically family exposure, and they often had a prolonged incubation period. Most patients infected with the SARS-CoV-2 virus are asymptomatic or present with moderate to severe symptoms; the most common clinical symptoms are high fever and cough



Introduction

At the end of 2019, an out break of pneumonia epidemic caused by the novel coronavirus started in Wuhan, China, and then spread worldwide.¹ The causative agent of this disease is SARS-CoV-2 (severe acute respiratory syndrome coronavirus 2).² In addition to COVID-19, coronaviruses also cause SARS (severe acute respiratory syndrome) and MERS (Middle East respiratory syndrome), and can be

seen as a sign of severe respiratory distress³. COVID-19 has a long latent period in adults, with more severe disease, atypical clinical symptoms, and high mortality^{4–6}.

Since people of any age are susceptible to COVID-19 infection, and the disease has spread worldwide, it can pose a significant threat to human health for an extended period. 5, 6 For this reason, a complete understanding of the epidemiological and clinical characteristics of

*Corresponding Author: Farinaz Amirikar, Email: Amirikarfarinaz@gmail.com© 2026 The Author(s). This is an open access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0/>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

COVID-19 can help control the disease's spread and improve patients' recovery rate during this pandemic. The death rate is crucial in turning an infection into a public concern and pandemic risk. Different viruses spread annually as epidemics, but very few become a public health concern.⁷⁻⁹ SARS (severe acute respiratory syndrome), swine H1N1 (swine influenza A H1N1 virus), and Ebola (Zaire ebolavirus) viruses have caused global concern in recent years due to their widespread involvement and high mortality rates.^{10, 11} The COVID-19 disease has also attracted attention and caused concern due to the high mortality rate.^{12, 13} For example, although influenza is widespread, its death rate is only 0.1% of cases.

Some reports have also shown that COVID-19 is highly infectious through various routes.¹³⁻¹⁵ Although the rate of infection is one of the main factors, the rate of death caused by COVID-19 is not correctly estimated; Because the primary mortality rate is reported only in patients with severe conditions, and they are just part of the statistical population, and patients with mild and moderate conditions are not included in the study¹⁵. The widespread spread of this virus has led to hundreds of thousands of patients^{16, 17}. Very few studies have evaluated the infection of COVID-19 in children¹⁸⁻²⁰ compared to adults. Especially, the epidemiological and clinical characteristics of COVID-19 should be fully defined in children aged 0 to 14 years. Additionally, due to the increasing global trend of this disease and the emergence of various variants, the number of affected children is rising significantly^{19, 21}. On the other hand, based on the geographical situation and other epidemiological variables associated with each infectious disease, its epidemiological and clinical characteristics also differ. For this reason, this study will be designed and implemented to evaluate the epidemiology of patients with COVID-19 at Tabriz Children's Hospital, Iran.

Methods

Study Sample

All children referred to Tabriz Children's Hospital between 2019 and 2023 were enrolled in this study. We evaluated children aged 0 to 14 years who presented with respiratory symptoms (such as cough and wheezing) and were suspected of having a COVID-19 infection.

Based on past studies and using the Power and Sample Size software, with an alpha error of 5% and a power of 90%, the proportion of referrals with a definite diagnosis of COVID in the recent pilot study was 40% ($p=0.4$). Therefore, the minimum sample size is 126 patients. The sampling was complete.

Six hundred sixty-two children are suspected of having COVID-19 due to respiratory symptoms and other clinical symptoms according to the national protocol, as well as MISC patients (multi-System inflammatory following COVID-19, including patients with gastrointestinal, pulmonary, cardiovascular symptoms and increased IgM and IgG levels) and admitted to the Covid ward were included in the study.

Evaluations

Patients' demographic information, including age, gender, delivery method (cesarean section, vaginal delivery), history of underlying diseases, family history of COVID-19, history of close contact with a person infected with COVID-19, city of residence, and travel history within the previous 3 months, was recorded.

For all the studied patients, a COVID-19 PCR test (using a nose and throat swab) was performed after hospitalization, and the results were recorded from the patient's clinical records. Paraclinical tests were also recorded, including CBC (with Diff), BUN, Creatinine, ALT, AST, CRP, ESR, and chest radiography or CT scan. The interval between the onset of symptoms and diagnosis, as well as the start of treatment and discharge, was also recorded.

