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Outcome & its correlation with Socio-Demographic factors in Multisystem Inflammatory Syndrome in Children (MIS-C) admitted in A Tertiary care Hospital in the Western Himalayan Region

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Abstract
Background: *The present study aimed to describe the Outcome & its correlation with socio-demographic factors among children admitted as a case of Multisystem Inflammatory Syndrome in Children (MIS-C) in A Tertiary care Hospital in the Western Himalayan Region .*
Material & Methods: *We conducted a cross sectional study for MIS-C from January to July 2021, in the pediatric ward of Indira Gandhi Medical College Shimla in Himachal Pradesh. All children admitted with a diagnosis of MIS-C were included in the study. Data regarding socio-demographic factors and outcome was extracted and analyzed using Epi Info V7 software.*
Results: *In the present study, a total of 31 children, diagnosed and admitted as a case of multisystem inflammatory syndrome in children (MIS-C) were included. Mean age of these patients was 7.12±4.78 years. Among the total 16(51.6%) were males while 15(48.4%) were females. Mean duration of hospital stay among participants was 9.19 ±5.24 days. Maximum of 13 (41.9%) children of MIS- C, had a hospital stay duration of ≤ 1 week, 12(38.7%) stayed for 1-2weeks and 6 (19.4%) for ≥2 weeks. Among the total admitted children, 23(74.2%) were discharged after full recovery, 5 (16.1%) died during treatment while 3(9.7%) left the hospital against medical advice. In the present study, mortality was higher in <10 years age group, in females and in children belonging to the rural areas. But there is no significant difference in mortality according to these socio-demographic factors. Mortality was higher in children having Fever & Vomiting, cough, hematemesis, bleeding diathesis, hepatomegaly & splenomegaly. But there was no statistically significant difference in mortality according to these symptoms. Similarly, mortality was higher in children having Tachypnoea, Respiratory Distress, Hypotension and Encephalopathy, but it was not statistically significant, except in the case of respiratory distress.*
Conclusion: *The present study indicates that prompt recognition of signs & symptoms and timely treatment are crucial to achieve a good prognosis and outcome .*
Keywords: *Outcome, correlation socio-demiographic factors , Multisystem Inflammatory Syndrome in Children (MIS-C)*

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I. Introduction

High index of suspicion for MIS-C disease in severe critical cases in the time of pandemic is the need of the hour. MIS-C may have different clinical presentations in different geographical areas. MIS-C was hypothesized to be mostly postinfectious and distinct from COVID-19 because many patients' respiratory specimens were SARS-CoV-2 negative and MIS-C peaked after reported COVID-19 cases.[1]

Multisystem inflammatory syndrome (MIS) can affect both young children and adolescents. Most of the children who contracted the COVID-19 virus infection, usually had only a mild illness. But in children who go on to develop severe MIS-C, some organ systems and tissues such as the lungs, blood vessels, kidneys heart digestive system, brain, skin or eyes become severely inflamed. Once multi-organ dysfunction develops because of severe inflammation outcome become worse.[2]

Most of the children recovered to an excellent state of health with careful intervention and timely treatment. However, children suffering from MIS-C required hospitalization and even intensive care, but only a very small percentage of the children have a fatal outcome.[3,4]

According to many systematic reviews, the duration of hospitalization ranged from 4–13 days (median, 7 days), and intensive care was required in almost half of patients. Inotropic support, mechanical ventilation and ECMO were also required in a few patients. The fatality rate was reportedly low in the US, Europe and many other countries. Among the various studies, reported outcomes at discharge or during follow-up, most of the children with cardiac involvement experienced nearly full recovery of left ventricular function and normalization of cardiac inflammatory markers except for mild cardiac dysfunction at discharge. However, the long-term prognosis of MIS-C remains unknown. For example, long-term follow-up is required for coronary arterial aneurysm if present. In addition, long term follow up studies and cardiac surveillance are required to monitor cardiac function and coronary arterial abnormalities.[5-8]

There is an urgent need for collection of standardized data that describe, severity, outcomes and its correlation with socio-demographic factors of MIS-C in this hilly region. Against this backdrop, the study was conducted to describe Outcome & its correlation with socio-demographic factors among children admitted as a case of Multisystem Inflammatory Syndrome in Children (MIS-C) in Indira Gandhi Medical college, Shimla, a tertiary care Hoaspital in the Western Himalayas.

Aims & objectives

To evaluate the Outcome & its correlation with socio-demographic factors associated with multisystem inflammatory syndrome in children (MIS-C).

