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Clinical Epidemiology of COVID-19 and MIS-C in Jamaican Children

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Short Running Title:
Clinical Epidemiology of COVID-19 in Jamaican children

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Abstract: ***This study describes the epidemiology, clinical features, and outcomes of COVID-19 and MIS-C among children aged 0 to 12 years presenting to Jamaica's Bustamante Hospital for Children from April 2020 to April 2022. A retrospective review of confirmed SARS-CoV-2 cases and MIS-C diagnoses identified 435 affected children, most with mild illness, though comorbid asthma and sickle cell disease were associated with severe outcomes. MIS-C accounted for 6.4 percent of cases and required higher levels of intervention, including oxygen therapy, transfusion, and ICU admission, with a mortality rate of 14.3 percent. Overall mortality was low at 0.9 percent, and most children recovered without complications. The findings highlight the distinct clinical patterns and risk factors influencing disease severity in Jamaican children during the pandemic.***

Keywords: COVID-19, MIS-C, pediatric epidemiology, Jamaica, clinical outcomes

1.Background

Children infected with SARS-CoV-2 often experience mild symptoms, with 15-35% being asymptomatic (1). Severe cases require intensive care (ICU) due to respiratory failure, shock, or multi-organ failure.

Paediatric Inflammatory Multisystem Syndrome (PIMS) or multisystem inflammatory syndrome of children (MIS-C) is a severe condition associated with SARS_CoV-2 infection. It was first described in April 2020 and has been reported globally in association with Kawasaki Disease (4-100%) and Toxic shock syndrome (~13%). It may involve a single organ or multiple organ systems (2). The United States Centers for Disease Control and Prevention (CDC) defines MIS-C as a condition in individuals aged <21 years with fever, evidence of inflammation, severe illness requiring hospitalization, multisystem organ involvement, no alternative diagnoses, and evidence of SARS-CoV-2 infection or exposure. Patients with SARS-CoV-2 who died or who had Kawasaki disease were also categorized as MIS-C cases (3).

Multiple retrospective and prospective studies revealed the median age of presentation as 5-10 years, with a male preponderance (50-60%) (1, 4-12). Cardiovascular and gastrointestinal systems were the most common organ systems, 12-100% and 42-100%, respectively followed by neurological system (13-56%). Confirmation was by SARS-CoV-2 PCR (20-75%) or SARS-CoV-2 serology (33-90%). ICU admission was required in 21-100% with 9-62% requiring mechanical ventilation. Obesity (10-25%) and Asthma/ lung disease (9-13%) were among the most common documented co-morbidities. There was a maximum mortality of 4% (4-12).

A multi-centre study across Barbados, Bahamas, and Jamaica by Evans-Gilbert, T. et al, found that 45% of hospitalized children aged 0-17 had comorbidities. This included asthma (8.8%) sickle cell disease (8.4%), and neurological conditions, cardiac disease, diabetes accounting for 5% each. Oxygen use was more likely in children with asthma, obesity, and MIS-C (13).

A local study at the University Hospital of the West Indies (UHWI) in Kingston identified 79 children under 16 years with SARS-CoV-2 infection or COVID-19 during the first 15 months of the pandemic (14). Eighteen of 41 admitted children (44%) were diagnosed with MIS-C (14). Common symptoms included fever and multiple organ system involvement, including cardiac, dermatologic, gastrointestinal, neurologic, hematological, renal and respiratory. MIS-C patients were treated with intravenous gamma globulin, aspirin, and high-dose corticosteroids (14).

The study endeavors to expand the knowledge of COVID-19 and MIS-C in the English-speaking Caribbean. We

describe the epidemiology of COVID-19 patients presenting to Bustamante Hospital for Children (BHC) in Kingston, Jamaica from April 2020-April 2022 and document the level of severity, the clinical outcomes and the characteristics of patients presenting with covid -19 and MIS-C over the time period.

2.Methods

This retrospective descriptive study included children 0-12 years of age who tested positive for SARS-CoV-2 infection at the BHC between April 1, 2020, to April 1, 2022. The BHC for Children is the only specialist paediatric hospital in the English-speaking Caribbean. It serves Jamaica and accepts referrals from neighboring Caribbean islands. It provides a comprehensive range of diagnostic, preventive, curative, rehabilitative and ambulatory services in paediatric medical and surgical specialties and subspecialties **(**27**).** Services comprise in-patient care, with an approximate bed capacity of 279 on 10 wards, and multidisciplinary outpatient clinics.