The severity of COVID-19 was determined based on clinical symptoms, laboratory test results, and chest radiography as mild, moderate, and severe, which are based on the following criteria⁸:

1. Asymptomatic infection: patients without clinical symptoms, a normal chest X-ray, and a positive PCR.
2. Mild infection: patients with upper respiratory symptoms, fever, contusion, myalgia, cough, sore throat, runny nose, nasal congestion, normal chest auscultation, and gastrointestinal symptoms, including nausea, vomiting, abdominal pain, and diarrhea.
3. Moderate infection: patients with pneumonia, multiple fevers, cough (primarily dry with occasional expectoration), auscultation without hypoxia and related symptoms; or asymptomatic patients with more than 20% involvement in chest CT scan.
4. Severe infection: respiratory symptoms, fever, and cough, accompanied by digestive symptoms, including diarrhea. Illness lasting one week with dyspnea and central cyanosis. Oxygen saturation below 92% or other symptoms indicating hypoxia.
5. Critical infection: Children who progress rapidly to ARDS or respiratory arrest, shock, encephalopathy, myocardial damage and cardiac arrest, coagulation disorders, and kidney damage.

Statistical Analysis

The obtained data were analyzed using SPSS statistical analysis software version 21. Demographic information was reported using descriptive statistics, and the results were presented as median (Q1-Q3) and frequency (%). Data normality was checked using the Kolmogorov-Smirnov test. Chi-square tests or Fisher's exact test (depending on the normality of the data) were used to compare qualitative variables. A p -value less than 0.05 was considered statistically significant.

Results

Epidemiological characteristics of COVID-19

This study extracted clinical information from 745 children suspected of having COVID-19 from their

Table 1. Epidemiological characteristics of COVID-19

Variable	Finding
Age (month), median (range)	48 (2 days - 15 years)
Gender ratio	
Male/Female (ratio)	377/285 (1.32)
Disease contamination source	
Family members with COVID-19	363/583 (62.3%)
Non-family members with COVID-19	57/583 (9.8%)
Exposure to the epidemic area	119/583 (20.4%)
Negative	44/583 (7.5%)
Data unavailable	79/662 (11.9%)
Gestational delivery	
NVD	239 (36.1%)
C/S	423 (63.9%)
Incubation period (days), Median (Q1-Q3)	8 (5-12) (range: 1-21)
Diagnosis	
Suspected COVID-19	563 (85%)
Confirmed by PCR COVID-19	99 (15%)

NVD: Natural vaginal delivery; C/S: Cesarean section

clinical health records. Children under the age of 15 were included in the study. The records that showed the age or gender of patients were not available in clinical health records and were excluded. A total of 83 cases were excluded from the study for this reason, and ultimately, 662 patients were examined. The median age of the children was four years, ranging from 2 days to 15 years, and 46.4% of the patients were between 4 and 15 years old. The gender ratio of male to female was 3:2 (377 boys and 285 girls). We summarized the epidemiological findings of the examined children in [Table 1](#).

According to the findings in [Table 1](#), family transmission is the most common route of children's COVID-19 infection. So, 363 children (62.3%) fell ill after coming into contact with family members. Also, among the 363 patients mentioned, three neonates had a positive PCR test for SARS-CoV-2 on days 5, 6, and 7 after birth. Fifty-seven patients (9.8%) were infected with COVID-19 after coming into contact with infected individuals other than family members. Additionally, 44 patients (7.5%) did not report a history of exposure to infected individuals. Out of 662 patients, 99 (15%) had a positive PCR test, and the median time from the onset of symptoms to disease confirmation was eight days, with a range of 1 to 21 days.

Clinical characteristics of COVID-19

In the evaluation of the severity of the infection with COVID-19 according to the relevant guidelines²², 133 patients (20.1%) had mild disease (clinical symptoms without any imaging evidence of pneumonia) ([Table 2](#)). The severity of COVID was moderate (fever and respiratory tract symptoms with imaging evidence of pneumonia) in 202 patients (30.5%), severe (an onset of respiratory distress with acute hypoxia) in 308 patients (46.5%), and critical (an onset of respiratory failure and shock) in 19 patients (2.9%) ([Table 2](#)).