II. Material & Methods

- **Research Approach**-Descriptive
- **Study Design**- A Cross Sectional Institutional based Study
- **Setting of the study**- Indira Gandhi Medical College Shimla in Himachal Pradesh
- **Study duration**- between Jan 2021- July 2020
- **Study population**- Children admitted with diagnosis of MISC In pediatric ward of Indira Gandhi Medical College Shimla in Himachal Pradesh

- **Sample size**- All Children admitted with diagnosis of MISC In pediatric ward of Indira Gandhi Medical College Shimla in Himachal Pradesh between Jan 2021- July 2020
- **Operational definition for a case of MIS-C[9]**

Children and adolescents 0–19 years of age with fever > 3 days
AND two of the following:
a) Rash or bilateral non-purulent conjunctivitis or muco-cutaneous inflammation signs (oral, hands or feet).
b) Hypotension or shock.
c) Features of myocardial dysfunction, pericarditis, valvulitis, or coronary abnormalities (including ECHO findings or elevated Troponin/NT-proBNP),
d) Evidence of coagulopathy (by PT, PTT, elevated d-Dimers).
e) Acute gastrointestinal problems (diarrhoea, vomiting, or abdominal pain).
AND
Elevated markers of inflammation such as ESR, C-reactive protein, or procalcitonin.

AND
No other obvious microbial cause of inflammation, including bacterial sepsis, staphylococcal or streptococcal shock syndromes.
AND
Evidence of COVID-19 (RT-PCR, antigen test or serology positive), or likely contact with patients with COVID-19

- **Permission**- obtained from the concerned authorizes of Indira Gandhi Medical College Shimla in Himachal Pradesh
- **Data analysis**-The data were collected from the record files of admitted children, compiled and entered in MS Excel, and analyzed using appropriate statistical tools in software Epi info V7 by applying appropriate statistical test in terms of frequencies and percentage.

III. Results

In the present study a total of 31 children were diagnosed and admitted as a case of multisystem inflammatory syndrome in children (MIS-C) in the pediatric ward of Indira Gandhi Medical College Shimla in Himachal Pradesh between Jan 2021- July 2021.

In the present study age of the children diagnosed as multisystem inflammatory syndrome in children (MIS-C) was 7.12±4.78 years. Maximum 12 (38.7%) were of age group 5-10 years followed by 10 (32.3%) of age group 6-10 years , 8 (25.8%) of 11-15 years and 1 (3.2%) of 15-19 years age group. among the total 16(51.6%) were males while 15(48.4%) were females.29(93.5%) belonged to rural area while 2(6.5%) to Urban area. (Table-1)

		Frequency	Percent
Age Group	0-5	12	38.7
	6-10	10	32.3
	11-15	8	25.8
	15-19	1	3.2
Mean age		7.12±4.78 years	
Gender	Male	16	51.6
	Female	15	48.4
Rural/Urban	Rural	29	93.5
	Urban	2	6.5
Total		31	100.0

Table-1: Socio-Demographic variables of MISC-C patients

Mean duration of hospital stay among participants was 9.19 ±5.24 days. A maximum of 13 (41.9%) children of MIS-C, had a hospital stay of ≤ 1 week, 12(38.7%) stayed for a duration of 1-2weeks and 6 (19.4%) for ≥2 weeks duration. Of the total admitted MIS-C children, 23(74.2%) were discharged after full recovery, 5 (16.1%) died during treatment while 3(9.7%) left the hospital against medical advice. (Table-2)

		Frequency	**Percent**
Duration of stay	≤ 1 week	13	41.9
	1-2weeks	12	38.7
	≥2 weeks	6	19.4
Mean Duration of stay		9.19 ±5.24 days	
Outcome	Discharged	23	74.2
	Death	5	16.1
	LAMA	3	9.7
Total		31	100.0

Table-2: Duration of stay and Outcome of MIS-C Patients

In the present study, mortality was higher in <10 years age group, in females, and those belonging to rural areas. But there is no significant difference in mortality according to age groups, gender and place of living. (Table-3)

			Outcome		**Total**	**P Value**
			Discharge/ Lama	**Death**		
Adolescent	0-10 years	Count	19	3	22	.613
		%	86.4%	13.6%	100.0%	
	11-19 years	Count	7	2	9	
		%	77.8%	22.2%	100.0%	
Gender	Male	Count	15	1	16	.172
		%	93.8%	6.2%	100.0%	
	Female	Count	11	4	15	

		%	73.3%	26.7%	100.0%	
Geographic Region	Rural	Count	25	4	29	.301
		%	86.2%	13.8%	100.0%	
	Urban	Count	1	1	2	
		%	50.0%	50.0%	100.0%	

Table-3: Association of outcome with socio-demographic variables

In the present study, mortality was higher in children suffering from Fever & Vomiting, (in absence of rash) cough, hematemesis, bleeding diathesis, hepatomegaly & splenomegaly. But there was no significant difference in mortality according to these symptoms. (Table-4)

