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Coinfection Characteristics among Children with COVID-19

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INTRODUCTION

Co-infections have a potential role in increased morbidity and mortality rates during pandemics. There is limited data on co-infection in pediatric patients with COVID-19.

Understanding the proportion of COVID-19 patients with acute bacterial, viral or fungal co-infection, and the culprit pathogens are crucial for treating patients with COVID-19 and to help ensure responsible use of antibiotics and antifungals and minimize negative consequences of overuse.

METHODS

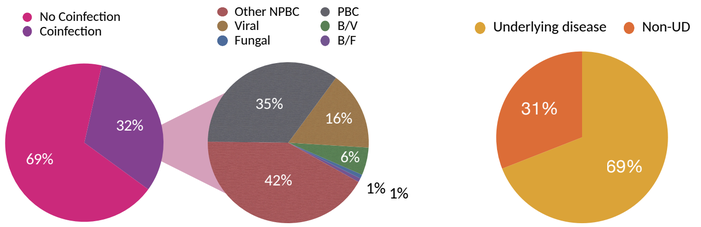
We retrospectively reviewed and analyzed electronic medical data of all pediatric patients who tested positive for severe acute respiratory coronavirus virus-2 (SARS-CoV-2) from April 16, 2020, through 2022 in our center, the National Institute of Pediatrics (INP). Confirmation of COVID-19 was based on a positive real-time reverse transcription-polymerase chain reaction (RT-PCR). Viral co-infections (VC) were defined as simultaneous viral isolates other than SARS-CoV-2 by multiplex RT-PCR respiratory panel assay. Bacterial pneumonia co-infection (BC) was defined as ≥ 4 points according to pediatric-validated Bacterial Pneumonia Score (BPS). Other non-pulmonary bacterial infections were described as clinical presentations. Fungal co-infection (FC) was based on the European Organization Consensus definitions of Invasive Fungal Disease.

RESULTS

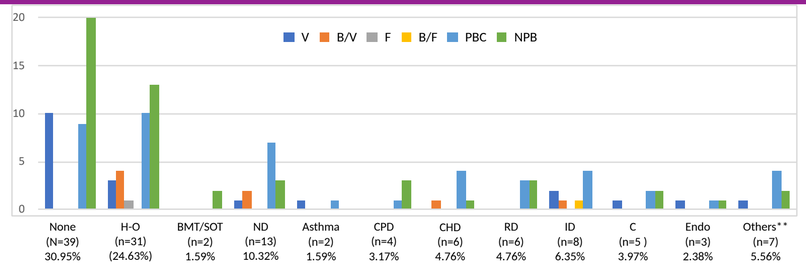
Among the 400 pediatric patients with COVID-19, 126 children were reported as presenting with co-infection during the study period corresponding to 32% of all.

The median patient age was 112 months ranging from 2 to 215 months. The median proportion of female patients was 43.6%. Children >10 years were the most affected age group. Among 126 patients, the underlying disease was present in 69%, and hemato-oncological patients n=32 were the most common (25.3%), as the main group needing hospitalization. **Graphic 1,2.**

Bacterial pneumonia co-infection was detected in 44 patients (34.9%), viral pneumonia co-infection in 20 (12.8%), 4 patients presented as viral pneumonia co-infection and bacterial non-pulmonary infection, and 1 patient with proven pulmonary aspergillosis (0.8%). **Graphic 1**



Graphic 1. General co-infection rate (pulmonary/non-pulmonary), proportion of co-infection, and underlying disease.
PBC: Bacterial pneumonia coinfection, B/V: bacterial and viral; B/F: bacterial and fungal, NPB: Non-pulmonary bacterial co-infection UD: Underlying disease



Graphic 2. Underlying disease of children with COVID-19 and all co-infections. *H-O: hemato-oncology, BMT/SOT: Bone marrow transplant/Solid organ transplant, ND: Neurological disease, CPD: Chronic pulmonary disease, CHD: Congenital heart disease RD: Renal disease ID: Immunodeficiency C: Chromosomopathy **Others: Preterm, obesity, sickle-cell*

Analyzing the clinical presentation of all patients, fever was the main sign presented in 89.6%, followed by cough in 63.4% and nasal discharge in 34%. Higher fever >40°C was mostly observed in the BC group (22% n=10). Of all bacterial co-infection, specific pulmonary-bacteria co-infection was identified in 35%. We compared clinical presentation on VC vs PBC and non-statistical difference was observed between both groups. **Table 1.** Third-generation cephalosporins (3GC) were the main antibiotic prescribed in both bacterial co-infections, 47% of PBC and 37% in Non-PBC. **Graphic 3.**

VC was identified in 15.87% (n=20), prevailing rhinovirus (65%) followed by adenovirus and parainfluenza-3 20% respectively. We made further analysis of the seasonal presentation of all VC, most isolates were identified on the 20-21 and 21-22 winter seasons, 45% and 30% respectively. No influenza circulation was detected. **Graphic 4.**