The study participants comprised of all patients, inpatient or outpatient, with confirmed SARS CoV-2 infection by RT-PCR, or antigen testing as well as those meeting the CDC's or WHO's criteria for MISC. As in other studies, criteria for performing SARS-CoV-2 testing changed over time at the BHC. Initially, only patients with a positive contact or travel history and clinical features in keeping with COVID-19 were tested. As the pandemic escalated it was mandated that all patients admitted to the institution receive a SARS-CoV-2 PCR, or antigen test regardless of their presentation.

A list of all patients who tested positive for SARS-CoV-2 infection was collected by the hospital's infectious disease department. The study participants were identified from this list and the Patient Administration System (PAS) where the discharge diagnoses for all patients are recorded. The dockets for all patients from this list and those with a discharge diagnosis of inclusion criteria were included.

Case definitions included confirmed case of SARS-CoV-2 infection (6), comprising a child with a positive Nucleic Acid Amplification Test (NAAT), a positive SARS-CoV-2 Ag-RDT AND meeting either the probable case definition or suspected criteria and an asymptomatic child with a positive SARS-CoV-2 Ag-RDT AND who is a contact of a probable or confirmed case, as well as MIS-C according to CDC or WHO definitions (3)

Patients included, were children aged 0-12 years who tested positive for SARS-CoV-2 infection by PCR or antigen test during the study period of April 1, 2020 to April 1, 2022, children who met the criteria for MIS-C, or children who tested negative for SARS-CoV-2 infection and met MIS-C criteria in the absence of a confirmatory SARS-CoV-2 antibodies, or antigen tests.

Participants data was collected from medical files using a data extraction sheet. Data included date of admission, age, sex, symptoms of the disease, investigations, treatment, and outcomes. Clinical outcomes were defined by death, admission to ICU/HDU and the length of stay in hospital.

Data were analyzed using the 25th version of the Statistical Package for the Social Sciences (SPSS). Descriptive statistics were performed and summarized as percentages with means and standard deviations. Associations between variables were ascertained using chi-squared for categorical variables and t-test for continuous variables. A p-value <0.05 was used to indicate statistical significance.

Ethical approval for the study was obtained from both the Ethics Committees of the South-East Regional Health Authority (SERHA) and the UWI Mona Campus Research Ethics. Each identified case was assigned a unique number that was used only for the purpose of this study, and collated data was stored digitally in the principal investigator's possession. The access to this data was highly restricted including only persons assisting with the research process. All data were password protected and encrypted. This data will be deleted 5 years post completion of this project. There was minimal risk to the participants. Informed consent was unnecessary, due to the nature of the study.

3.Results

Four hundred and thirty-five children were included in the study. Four hundred and sixteen patients (95.6%) were confirmed to be infected with SARS-CoV-2 while 19 patients (4.4%) were unconfirmed but met MIS-C criteria. Twenty-one patients (5.1%) tested positive in 2020, 201 (48.3%) in 2021 and 194 patients (46.6%) in 2022. Three hundred and sixteen patients (72.6%) were tested during their hospitalization and 90 patients (20.7%) were tested in the emergency department. Eleven patients (2.5%) were tested through the outpatient department and the place of testing for the remaining 4.1% of patients was not specified. SARS CoV-2 positive cases increased dramatically from wave 1 (N=10), to Wave 2 (N=66), Wave 3 (N=109) to Wave 4 (N=195) through the COVID-19 pandemic and represented a nineteen-fold increase in cases noted by the fourth wave (28).

The mean age was 3.85 years (SD 3.76). One hundred and sixty-seven patients (38.4%) were between 1-5 years of age. This group was closely followed by the 6–10-year age group (26.7%, N=145) and the less than 1 year age group (25.5%, N=123). Male patients predominated slightly 1.4:1, accounting for 253 patients (58.2%) and 178 female patients (40.9%).