Table 2. Clinical characteristics of COVID-19

Variable	Finding
COVID-19 severity	
Mild	133 (20.1%)
Moderate	202 (30.5%)
Severe	308 (46.5%)
Critical	19 (2.9%)
Clinical symptoms	
Cough	175 (26.4%)
Fever (37.3-40 °C)	418 (63.1%)
Myalgia	5 (0.8%)
Diarrhea	73 (11%)
Vomiting	93 (14%)
Nausea	16 (2.4%)
Respiratory distress	107 (16.2%)
Fatigue	37 (5.6%)
Unconsciousness	56 (8.5%)
Coexisting disorders	276 (40.3%)
Treatment	585
Antiviral treatment	137 (23.4%)
Antibiotic treatment	241 (41.2%)
Symptomatic treatment	207 (35.4%)
Immunoglobulin therapy	19 (3.3%)
Glucocorticoid therapy	7 (1.2%)
No taking medicine	37 (5.9%)
Mechanical ventilation	130 (22.2%)
Days, median (range)	4 (1-30)
Clinical outcome	
Death	0
Time from onset to cure (days)	
Median (range)	17 (7-41)
Quartile (Q1-Q3)	12-23
Admission vital signs, median (range)	
SBP (mmHg)	86 (40-105)
DBP (mmHg)	55 (27-87)
HR (beats/min)	120 (40-203)
RR (breath/min)	30 (12-86)
SpO ₂ (%)	95 (76-100)

SBP: Systolic blood pressure; DBP: Diastolic blood pressure; HR: Heart rate; RR: Respiratory rate

In this study, 586 patients presented with clinical symptoms, the most common of which were fever (63.1%), measured using a mercury thermometer and from the mouth and defined as having a fever between 37.3 and 40 Celsius degrees, followed by cough (26.4%) and respiratory distress (16.2%) ([Table 2](#)). 40.3% of patients with COVID-19 in our study had underlying diseases, the most common of which include cardiovascular diseases (6.6%), neurodevelopmental diseases (5.1%), and hematological diseases (5.1%) ([Table 2](#)).

Patients with COVID-19 infection were admitted in symptomatic and asymptomatic groups, although some did not require treatment. Supportive and antiviral

treatments were prescribed in symptomatic patients with abnormal chest radiography. In patients with severe and critical disease, glucocorticoid therapy and mechanical ventilation were used, and the average duration of mechanical ventilation was four days, with a range of 1 to 30 days. In this study, no mortality was observed, and all patients were discharged following a successful recovery and achieved the desired outcome, as defined in Table 2.

In comparing the severity of COVID-19 according to the age groups, it was significantly observed that the highest rate of severe disease is in the age group under two months, and the highest rate of asymptomatic or mild disease is in the age group of 4 to 9 years ($X^2=35.338$; $p=0.018$; Table 3). On the other hand, in terms of gender, there was no difference between male and female patients regarding the severity of infection with COVID-19 ($X^2=0.739$; $p=0.946$; Table 4).

Paraclinical characteristics of COVID-19

Of the patients with COVID-19 studied in the current study, 64.7% had normal chest radiograph findings, and 68.6% had normal chest CT scan findings. The median severity of chest involvement in patients with abnormal results was 25%, ranging from 10-60% (Table 4).