			Outcome		Total	P Value
			Discharge/ Lama	Death		
Fever	Yes	Count	25	5	30	.839
		%	83.3%	16.7%	100.0%	
	No	Count	1	0	1	
		%	100.0%	0.0%	100.0%	
Rash	Yes	Count	11	2	13	.659
		%	84.6%	15.4%	100.0%	
	No	Count	15	3	18	
		%	83.3%	16.7%	100.0%	
Cough	Yes	Count	5	0	5	.387
		%	100.0%	0.0%	100.0%	
	No	Count	21	5	26	
		%	80.8%	19.2%	100.0%	
Hematemesis	Yes	Count	0	1	1	.161
		%	0.0%	100.0%	100.0%	
	No	Count	26	4	30	
		%	86.7%	13.3%	100.0%	
Bleeding Diathesis	Yes	Count	0	1	1	.161
		%	0.0%	100.0%	100.0%	
	No	Count	26	4	30	
		%	86.7%	13.3%	100.0%	
Vomiting	Yes	Count	12	4	16	0.186
		%	75.0%	25.0%	100.0%	
	No	Count	14	1	15	
		%	93.3%	6.7%	100.0%	
Hepatomegaly	Yes	Count	13	2	15	.532
		%	86.7%	13.3%	100.0%	
	No	Count	13	3	16	
		%	81.2%	18.8%	100.0%	
Splenomegaly	Yes	Count	13	2	15	.532
		%	86.7%	13.3%	100.0%	
	No	Count	13	3	16	
		%	81.2%	18.8%	100.0%	
Total		Count	26	5	31	
		%	83.9%	16.1%	100.0%	

Table-4: Association of outcome with Clinical Presentation at Admission

In the present study, mortality was higher in children having tachypnea, Respiratory Distress, Hypotension and Encephalopathy, but lesser in those with an absence of seizures. But there was no significant difference in mortality according to these symptoms except for respiratory distress. (Table-5)

			Outcome		**Total**	**P Value**
			Discharge/ LAMA	**Death**		
Tachypnea	Yes	Count	14	4	18	0.285
		%	77.8%	22.2%	100.0%	
	No	Count	12	1	13	
		%	92.3%	7.7%	100.0%	
Respiratory Distress	Yes	Count	10	5	15	0.018
		%	66.7%	33.3%	100.0%	
	No	Count	16	0	16	
		%	100.0%	0.0%	100.0%	
Hypotension	Yes	Count	14	5	19	0.068
		%	73.7%	26.3%	100.0%	

	No	Count	12	0	12	
		%	100.0%	0.0%	100.0%	
Seizure	Yes	Count	4	1	5	0.613
		%	80.0%	20.0%	100.0%	
	No	Count	22	4	26	
		%	84.6%	15.4%	100.0%	
Encephalopathy	Yes	Count	5	3	8	0.093
		%	62.5%	37.5%	100.0%	
	No	Count	21	2	23	
		%	91.3%	8.7%	100.0%	
Total		Count	26	5	31	
		%	83.9%	16.1%	100.0%	

Table-5: Association of outcome with Respiratory & CNS Symptoms

IV. Discussion

In the present study age of the children diagnosed as multisystem inflammatory syndrome in children (MIS-C) was 7.12±4.78 years. Maximum 12 (38.7%) were of age group 5-10 years followed by 10 (32.3%) of age group 6-10 years, 8 (25.8%) of 11-15 years and 1 (3.2%) of 15-19 years age group. Among the total 16(51.6%) were males while 15(48.4%) were females.29(93.5%) belonged to rural area while 2(6.5%) to Urban area.

Mean duration of hospital stay among participants was 9.19 ±5.24 days. Maximum 13 (41.9%) children of MIS- C had a hospital stay for ≤ 1 week, 12(38.7%) of 1-2weeks and 6 (19.4%) had a hospital stay of ≥2 weeks. Among the total admitted children, 23(74.2%) were discharged after full recovery, 5 (16.1%)children died during treatment while 3(9.7%) left the hospital against medical advice.

In the present study, mortality was higher in the <10 years age group, in females and in children belonging to rural area. But there is no significant difference in mortality according to these socio-demographic factors. Mortality was more in children having Fever & Vomiting(in absence of rash), cough, hematemesis, bleeding diathesis, hepatomegaly & splenomegaly. But there was no statistically significant difference in mortality according to these symptoms. Similarly, mortality was more in children having Tachypnea, Respiratory Distress, Hypotension and Encephalopathy. But there was no statistical significant difference in mortality according to these symptoms except for respiratory distress. Similar types of results were observed in the studies done by Levi Hoste et al[10], Fouriki A et al[11], Leora R et al1[2] and M. Ahmed et al[13].

MIS-C mostly affects school-age children, but this syndrome also has been seen in infants and adolescents. MIS-C symptoms normally appear between 2-6 weeks (on an average 4 weeks) after COVID-19 infection. Most children with MIS-C have developed antibodies to the SARS-CoV-2 virus. In Multisystem inflammatory syndrome (MIS), various organ systems become inflamed, including the heart, lungs, kidneys, brain, skin, eyes and gastrointestinal organs.[7,8]

MIS-C is a treatable condition and majority of the children recover fully from this illness with early and prompt intervention. We should emphasizes the importance of investigating for MIS-C, along with other tropical infections in pediatric and adolescent patients with COVID-19 presenting with gastrointestinal symptoms like vomiting and hypoxemia or respiratory distress and cardiac involvement.[3,4,8]

V. Conclusions

MIS-C is rare and majority of the children improved with timely intervention, but some children rapidly deteriorate, to a poor outcome**.** Gastrointestinal manifestations like vomiting and cardio-respiratory involvement were factors associated with this life-threatening hyper-inflammatory syndrome. Prompt recognition & timely management are crucial to achieve good prognosis & outcomes but longer term follow-up is needed to assess outcomes and its sequelae.

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