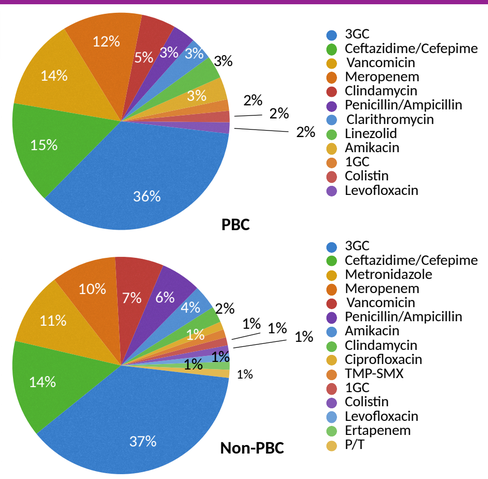
Sign and symptoms	Total n = 126 (%)	Viral n = 20 (%)	Bacterial n = 44 (%)
Cough	80 (63.4)	15 (70)	30 (68.1)
Fever	113 (89.6)	18 (90)	42 (95.4)
Nasal discharge	43 (34.1)	9 (45)	14 (31.8)
Headache	30 (23.8)	7 (35)	16 (36.3)
Sore throat	32 (25.4)	7 (35)	10 (22-7)
Dyspnea	35 (27.7)	6 (30)	11 (25)
Chest pain	7 (5.5)	2 (10)	3 (6.8)
Abdominal pain	32 (25.3)	10 (50)	7 (15.9)
Diarrhea	13 (10.3)	2 (10)	6 (13.6)
Vomiting	27 (21.4)	5 (25)	7 (15.9)
Myalgias	30 (23.8)	4 (20)	11 (25)
Arthralgias	20 (15.8)	3 (15)	9 (20)

Table 1. Clinical presentation of children with COVID-19 and viral/bacterial pneumonia co-infection

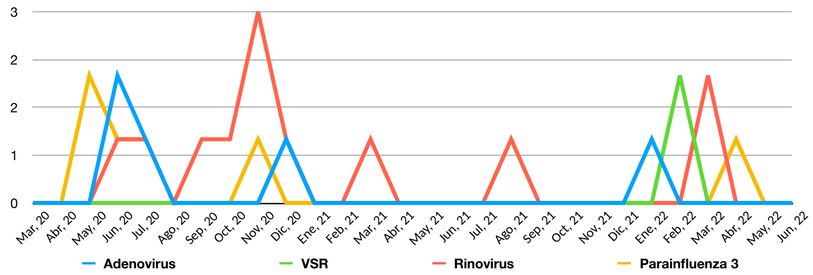
Non-pulmonary BC was the principal co-infection detected. Febrile neutropenia was the main admission indication and antibiotics prescription, with Cefepime in 57%, mostly in 2020 admissions (57%). Septic shock diagnosis was identified in 13 patients (10.3%), of whom 53% were immunocompromised patients. Unusual BC was presented as congenital syphilis and primary peritonitis; acute appendicitis was the initial presentation of COVID-19 in 8 patients. (6.4%). **Table 2.** Another unusual VC presentation was VZV infection as chickenpox.

Non-pulmonary bacterial co-infection	N= 126 (%)
Febrile neutropenia	14 (11.1)
Septic shock	13 (10.3)
Ventilator-associated pneumonia	9 (7.1)
Apendicitis	8 (6.3)
Pyelonephritis	3 (2.3)
Bacterial gastroenteritis	2 (1.5)
Celulitis	2 (1.5)
Bacteriemia	2 (1.5)
Typhlitis	1 (0.7)
CRBSI	1 (0.7)
Primary peritonitis	1 (0.7)
Peianal-oerirectal abscess	1 (0.7)
Mastoiditiis	1 (0.7)
C. difficile infection	1 (0.7)
Congenital syphilis	1 (0.7)

Table 2. Non-pulmonary bacterial co-infections and antimicrobial treatment *CRBIS: Catheter-related bloodstream infection*



Graphic 3. Pulmonary and Non-pulmonary bacterial co-infection antimicrobial treatment. *3GC: Third-generation cephalosporin, 1GC: first generation cephalosporin*



Graphic 4. Seasonality trending of viral co-infection.

Forty nine patients (38.8%). were admitted to the pediatric intensive care unit (PICU) of whom 22 patients with PBC (17.4%) were admitted compared to 1 patient with VC (0.7%) with a OR 3.9 IC 95% (1.2-12.6). Ten patients (4.1%) died. All VC cases resolved without complications.

CONCLUSION

Pediatric patients with COVID-19 co-infection, especially BC were common in our center. Nearly one-third of the infected children had co-infection including unusual co-infections. BC was identified as a risk factor for ICU admission OR 3.9 IC 95% (1.2-12.6), Favorable outcomes were observed in most cases.

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