# A study of epidemiological and clinical features in children with COVID-19 infection admitted at tertiary care hospital

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## Abstract

**Background:** Limited data is available on epidemiological features and clinical manifestations of COVID 19 disease in children. Present study aimed to analyse demography, epidemiology, clinical features and outcome in children infected with COVID-19 admitted at a tertiary care institution. **Material and Method:** A retrospective study was carried out evaluating data of 209 cases, admitted at a dedicated COVID hospital from March 2020 to February 2021. **Results:** Data of 209 children, from age 1 month to 12 years with confirmed diagnosis of COVID-19 with a mean age of 4.7±3.6 years and male-female ratio of 1.09:1 were studied. 177(84.68%) patients were from identified containment zone. Overcrowding was observed in 115 (55.02%) cases. Close contact with positive family members was observed in 166 (79.42%) cases with majority coming from lower middle socio economical class. 60 (28.71%) patients were asymptomatic and 149 (71.29%) were symptomatic. Among symptomatic patients, 118 (79.19%) patients had fever as the main presenting complaint. Positive findings on chest radiograph were found in only 25 (11.96%) patients. In asymptomatic and mild cases, chest radiograph was found to be normal. Vitamin D deficiency was observed in 170 (81.34%) patients. A total of 206 patients (98.56%) recovered while 3 patients (1.43%) died. **Conclusion:** A milder disease pattern is observed in majority of children with COVID 19. There is higher disease burden observed in lower middle socio-economic class with majority of children having positive household contact. Majority of cases recover with supportive treatment while treatment modalities like oxygen therapy, mechanical ventilation, steroids and low molecular weight heparin are required only in moderate to severe case. Mortality is observed in patients with severe disease and havingco-morbidities.
**Key words:** Paediatric COVID -19, Epidemiology, Clinical Characteristics, Vitamin D

## Introduction

Coronavirus disease (COVID 19) is caused by Severe Acute Respiratory Syndrome Coronavirus 2 (SARS Co-V 2). Many countries of the world are engulfed in the wrath of this extremely severe infectious disease which has been in circulation for more than a year now.[1] The first case of COVID 19

was observed in China in December 2019. The virus soon spread to many countries across the world and was eventually labeled as a pandemic by WHO on 11th march 2020. The first case of COVID 19 in India was reported in January 2020. Paediatric population comprises of less than 5% of the total population affected by COVID 19.[2] Though there have been a growing number of studies focused on COVID 19, limited data is available on epidemiological features and clinical manifestations in children. Therefore, our study aimed to analyze epidemiology, clinical features and outcome in children infected with COVID 19 admitted at a tertiary care hospital. A better understanding of these aspects will help to control the spread and improve the cure rate of this pandemic.

## Material & Method

A retrospective observational study was carried out at the Department of Paediatrics of a dedicated COVID-19 tertiary care hospital. Data of patients admitted over a span of one year i.e. from March 2020 to February 2021 was collected. Prior approval was taken from the Institutional Ethics Committee. Data of children between 1 month to 12 years of age, diagnosed positive for COVID 19 either by RTPCR or by Rapid Antigen Test was collected in this study. Neonates and children more than 12 years of age were excluded from the study. After taking informed telephonic consent from parents, data of patients was collected from Electronic Medical Records (EMR). Children were categorized as per protocol issued by the Ministry of Health and Family Welfare, Government of India (June 2020).[3] Categorization was done into asymptomatic, mild, moderate and severe COVID-19.[4,5] Detailed information regarding demographics, contact history, living conditions, overcrowding, family profile, symptoms and presence of co-morbid conditions was collected. Overcrowding was defined based on persons per room criteria.[6] Baseline laboratory parameters and radiological findings were evaluated in all children.[7] Data of HRCT thorax performed in patients who presented with severe manifestations were also collected. All patients were treated and monitored as per standard protocol.[8,9] Socio-economic status of enrolled patients was determined using modified Kuppuswamy classification.[10] Complications and outcome of patients were noted. Data was analyzed by using appropriate statistical tools. P value <0.05 was considered significant.