One hundred and fourteen participants (26.2%) had coexisting comorbid medical conditions **(Table 1)**. The most common were bronchial asthma (8.3%), sickle cell disease (4.1%), malignancy (2.8%) and chronic cardiac disease (2.3%).

Three hundred and seventy-six patients (86.4%) were symptomatic of their SARS-CoV-2 infection while the remaining 59 patients (13.6%) were asymptomatic. The main symptoms of COVID-19 disease were fever (55.9%), cough (41.8%) and nausea/vomiting (33.8%) **[Table 2].** The characteristic loss of smell/taste only accounted for 0.5% each. Symptoms were noted for an average duration of 3.20 days, with fever specifically being seen for an

average of 2.40 days. Most patients, (53.3%, N=232)) had a mild presentation.

A statistically significant relationship (p value 0.000) was found between patients with comorbid medical conditions and the level of severity of their illness **[Table 3].** The mean age of presentation and the mean length of stay in hospital was also significant. Of the top presenting comorbid conditions, bronchial asthma and sickle cell disease were significant (p value 0.000) **[Table 3]**

It was found that 292 patients (67.1%) required hospitalization and 85 patients (19.5%) were managed as outpatients. Among the hospitalized, 2.5% were severely presented. The average length of stay in hospital was 8.01 ± 11.13 days.

Treatment modalities included 42 (9.7%) who required oxygen support and 13(3%) required ICU/HDU admission. Three patients (0.7%) required noninvasive ventilatory support and 4 patients (0.9%) required mechanical ventilation. Two patients (0.5%) required dialysis and 5 patients (1.1%) required ionotropic support.

Complications were noted in 42.1% of patients (**Table 4**). One hundred and twenty-two patients (28%) developed pneumonia, the most common complication. Overall, the main clinical outcome was complete recovery with a healthy status (97.7%). Four patients died (0.9%), 2 patients recovered with complications (0.5%), 2 patients (0.5%) remained admitted at the time of the study and 1 patient was transferred to another facility for continued care.

A statistically significant relationship (p value 0.003) existed between clinical outcome and the level of severity of illness at presentation.

Twenty-eight patients (6.4%) presented with MIS-C and most cases were not life threatening (n=18, 64%). Of the 28 patients that met the criteria for MIS-C, there was an equal number of males and females, the mean age of presentation was 4.53 ± 3.55 years and 39% of patients had a comorbid medical condition. The mean length of stay was 17.79 ± 13.64 days. A statistically significant relationship (p value 0.000) exists between the mean length of stay and MIS-C.

Of the patients presenting with MIS-C, 14 patients (50%) required oxygen therapy, 14 patients (50%) required blood transfusion, 8 patients (29%) required ICU/HDU admission, 3 patients (11%) required noninvasive ventilatory support and 2 patients (7%) required mechanical ventilation.

The mean length of stay in ICU/HDU was 11 ± 10.42 days. Five patients (18%) required ionotropic support and a single patient (4%) received dialysis. All these interventions were noted to be statistically significant (p value 0.000; 0.012). Twenty-two patients (78.6%) recovered without complications and there were 4 deaths (14.3%) **[Table 5A, 5B].**

4.Discussion

This retrospective study of 435 ambulatory and hospitalized cases proved that children under 12 years of age in an upper middle income developing country were indeed affected by COVID-19, particularly the preschool age group. This was in keeping with studies conducted in the United Kingdom (15, 16), however, several studies, including the recent study by Berry et al. at the UHWI (who reported consecutively hospitalized children < 16 years), found that the adolescent population was more affected.(14, 19, 20-21) A slight male predominance was noted with a ratio of 1.4:1. Developed and developing countries saw a similar pattern with either a slight male predominance or no significant gender difference (14-18, 20-21)

COVID-19 cases at BHC rose sharply from 2020 to 2022, especially after community spread began in August 2020. Variants like Delta and Omicron, with higher virulence and infectivity, likely caused more hospitalization during later waves. Improved testing and surveillance may also have contributed to the increase.