Discussion

The COVID-19 pandemic, which has spread globally and is now somewhat under control, highlighted an important point regarding health management criteria, including the design of preventive strategies. On the other hand, since the beginning of the pandemic, information about the disease in adults has been more comprehensive compared to children, and children have yet to be adequately evaluated in most conflict areas. Therefore, this study examined all affected children under 15 years of age in northwest Iran who had visited the hospital. The main limitation in child patients is the lack of parental visits and home treatments, which has led to the regulation of studies in this age group in our country. The results of the current study showed that in most children with COVID-19, the origin of the infection was family exposure, and they had a prolonged incubation period. Most patients infected with the SARS-CoV-2 virus are asymptomatic or present with

moderate to severe symptoms; the most common clinical symptoms are high fever and cough. Also, less than half of the children with COVID-19 had an underlying disease that impacted the course of the disease. Most patients

Table 4. Paraclinical and imaging characteristics of COVID-19

Variable	Finding
Chest radiograph	
Normal	428 (64.7%)
Consolidation	172 (26%)
Ground glass opacity	22 (3.3%)
Collapse	29 (4.4%)
HRAD	11 (1.7%)
Lung involvement in CT Scan (%), median (range)	25 (10-60)
Not involved	454 (68.6%)
Blood tests, median (range)	
WBC (cells/mm3)	9.6 (4.2-27.2)
Neutrophil (%)	61 (37-95)
Lymphocyte (%)	22.3 (8-78)
Hemoglobin (g/dL)	8.1 (4.4-12.2)
Hematocrit (%)	24.8 (11.7-38.8)
Platelet (cells/mm3)	178 (109-234)
BUN (mg/dL)	21 (9-31)
Creatinine (mg/dL)	0.67 (0.34-0.93)
SGOT (IU/L)	12 (8-22)
SGPT (IU/L)	17 (9-23)
PT (sec)	13.1 (13.1-14.9)
PTT (sec)	32 (30-34)
INR	1 (1-1.4)
ESR (mm/h)	20 (1-140)
CRP (positive), No. (%)	338 (58.6%)
VBG test	
pH	7.38 (6.9-7.6)
PCO ₂	34 (29-45)
HCO ₃ ⁻	20 (16-25)

HRAD: Hyper-reactive airway disease; WBC: White blood cells; BUN: Blood urea nitrogen; SGOT: Serum glutamic-oxaloacetic transaminase; SGPT: Serum glutamate pyruvate transaminase; PT: Prothrombin time; PTT: Partial thromboplastin time; INR: International normalized ratio; ESR: Erythrocyte sedimentation rate; CRP: C-Reactive protein

Table 3. Different severity of illness by age groups

Age group	Asymptomatic, n (%)	Mild, n (%)	Moderate, n (%)	Severe, n (%)	Critical, n (%)	Total, n
<2 month	3 (4.9%)	7 (11.5%)	10 (16.4%)	40 (65.6%)	1 (1.6%)	61
<4 years	22 (8.6%)	18 (7%)	79 (30.7%)	128 (49.8%)	10 (3.9%)	257
4 years	1 (2.7%)	2 (5.4%)	18 (48.6%)	15 (40.5%)	1 (2.7%)	37
4-9 years	22 (12.3%)	19 (10.6%)	56 (31.3%)	78 (43.6%)	4 (2.2%)	179
9-14 years	18 (15.1%)	18 (15.1%)	35 (29.4%)	45 (37.8%)	3 (2.5%)	119
>14 years	1 (11.1%)	2 (22.2%)	4 (44.4%)	2 (2.22%)	0	9
Total	67 (10.1%)	66 (10%)	202 (30.5%)	308 (46.5%)	19 (2.9%)	662
Gender						
Female	30 (10.5%)	30 (10.5%)	84 (29.5%)	134 (47%)	7 (2.5%)	285
Male	37 (9.8%)	36 (9.5%)	118 (31.3%)	174 (46.2%)	12 (3.2%)	377

were managed with antiviral and antibiotic treatments, as well as symptomatic treatment. Finally, children with COVID-19 had a good prognosis but presented with moderate to severe disease, which requires proper treatment management.

In the current study of children with COVID-19, the source of their infection was direct contact with infected family members. 62.3% of cases were related to direct contact with infected members, and 20.4% were related to exposure and presence in epidemic areas. On the other hand, our study found no maternal-fetal vertical transmission of COVID-19, indicating effective control of the disease in maternal health. On the other hand, previous studies have reported various cases of vertical transmission of the disease.^{23, 24} Contrary to the present study, Zeng et al. reported that 3 out of 33 infants with COVID-19 from infected mothers were also infected with COVID-19.²⁵ With this, there is no complete information about the vertical transmission of infection from mother to fetus, but the necessary care in this field should be considered. Additionally, our study revealed that the source of infection could not be identified in some cases. Epidemiological profile information for 11.9% of the examined patients, regarding exposure and presence in endemic areas, was not available to definitively determine the origin of the disease. This point highlights a new layer of complexity in the transmission of COVID-19 in children, underscoring the importance of developing strategies to limit exposure in children during the early stages of contagious infection seasons.