## Results

### Epidemiological characteristics of hospitalized children diagnosed as confirmed cases of COVID 19

Data of 209 children, aged 1 month to 12 years admitted with confirmed diagnosis of COVID 19 was studied. Children less than 1 month and more than 12 years of age were excluded from this study. The observed mean age was 4.7±3.6 years and male to female ratio was 1.09:1. Majority of patients were from lower middle SE status (101, 48.32%), followed by 50 (23.92%) patients from upper lower SE status. A total of 177 (84.68%) patients were from containment zones. Pertaining to family profile, 113 (54.06%) patients belonged to joint families, while 96 (45.93%) patients belonged to nuclear families. Overcrowding was observed in 115 (55.02%) cases. Out of 209 cases, 166 (79.42%) patients had history of close contact with positive family members. In 107 (64.46%) of these cases, more than half of the family members were infected. Eleven (5.26%) cases had a COVID-19 positive health care worker in their family. In our study, we observed that 84 (40.19%) patients were admitted during lockdown (From 24/3/20 to 31/5/20) and 125 (59.81%) patients were admitted after the lockdown period **[Table 1].**

### Clinical characteristics of hospitalized children diagnosed as confirmed cases of COVID 19

Out of 209 children, 60 (28.71%) were asymptomatic (with no overt clinical symptoms) while 149 (71.29%) were symptomatic. Among symptomatic patients, 120 (57.41%) were suffering from mild (clinical symptoms without any radiological evidence of pneumoniae), 10 (4.78%) were suffering from moderate (fever and respiratory symptoms with radiological evidence of pneumoniae) and 19 (9.09%) were suffering from severe COVID 19 **[Figure 1].** In symptomatic patients, median incubation period was 3 days.

The presenting symptoms included fever in 118 (79.19%), cough in 54 (36.34%) cases and cold in 51 (34.22%) cases, followed by GI symptoms (vomiting and diarrhoea) in 44 (29.53%) patients **[Figure 2].** Overall, six (2.8%) patients developed complications in form of myocardial injury, liver injury and pediatric multisystem inflammatory syndrome (PMIS).[11]

On laboratory evaluation, 150 (71.77%) patients had normal leukocyte count. Mean leukocyte count of patients at admission was 9174±5410 cells/cubic mm. Leucocytosis was observed in 51 (24.40%) children. Unlike adult patients, leukopenia was seen in only 8 (3.82%) children. NLR was ≥ 3 in 25 (11.96%) cases and <3 in 184 (88.04%) cases. Among patients with moderate and severe disease (n=29), 23 (79.31%) had raised CRP value and 21 (72.41%) had raised D-Dimer value. CRP and D-Dimer are not performed in patients with asymptomatic and mild disease. Only 25 children (11.96%) had positive findings on chest radiograph in form of pneumonia. In asymptomatic and mild cases, chest radiograph was found to be normal. HRCT thorax was performed in patients with moderate and severe illness. Out of them, 20 (68.96%) patients had positive finding in form of ground glass opacities, consolidation and fibrosis.

**Table 1. Epidemiological characteristics of hospitalized children diagnosed as confirmed cases of COVID 19 (n=209)**

| Parameter | Observations |
|---|---|
| Total number of patients | 209 |
| Age group<br>≥ 5 Years<br><5 Years | <br>103 (49.28%)<br>106 (50.72%) |
| Mean age | 4.7 ± 3.6 years |
| Gender ratio (Male: female) | 1.09:1 |
| **Socioeconomic status**<br>Upper<br>Upper middle<br>Lower middle<br>Upper lower<br>Lower | <br>12 (5.74%)<br>31 (14.83%)<br>101 (48.32%)<br>50 (23.92%)<br>15 (7.19%) |
| Overcrowding | 115 (55.02%) |
| H/O close contact with COVID 19 positive family members | 166 (79.42%) |
| **Total family members infected with COVID 19 (n=166)**<br>≤50%<br>>50% | <br><br>59 (35.54%)<br>107 (64.46%) |
| Presence of a COVID-19 positive healthcare worker in family | 11 (5.26%) |