Patients with comorbidities are a well-known risk factor for disease severity and mortality. The presence of even one comorbidity was noted to increase mortality in Brazilian children (20)**.** Less than a third of the participants with this study had comorbidities but these patients were significantly more likely to present severely, especially children with bronchial asthma and sickle cell disease (p value 0.000). Interestingly, patients with comorbidities did not confer a higher risk of MIS-C. Similar studies in the Caribbean noted that most of the comorbid conditions seen in paediatric patients afflicted by COVID-19 included sickle cell disease and asthma.(13-14**)** The Brazilian study by Atamari-Anahui et al found bronchial asthma to be protective against mortality **(**20**)**. Notably, the researchers observed that patients with malignancy, who were likely to be significantly immunocompromised and ranked amoung the top four comorbidities noted in the study, did not infer an increased risk of severe disease.

The rate of asymptomatic cases and the milder presentation of illness followed existing patterns of paediatric COVID-19.**(**1) Fever, respiratory and gastrointestinal symptoms predominated and this was quite similar to the global picture **(**15-17, 23). The subset of MIS-C patients presenting severe or critical disease was low and this finding was consistent with previous studies(15-19, 21, 23).

The outcome of study participants was positive with 99.3% of patients without MIS-C having a complete recovery. The rate of recovery among the MIS-C group, however, was lower at 78.6%. The overall mortality rate was 0.9%. This rate paralleled paediatric mortality rates seen across developed and developing countries which generally ranged 1% or less.(14-15, 17-18, 24) The mortality rate among the MIS-C group of 14.3% contrasted this. Of the four deaths, 3 had malignant conditions and 1 had nephrotic syndrome, suggesting that comorbid illness is a risk factor for mortality. Seventy-five percent had a severe to critical presentation with fifty percent developing multiorgan dysfunction and requiring ICU/HDU care. The patient with

stage 4 osteosarcoma developed respiratory compromise. It is difficult to say what role COVID-19 played in her outcome. Less than half of participants were affected by complications. Pneumonia was the most common. The need for respiratory support in the study remained low.

There was no sex difference noted among the MIS-C patients presenting to BHC. The mean age of presentation 4.53 ± 3.55 years was younger than that of MIS-C patients studied in the Caribbean and other developed countries. (15, 26) The MIS-C patients were more likely to require supportive interventions such as blood transfusion and oxygen therapy, HDU/ICU admission, ventilation, ionotropic support (p value 0.000) and dialysis (p value 0.007) than the non-MIS-C group. In a multicenter study in the UK, children with MIS-C were five times more likely than others to be admitted to critical care and were more likely to require ventilatory and ionotropic support.(15) A systematic review of MIS-C patients throughout Latin America and the Caribbean found that 47% of patients were admitted to the PICU with a significant number requiring mechanical ventilation and vasoactive drugs.(26) The mortality rates were low among the MIS-C studies.(14, 15, 26)

Limitations of this retrospective study include missing or unavailable medical records and undocumented data.

In recommendation, prompt SARS-Cov-2 and antibody testing to be done for MIS-C cases. More widespread testing for circulating variants of concern/interest would highlight possible differences in clinical presentations and clinical outcomes. COVID-19 vaccine should continue in children aged less than 12 years with comorbidities, according to Jamaica's national COVID-19 policy.

The researchers note the need for longitudinal studies to determine potential long-term complications of COVID-19 and MIS-C. Follow up of patients presenting with comorbidities, most notably asthma and sickle cell disease, would be paramount.

The study confirms that COVID-19 significantly affected Jamaican children under 12 years, with most presenting mild symptoms. Comorbid asthma and sickle cell disease were associated with increased severity, while MIS-C cases experienced more intensive clinical courses and higher mortality. These findings underscore the need for vigilant monitoring, early recognition of MIS-C, and strengthened pediatric care pathways during infectious disease outbreak.

Disclosure: The authors have no conflicts of interest to disclose.

Footnotes: This work is an abbreviation of a doctoral thesis submitted by Dr Kahri Royal, in consideration for her Doctorate in Pediatric Medicine degree, from the University of the West Indies.