The current study showed that the median and quartile range of the infection incubation period in children with COVID-19 is eight days, with quartiles of 5 and 12 days. On the other hand, studies related to adults have reported these values as 4 to 5 days and 1 to 9 days, respectively. This difference is related to the fact that children's immune systems are not yet fully developed and can respond differently to pathogens than adults. In addition, young children, especially children who have yet to go to school, cannot describe their clinical condition to receive a complete clinical history, leading to a lack of correct diagnosis of the disease. Regardless of the underlying causes and other factors involved, the longer incubation period of the disease in children compared to adults also highlights that parents, in cases of infectious and respiratory diseases, including COVID-19, should prioritize the care of the children in their household. Monitor the house closely so that, in the event of an infection, necessary treatment measures can be implemented immediately.

In our study, none of the affected children had asymptomatic disease, but in other studies, this rate has been reported as 5.9%, and in studies conducted in adults, this rate has been reported as 1%.²⁶ Contrary to the current study, the rate of children with asymptomatic disease with abnormal chest radiograph findings is high and is reported to be around 20-30%.²⁷⁻³⁰ Of course, although the abnormal evidence in the chest X-ray of patients with

COVID-19 does not necessarily indicate the patient's symptoms and severity, lung lesions in asymptomatic patients can suggest the need for drug treatment to reduce pulmonary inflammation. Notably, in the current study, no lung lesions were observed in the chest radiographs of the affected children.

Clinical symptoms in children with COVID-19 typically present as atypical symptoms, the most common of which are fever and cough, and can be accompanied by occasional severe respiratory symptoms and gastrointestinal symptoms, such as nausea, vomiting, and diarrhea. Of course, some patients may also experience other symptoms, such as sneezing, a runny nose, sore throat, confusion, headache, myalgia, and conjunctivitis. Of course, the clinical symptoms in this population age group differ from those in adults, typically having low intensity and mainly consisting of atypical symptoms.⁵ In the current study, 40.3% of children with COVID-19 had underlying diseases such as epilepsy, CP, developmental disorders, congenital cardiovascular disorders, etc. Of course, contrary to underlying diseases, there was no mortality in the studied patients, although they suffered from severe disease in some cases.

Conclusion

In most children with COVID-19, the origin of the infection was typically family exposure, and they often had a prolonged incubation period. Most patients infected with the SARS-CoV-2 virus are asymptomatic or present with moderate to severe symptoms; the most common clinical symptoms are high fever and cough. Also, less than half of the children with COVID-19 had an underlying disease that impacted the course of the disease. Children with COVID-19 had a good prognosis but presented with moderate to severe disease, which requires proper treatment management.

Acknowledgments:

We would like to thank the Clinical Research Development Unit of Zahra Mardani Azari children educational and treatment center, Tabriz university of medical sciences, Tabriz, Iran. for their assistance in this research.

Authors' Contribution

Conceptualization: Farinaz Amirikar
Data curation: Mehri Rasekhi, Roghayye Nasiri
Formal analysis: Farinaz Amirikar
Funding acquisition: Farinaz Amirikar, Nemat Bilan
Investigation: Shahram Abdoli Oskouie
Methodology: Mirhadi Mousavi
Project administration: Nemat Bilan
Resources: Sina Hamzehzadeh2
Software: Farinaz Amirikar
Supervision: Nemat Bilan
Validation: Amirhossein Jafarirouhi
Visualization: Babak Abdinia
Writing—original draft: Farinaz Amirikar
Writing—review & editing: Farinaz Amirikar

Competing Interests

None.

Ethical Approval

The Ethics Committee approved this study at Tabriz University of Medical Sciences (IR.TBZMED.REC.1400). All patient information was confidential. We used only the information from the patient's clinical records; no intervention was done.