Asymptomatic patients (24%) were managed by supportive therapy. Oral antibiotic was provided in 136 (65.07%) cases. Oxygen therapy was given to 19 patients (9.09%) and mechanical ventilation was required in 2 patients (0.95%). Patients with moderate and severe COVID-19 were managed with steroids and low molecular weight heparin in addition to IV antibiotics and oxygen therapy. While evaluating co-morbidities, vitamin D deficiency was found in 170 (81.34%) patients, anaemia was observed in 76 (36.36%) patients, malnutrition was observed in 15 (7.17%) patients, sickle cell anaemia was observed in 2 (0.95%) patients and congenital heart disease was observed in 2 (0.95%) patients. Overall prognosis of children with COVID-19 was good with decent recovery. Mortality was observed in 3 (1.43%) patients who presented with severe disease. Among them, two had severe acute malnutrition as co-morbid condition. In our study, we found that mean hospital stay was 9.3±4 days. A

total of 206 patients (98.56%) recovered and were discharged according to Government guidelines **[Table 2].**

**Figure 1: Severity of COVID 19 disease (%) in hospitalized children diagnosed as confirmed cases of COVID 19 (n=209)**
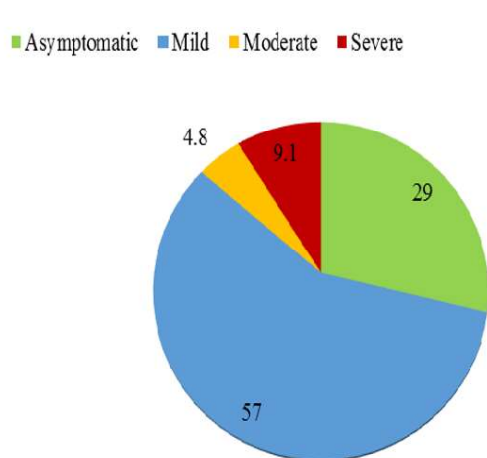


**Table 2 Clinical profile of hospitalized children diagnosed as confirmed cases of COVID 19 (n=209)**

| Laboratory investigations | |
|---|---|
| Mean leukocyte count | 9174 ±5410 cells/cu mm |
| Leukocytosis | 51 (24.40%) |
| Leucopenia | 8 (3.82%) |
| Lymphopenia | 18 (8.61%) |
| **Complications (7, 3.3%)** | |
| Myocardial injury | 4 (1.91%) |
| Multisystem inflammatory syndrome | 3 (1.43%) |
| **Moderate and Severe COVID cases** (n=29) | |
| NLR ratio ≥ 3 | 25(11.96%) |
| Raised CRP | 23 (79.31%) |
| Raised D-dimer | 21 (72.41%) |
| **Co-morbidities** (n=209) | |
| Vitamin D deficiency | 170 (81.34%) |
| Anemia | 76 (36.36%) |
| Malnutrition | 15 (7.17%) |
| Severe Acute Malnutrition | 2 (0.95%) |
| Congenital Heart Disease | 2 (0.95%) |
| Sickle cell Anemia | 2 (0.95%) |
| Mean hospital stay | 9.3±4 days |
| **Outcome** | |
| Discharged | 206 (98.56%) |
| Death | 3 (1.43%) |