Abbreviations

2019-nCoV: 2019 novel coronavirus
AAP: American Academy of Paediatrics
Ag-RDTs: Antigen-detecting rapid diagnostic tests
BHC: Bustamante Hospital for Children
CDC: Centers for Disease Control and Prevention
COVID-19: Coronavirus disease
CPAP: Continuous Positive Airway Pressure
ECMO: Extracorporeal Membrane Oxygenation
HCoV: Human Coronavirus
HDU: High Dependency Unit
ICTV: International Committee on Taxonomy of Viruses
ICU: Intensive Care Unit
LAC: Latin America and the Caribbean
MERS: Middle East Respiratory Syndrome Coronavirus
MIS-C: Multisystem Inflammatory Syndrome in Children
NAAT: Nucleic acid amplification test
PICU: Paediatric Intensive Care Unit
SARS-Cov: Severe Acute Respiratory Syndrome Coronavirus
SARS-CoV-2: Severe Acute Respiratory Syndrome Coronavirus 2
SERHA: South East Regional Health Authority
SPSS: Statistical Package for the Social Sciences
UHWI: University Hospitall of the West Indies
VOC: Variant of concern
VOI: Variant of interest
WHO: World Health Organization

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Table 1: The distribution of comorbid medical conditions among the participants

Comorbidity (n=435)	Frequency, n (%)
Asthma	36 (8.3)
Chronic cardiac disease	10 (2.3)
Chronic pulmonary disease	2 (0.5)
Chronic liver disease	1 (0.2)
Chronic kidney disease	1 (0.2)
Chronic neurologic disease	8 (1.8)
Diabetes	2 (0.5)
Hypertension	1 (0.2)
Secondhand smoke inhalation	-
Malignant neoplasm	12 (2.8)
HIV	-
Obesity	3 (0.7)
Sickle cell disease Hb SS Hb SC Hb B0 Thal	18 (4.1) 8 (1.8) 2 (0.5) 1 (0.2)
Other comorbidities	31 (7.1%)
	114 (26.2%)

Table 2: The clinical presentation of COVID-19 among the participants

COVID-19 Characteristics (n=435)	Frequency, n (%)
Symptomatic	**376 (86.4%)**
Fever	243 (55.9%)
Cough	182 (41.8)
Hemoptysis	1 (0.2)
Sore throat	16 (3.7)
Rhinorrhea	84 (19.3)
Wheeze	48 (11.0)
Shortness of breath	73 (16.8)
Chest pain	18 (4.1)
Myalgia	6 (1.4)
Joint pain	9 (2.1)
Lethargy	83 (19.1)
Headache	41 (9.4)
Altered consciousness	16 (3.7)
Seizures	42 (9.7)
Abdominal pain	47 (10.8)
1Nausea/vomiting	147 (33.8)
Diarrhea	55 (12.6)
Conjunctivitis	9 (2.1)
Skin rash	22 (5.1)
Skin ulcer	-
Lymphadenopathy	7 (1.6)
Haemorrhage	7 (1.6)
MIS-C	25 (5.7)
Loss of smell	2 (0.5)
Loss of taste	2 (0.5)
Other symptoms	149 (34.3%)

Table 3: Demography, length of stay, Comorbidity and Health Outcomes According to Severity of Illness (by WHO classification)

	Asymptomatic n=59	Mild n=228	Moderate n=89	Severe n=50	Critical n=5	P value
	14%	**53%**	**20%**	**12%**	**1%**	
Male	36 (61%)	135 (59%)	51 (57%)	29 (58%)	2	0.916
Female	23 (39%)	93 (41%)	38 (43%)	21 (42%)	3	
	n=59	n=232	n=89	n=50	n=5	
Comorbidity	14 (24%)	58 (25%)	11 (12%)	28 (56%)	3 (60%)	0.000
No comorbidity	45 (76%)	174 (75%)	78 (88%)	22 (44%)	2 (40%)	
Mean age ± SD (years)	6.17 ± 3.50	3.66 ± 3.71	1.89 ± 2.96	5.36 ± 3.54	4.81 ± 4.52	0.000
Mean length of stay ± SD (days)	13.79 ± 19.38	5.77 ± 7.91	6.54 ± 6.54	10.45 ± 11.9	20.8 ± 5.98	0.000
Comorbidities	**Asymptomatic**	**Mild**	**Moderate**	**Severe**	**Critical**	**P value**
Asthma	3 (5.1%)	14 (6%)	6 (6.7%)	13 (26%)	-	0.000
Sickle Cell disease	-	7 (3%)	3 (3.4%)	8 (16%)	-	0.000
Malignancy	-	10 (4.3%)	-	2 (4%)	-	0.152
Chronic cardiac disease	3 (5.1%)	4 (1.7%)	-	3 (6%)	-	0.106
Outcomes	**Asymptomatic n=59**	**Mild n=231**	**Moderate n=89**	**Severe n=50**	**Critical n=5**	**P value**
Recovered/healthy	59 (100%)	228 (98.7%)	88 (99%)	46 (92%)	4 (80%)	0.003
Recovered/complications	0	1 (0.4%)	0	1 (2%)	0	
Death	0	1 (0.4%)	0	2 (4%)	1 (20%)	
Transfer to another facility	0	1 (0.4%)	0	0	0	
Other	0	0	1 (1%)	1 (2%)	0	