Funding

None.

References

- Wang C, Horby PW, Hayden FG, Gao GF. A novel coronavirus outbreak of global health concern. *Lancet* 2020;395(10223):470-3. doi:10.1016/s0140-6736(20)30185-9
- Kandel N, Chungong S, Omaar A, Xing J. Health security capacities in the context of COVID-19 outbreak: an analysis of International Health Regulations annual report data from 182 countries. *Lancet* 2020;395(10229):1047-53. doi:10.1016/s0140-6736(20)30553-5
- Lu R, Zhao X, Li J, Niu P, Yang B, Wu H, et al. Genomic characterisation and epidemiology of 2019 novel coronavirus: implications for virus origins and receptor binding. *Lancet* 2020;395(10224):565-74. doi:10.1016/s0140-6736(20)30251-8
- Wang D, Hu B, Hu C, Zhu F, Liu X, Zhang J, et al. Clinical characteristics of 138 hospitalized patients with 2019 novel coronavirus-infected pneumonia in Wuhan, China. *JAMA* 2020;323(11):1061-9. doi:10.1001/jama.2020.1585
- Guan WJ, Ni ZY, Hu Y, Liang WH, Ou CQ, He JX, et al. Clinical characteristics of coronavirus disease 2019 in China. *N Engl J Med* 2020;382(18):1708-20. doi:10.1056/NEJMoa2002032
- Chen T, Wu D, Chen H, Yan W, Yang D, Chen G, et al. Clinical characteristics of 113 deceased patients with coronavirus disease 2019: retrospective study. *BMJ* 2020;368:m1091. doi:10.1136/bmj.m1091
- Schlagenhauf P, Ashraf H. Severe acute respiratory syndrome spreads worldwide. *Lancet* 2003;361(9362):1017. doi:10.1016/s0140-6736(03)12843-7
- Aylward B, Barboza P, Bawo L, Bertherat E, Bilivogui P, Blake I, et al. Ebola virus disease in West Africa--the first 9 months of the epidemic and forward projections. *N Engl J Med* 2014;371(16):1481-95. doi:10.1056/NEJMoa1411100
- Viboud C, Simonsen L. Global mortality of 2009 pandemic influenza A H1N1. *Lancet Infect Dis* 2012;12(9):651-3. doi:10.1016/s1473-3099(12)70152-4
- Dawood FS, Iuliano AD, Reed C, Meltzer MI, Shay DK, Cheng PY, et al. Estimated global mortality associated with the first 12 months of 2009 pandemic influenza A H1N1 virus circulation: a modelling study. *Lancet Infect Dis* 2012;12(9):687-95. doi:10.1016/s1473-3099(12)70121-4
- Nicholls JM, Poon LL, Lee KC, Ng WF, Lai ST, Leung CY, et al. Lung pathology of fatal severe acute respiratory syndrome. *Lancet* 2003;361(9371):1773-8. doi:10.1016/s0140-6736(03)13413-7
- Chan JF, Yuan S, Kok KH, To KK, Chu H, Yang J, et al. A familial cluster of pneumonia associated with the 2019 novel coronavirus indicating person-to-person transmission: a study of a family cluster. *Lancet* 2020;395(10223):514-23. doi:10.1016/s0140-6736(20)30154-9
- Huang C, Wang Y, Li X, Ren L, Zhao J, Hu Y, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. *Lancet* 2020;395(10223):497-506. doi:10.1016/s0140-6736(20)30183-5
- Chen N, Zhou M, Dong X, Qu J, Gong F, Han Y, et al. Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: a descriptive study. *Lancet* 2020;395(10223):507-13. doi:10.1016/s0140-6736(20)30211-7
- Wu JT, Leung K, Leung GM. Nowcasting and forecasting the potential domestic and international spread of the 2019-nCoV outbreak originating in Wuhan, China: a modelling study. *Lancet* 2020;395(10225):689-97. doi:10.1016/s0140-6736(20)30260-9