**Figure 2: Clinical manifestations in hospitalized children diagnosed as confirmed cases of COVID 19 (n=209)**
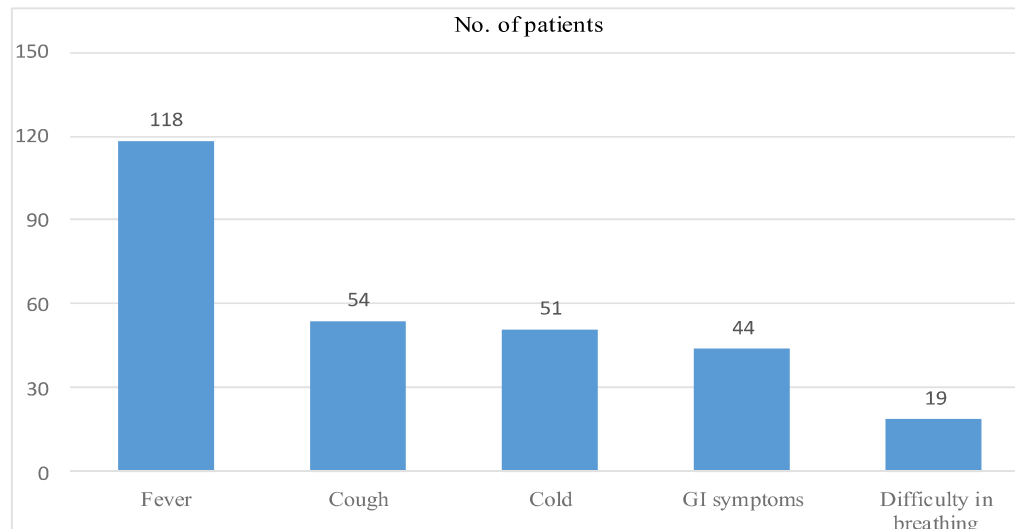


## Discussion:

With rapidly evolving severe acute respiratory syndrome Coronavirus 2 (SARS COV 2) pandemic, knowledge about disease manifestations and its severity has also evolved quickly. Due to its resemblance to SARS, influenza and other respiratory viruses, children were initially thought to be more susceptible than adults. However, <5% of total COVID 19 disease cases belong to the paediatric age group and severity has been milder than adults.[12] Due to this difference in manifestations of COVID 19 among paediatric patients from adults, there is a need to explore epidemiology, disease manifestations, laboratory findings and outcome of COVID 19 in children. In this context, we performed a retrospective study of COVID 19 in children from 1 month to 12 years of age to assess the parameters as described above. We excluded neonates to avoid clinical heterogeneity as the clinical manifestations, mode of transmission and outcome in neonatal population are different than paediatric populations and also, difficult to differentiate from other neonatal illnesses. In children, fatal complications like ARDS are rarely observed due to a variety of reasons including decreased generation of thrombin and fibrin, less co-morbidities, less exposure to particulate matter and pollutants and less susceptibility to develop cytokine storms as compare to adults.[2]

In our study, children <5 year of age accounted for nearly half of the cases. It can be attributed to inability of this group to comprehend and follow social distancing norms and their frequent close contacts with parents. No sex predisposition was observed in our study. Nearly half of the children were from lower middle socioeconomic class. Similar findings were observed in study done by Sarangi et al.13 Majority of children were from identified containment zones. Most of children had history of exposure to positive household contact. In our study, more than half of the cases had more than 50% family members affected, suggestive of family clustering as a major cause for transmission in paediatric population. In symptomatic patients, median incubation period was 3 days. Similar studies were not available for comparison of incubation period. Majority of patient were admitted after lockdown period. Majority of patients infected by SARS COV-2 presented as asymptomatic or mild cases.[14] Similar findings were observed in study by Qiu H et al.[15] Fever and respiratory symptoms were commonest clinical presentations in the current study, however, many patients presented with gastrointestinal symptoms also. So, a comprehensive screening strategy including respiratory as well as gastrointestinal

symptoms may be more useful for detection of COVID 19 in children. Symptoms like anosmia and ageusia could not be elicited in paediatric patients.