Table 4: Complications among Children with COVID-19

Complications, (n=435)	Frequency, n (%)
Stroke	-
Seizures	38 (8.7)
Meningitis/encephalitis	14 (3.2)
Anaemia	33 (7.6)
Cardiac arrhythmia	2 (0.5)
Cardiac arrest	4 (0.9)
Pneumonia	122 (28)
Bronchiolitis	9 (2.1)
ARDS	1 (0.2)
Bacteremia	8 (1.8)
Bleeding	3 (0.7)
Endocarditis	-
Myocarditis/Pericarditis	8 (1.8)
Acute kidney injury	4 (0.9)
Pancreatitis	-
Liver dysfunction	10 (2.3)
Cardiomyopathy	1 (0.2)
Other	9 (2.1%)
	183 (42.1)

Table 5A: Demography, Comorbidities, Length of stay, Treatments and Outcomes among the MIS-C and Non-MIS-C Participants

Demography, Comorbidities and Length of Stay	Non-MIS-C group n=403	MIS-C group n=28	P value
Male	239 (59%)	14 (50%)	0.334
Female	164 (41%)	14 (50%)	
	n=407	n=28	
Comorbidity	103 (25%)	11 (39%)	0.104
No comorbidity	304 (75%)	17 (61%)	
Mean age ± SD (years)	3.85 ± 3.77	4.53 ± 3.55	0.32
Mean length of stay ± SD (days)	7.23 ± 10.54	17.79 ± 13.64	0.000
Treatments and Interventions	**Non-MIS-C group n=407**	**MIS-C group n=28**	**P value**
Blood transfusion	11 (2.7%)	14 (50%)	0.000
Oxygen therapy	28 (6.9%)	14 (50%)	0.000
ICU/HDU admission	5 (1.2%)	8 (29%)	0.000
Noninvasive ventilation	-	3 (11%)	0.000
Invasive ventilation	2 (0.5%)	2 (7%)	0.000
Dialysis	1 (0.2%)	1 (4%)	0.012
Ionotropic support	-	5 (18%)	0.000
Outcomes	**Non-MIS-C group n=409**	**MIS-C group n=25**	**P value**
Recovered/healthy	403 (99.3%)	22 (78.6%)	0.000
Recovered/complications	2 (0.5%)	0	
Death	-	4 (14.3%)	
Transfer to another facility	1 (0.2%)	0	
Other	-	2 (7.1%)	

Table 5B: Demographics, clinical presentation and course of children who died

Age/Sex	Comorbidity	Presentation	Clinical course	Medication	Complications
2y F	Nephrotic syndrome/ Focal segmental glomerulosclerosis	Fever	ICU admission Ventilation Dialysis Blood transfusion	Corticosteroids IVIG Inotropes	Anaemia Pneumonia Acute Respiratory Distress Syndrome Myocardial dysfunction Acute kidney injury Liver dysfunction
9y M	Acute leukemia	Fever	No oxygen requirement Blood transfusion	None	-
2y F	Burkitt's lymphoma	Vomiting Abdominal pain	ICU admission Oxygen requirement No ventilation	Antibiotics	Anaemia Pneumonia Pleural effusion Pericarditis Acute kidney injury Liver dysfunction
10y F	Stage 4 Osteosarcoma	Shortness of breath Myalgia Abdominal pain	Oxygen requirement No ventilation Blood transfusion	Corticosteroids Antibiotics Anticoagulation	Pneumonia Pleural effusion DVT