- Fanidi A, Jouven X, Gaye B. Strategies to control COVID-19 and future pandemics in Africa and around the globe. *Eur Heart J* 2020;41(41):3973-5. doi:10.1093/eurheartj/ehaa278
- Morsali S, Rezazadeh-Gavani E, Oladghaffari M, Bahramian S, Hamzehzadeh S, Samadifar Z, et al. Effects of underlying heart failure on outcomes of COVID-19; a systematic review and meta-analysis. *Rom J Intern Med* 2023;61(1):6-27. doi:10.2478/rjim-2022-0021
- Wei M, Yuan J, Liu Y, Fu T, Yu X, Zhang ZJ. Novel coronavirus infection in hospitalized infants under 1 year of age in China. *JAMA* 2020;323(13):1313-4. doi:10.1001/jama.2020.2131
- Dong Y, Mo X, Hu Y, Qi X, Jiang F, Jiang Z, et al. Epidemiology of COVID-19 among children in China. *Pediatrics* 2020;145(6):e20200702. doi:10.1542/peds.2020-0702
- Ma H, Hu J, Tian J, Zhou X, Li H, Laws MT, et al. A single-center, retrospective study of COVID-19 features in children: a descriptive investigation. *BMC Med* 2020;18(1):123. doi:10.1186/s12916-020-01596-9
- Akbarzadeh MA, Vaez-Gharamaleki Y, Jahanshahloo F, Ghaffari Babil A, Hamzehzadeh S, Seifmansour S, et al. Outcomes of COVID-19 infection in patients with chronic lymphocytic leukemia: a systematic review and meta-analysis. *Rev Assoc Med Bras (1992)* 2024;70(8):e20240322. doi:10.1590/1806-9282.20240322
- Zayed NE, Abbas A, Lutfy SM. Criteria and potential predictors of severity in patients with COVID-19. *Egypt J Bronchol* 2022;16(1):11. doi:10.1186/s43168-022-00116-y
- Chen H, Guo J, Wang C, Luo F, Yu X, Zhang W, et al. Clinical characteristics and intrauterine vertical transmission potential of COVID-19 infection in nine pregnant women: a retrospective review of medical records. *Lancet* 2020;395(10226):809-15. doi:10.1016/s0140-6736(20)30360-3
- Zhu H, Wang L, Fang C, Peng S, Zhang L, Chang G, et al. Clinical analysis of 10 neonates born to mothers with 2019-nCoV pneumonia. *Transl Pediatr* 2020;9(1):51-60. doi:10.21037/tp.2020.02.06
- Zeng L, Xia S, Yuan W, Yan K, Xiao F, Shao J, et al. Neonatal early-onset infection with SARS-CoV-2 in 33 neonates born to mothers with COVID-19 in Wuhan, China. *JAMA Pediatr* 2020;174(7):722-5. doi:10.1001/jamapediatrics.2020.0878
- Wu Z, McGoogan JM. Characteristics of and important lessons from the coronavirus disease 2019 (COVID-19) outbreak in China: summary of a report of 72 314 cases from the Chinese Center for Disease Control and Prevention. *JAMA* 2020;323(13):1239-42. doi:10.1001/jama.2020.2648
- Guo CX, He L, Yin JY, Meng XG, Tan W, Yang GP, et al. Epidemiological and clinical features of pediatric COVID-19. *BMC Med* 2020;18(1):250. doi:10.1186/s12916-020-01719-2
- Song W, Li J, Zou N, Guan W, Pan J, Xu W. Clinical features of pediatric patients with coronavirus disease (COVID-19). *J Clin Virol* 2020;127:104377. doi:10.1016/j.jcv.2020.104377
- Zheng F, Liao C, Fan QH, Chen HB, Zhao XG, Xie ZG, et al. Clinical characteristics of children with coronavirus disease 2019 in Hubei, China. *Curr Med Sci* 2020;40(2):275-80. doi:10.1007/s11596-020-2172-6
- Sun D, Li H, Lu XX, Xiao H, Ren J, Zhang FR, et al. Clinical features of severe pediatric patients with coronavirus disease 2019 in Wuhan: a single center's observational study. *World J Pediatr* 2020;16(3):251-9. doi:10.1007/s12519-020-00354-4