Among laboratory parameters, majority of patients had normal leucocyte count. Among patients with an abnormal count, majority had leucocytosis. High Neutrophilic lymphocytic ratio (NLR) was seen in patients with moderate and severe disease. Similar observation was reported by Lagunas Rangel FA in a meta-analysis.[16]

In our study, majority of patients with moderate to severe COVID 19 had high CRP and D-Dimer value, similar to the findings of Wang L.[17] Children with COVID 19 also had co-morbid conditions. Majority of children were found to have vitamin D deficiency. Vitamin D deficiency is associated with increased risk of COVID 19, as mentioned in different studies conducted in adults.[18] Vitamin D modulates both innate and adaptive immunity and individuals with low Vitamin D levels are known to be susceptible to infection with bacteria and viruses.[19] Anaemia was found in about one third of patients and can be considered as an incidental finding. Malnutrition was observed as one of the co-morbid condition, similar to a study by Li T et al.[20]

In asymptomatic and mild cases, chest radiograph was found to be normal. High Resolution Computed Tomography (HRCT) thorax was done in patients with moderate to severe COVID 19, out of whom, 2/3$^{rd}$ patients had positive findings in the form of ground glass opacities, consolidation and fibrosis. Similar observations were present in studies by Meena J et al and Qui H et al.[2,15]

Although there are no clear guidelines for treatment of paediatric COVID 19, our study suggested that treatment measures for paediatric COVID 19 patients were not as complex as those for adults, even relatively simple. All paediatric patients were managed according to standard protocol. All asymptomatic and mild cases were managed by supportive treatment only. Treatment modalities for children with moderate to severe COVID 19 mainly consisted of oxygen therapy, mechanical ventilation, antibiotics, steroids and low molecular weight heparin. Paediatric population developed fewer complications like myocardial injury, liver injury and paediatric multisystem inflammatory syndrome (PMIS). Mean hospital stay was observed to be 9.3±4, similar to the observation by Qui H et al.15 As majority of cases were mild and asymptomatic, these required only isolation and supportive treatment. Prognosis of children with COVID 19 was good and mortality was observed in very few patients who presented with severe disease and had associated co-morbidities. Similar findings were observed in study by Guo Cx et al.[21]

**Limitation**

The study describes epidemiological features, clinical features, laboratory abnormalities and radiological findings of hospitalized patients. It does not represent mild and asymptomatic patients not requiring hospitalization.

## Conclusion

In conclusion, a milder disease pattern is observed in majority of children with COVID 19. Majority of the patients suffer from asymptomatic or mild COVID 19 disease. A higher disease burden is observed in lower middle socio-economic class with majority of children were having positive household contact. Majority of cases recover with supportive treatment while treatment modalities like oxygen therapy, mechanical ventilation, steroids and low molecular weight heparin are required only in moderate to severe cases. Prognosis of COVID-19 in children is good with mortality observed in few patients with severe disease and co-morbidies.

## References

1. Riou J, Althaus C. Pattern of early human-to-human transmission of Wuhan 2019 novel coronavirus (2019-nCoV), December 2019 to January 2020. Eurosurveillance. 2020; 25(4).
2. Meena J, Yadav J, Saini L, Yadav A, Kumar J. Clinical Features and Outcome of SARS-CoV-2 Infection in Children: A Systematic Review and Meta-analysis. Indian Pediatrics. 2020;57(9):820-826.

3. Revised National Clinical Management Guideline for COVID 19 [Internet]. Mohfw.gov.in. 2022,Availablefrom:https://www.mohfw.gov.in/pdf/RevisedNationalClinicalManagementGuidelineforCOVID1931032020.pdf

4. Coronavirus Disease 2019 [Internet]. https://www.ncdc.gov.in/. 2019 [cited 11 May 2022]. Available from:https://www.ncdc.gov.in/.

5. Indian Council of Medical Research, New Delhi [Internet]. Icmr.gov.in. 2022 [cited 11 May 2022].Available from: https://www.icmr.gov.in/

6. Park K. Environment and Health. *In*: Park K, ed. Park's Textbook of Preventive and Social Medicine. 23rd *ed*. Jabalpur: Bhanot Publishers; 2015.*p.*758.

7. Toussie D, Voutsinas N, Finkelstein M, Cedillo M, Manna S, Maron S, *et al*. Clinical and chest radiography features determine patient outcomes in young and middle age adults with COVID-19. Radiol. 2020;201754.

8. Global Surveillance for human infection with novel coronavirus (2019-nCoV). Available from: *https://www.who.int/publications-detail/global-surveillance-for-human-infection-with-novel-coronavirus-(2019-ncov)*.

9. AIIMS Covid Information Portal | Information by AIIMS New Delhi related to COVID-19 [Internet]. Covid.aiims.edu. 2020. Available from: https://covid.aiims.edu/

10. Wani RT. Socioeconomic status scales-modified Kuppuswamy and UdaiPareekh's scale updated for 2019. Journal of family medicine and primary care. 2019 Jun;8(6):1846.

11. World Health Organization. *Multisystem inflammatory syndrome in children and adolescents with COVID-19: scientific brief, 15 May 2020*. No. WHO/2019-nCoV/Sci_Brief/Multisystem_Syndrome_Children/2020.1. World Health Organization, 2020.

12. Hoffmann M, Kleine-Weber H, Schroeder S, Krüger N, Herrler T, Erichsen S, *et al*. SARS-CoV-2 cell entry depends on ACE2 and TMPRSS2 and is blocked by a clinically proven protease inhibitor. Cell. 2020;181:271-80.e8

13. Sarangi B, Reddy VS, Oswal JS, Malshe N, Patil A, Chakraborty M, Lalwani S. pidemiological and clinical characteristics of COVID-19 in indian children in the Initial Phas of the Pandmic. Indian Pediatr. 2020 Oct 15;57(10):914-917. Doi: 10.1007/s13312-020-1994-4. Epub 2020 Jul 28. PMID:32729850; PMCID: PMC7605483.

14. Coronavirus Disease 2019 (COVID-19). Centers for Disease Control and Prevention. 2020. Available from: *https://www.cdc.gov/coronavirus/2019-ncov/need-extra-precautions/ racial-ethnic-minorities.html.* Accessed June 20, 2020.

15. Qiu H, Wu J, Hong L, Luo Y, Song Q, Chen D. Clinical and epidemiological features of 36 children with coronavirus disease 2019 (COVID-19) in Zhejiang, China: An observational cohort study. Lancet Infect Dis. 2020;20:689-96.

16. Lagunas-Rangel FA. Neutrophil-to-lymphocyte ratio and lymphocyte-to-C-reactive protein ratio in patients with severe coronavirus disease 2019 (COVID-19): A meta-analysis. J Med Virol. 2020;10.1002/jmv.25819 [published online ahead of print, 2020 Apr 3].

17. Wang L. C-reactive protein levels in the early stage of COVID-19. Med Mal Infect. 2020;50:332-4.

18. Meltzer DO, Best TJ, Zhang H, Vokes T, Arora V, Solway J. Association of vitamin D status and other clinical characteristics with COVID-19 test results. JAMA network open. 2020 Sep 1;3(9):e2019722-.

19. F Gunville C, M Mourani P, A Ginde A. The role of vitamin D in prevention and treatment of infection. Inflammation & Allergy-Drug Targets (Formerly Current Drug Targets-Inflammation &Allergy)(Discontinued). 2013 Aug 1;12(4):239-45.

20. Li T, Zhang Y, Gong C, Wang J, Liu B, Shi L, *et al*. Prevalence of malnutrition and analysis of related factors in elderly patients with COVID-19 in Wuhan, China. Eur J Clin Nutr. 2020;74:871-9.

21. Guo CX, He L, Yin JY, Meng XG, Tan W, Yang GP, Bo T, Liu JP, Lin XJ, Chen X. Epidemiological and clinical features of pediatric COVID-19. BMC medicine. 2020 Dec;18(1):1-7.