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Original Research Article

Study On Clinical and Etiopathological Profile of Pancytopenia in Children Aged 1-18 Years: An Observational Analysis

Umese Ram[1], Rajesh Singh[2], Jiteshwar Prasad Mandal[3], Rakesh Ranjan[4]

[1]Senior Resident, Department of Pediatrics, Sri Krishna Medical College & Hospital, Muzaffarpur, Bihar.

[2]Senior Resident, Department of Pediatrics, Sri Krishna Medical College & Hospital, Muzaffarpur, Bihar.

[3]Associate Professor, Department of Pediatrics, Sri Krishna Medical College & Hospital, Muzaffarpur, Bihar.

[4]Associate Professor, Department of Pediatrics, Sri Krishna Medical College & Hospital, Muzaffarpur, Bihar.

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Corresponding author: Dr. Rajesh Singh
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Abstract

Background: An decrease in all three blood components; leukopenia, thrombocytopenia, and anemia below the normal level is known as pancytopenia. This study is an attempt to fill the lacunae regarding the information about pancytopenia in pediatric patients. The study aimed to study the clinical and etiopathological profile of pancytopenia in children aged 1–18 years.

Methods: This cross-sectional observational study was to find out more about the etiopathological profile, clinical characteristics, and demographics of pediatric pancytopenia. The study was conducted from June 2025 to November 2025 with 65 patients who fulfilled the inclusion criteria and were admitted to the pediatric department of Sri Krishna Medical College and Hospital in Muzaffarpur, Bihar, and were between the ages of 1 and 18. IBM's Statistical Package for the Social Sciences version 23 was used for the statistical study.

Results: The majority of cases (55%) out of 65 patients were in the 1–6 years age group. Our study revealed male predominance over females with male-to-female ratio of 2.09:1, mostly belonging to rural areas. The most common presenting complaint was easy fatigue in (90%) of patients followed by fever (54%). The most common physical finding was pallor (100%), followed by splenomegaly and pedal edema (38%) and (18%), respectively. Bone marrow cellularity shows hypocellular marrow (62%), hypercellular (31%), and normocellular (7%). Peripheral smears of most of the patients showed normocytic normochromic (34%), followed by macrocytic hypochromic (30%). Regarding etiology megaloblastic anemia (30%) was reported as the most common cause of pancytopenia followed by malignancies (30%) including myelodysplastic syndrome (9%), multiple myeloma (3%), acute lymphocytic leukemia (9%), and acute myeloid leukemia (9%) followed by aplastic anemia (14%) and sepsis (8%). The study also shows other rare causes of pancytopenia such as disseminated tuberculosis (6%), malaria (9%), and dengue (3%).

Conclusion: According to the present study, megaloblastic anemia, malignancies, and aplastic anemia are the most frequent nutritional causes of pancytopenia.

Keywords: Children, Megaloblastic anemia, Pancytopenia.

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Introduction

Pancytopenia is diagnosed when the absolute neutrophil count (ANC) is $<1.5\times10^9$/L, the absolute hemoglobin level (Hb) is <10 g%, and the platelet count is $<100\times10^9$/L. [1] The condition is marked as severe, when the patient has Hb <7 g%, ANC $<0.5\times10^9$/L, platelet count 20×10^9/L, and the reticulocyte count is 1%.[2] The frequency of causes of pancytopenia is influenced by demographic factors, therefore in developing countries nutritional and infectious causes prevail whereas in developed countries malignancies manifest as pancytopenia.[3] Studies from various region of India shows varied etiologies of pancytopenia a study from the northern region shows megaloblastic anemia as the most common etiology while in the northeastern region, the study found aplastic anemia as the first most common cause, followed by megaloblastic anemia.[4,5] A

study from the western region suggests acute myeloid leukemia (AML) as the most common cause followed by myelodysplastic syndrome and the southern region study shows normoblastic erythroid hyperplasia followed by megaloblastic anemia as causes of pancytopenia.[6,7] The present study was conducted to identify the clinical and etiopathological profile of pancytopenia in children admitted at our institution.

Material and Methods

A cross-sectional observational study conducted at Sri Krishna Medical College and Hospital in Muzaffarpur, Bihar, examined the clinical characteristics, demographics, and etiopathological profile of pancytopenia in children admitted to the Department of Pediatrics between June 2025 and November 2025. Every patient with pancytopenia who presented to our hospital was asked to participate in our study and have their bone marrow examined using the purposive sampling technique; however, only 65 patients who met the study's inclusion requirements were accepted after providing their signed and informed consent.

Selected patients age between 1 to 18 completed years, presenting with signs and symptoms of pancytopenia, history of recurrent blood transfusion but not within 1 month and guardian willing to give informed consent were included in this study.

Children aged <1 year or more than 18 years, known or previously diagnosed cases of pancytopenia, history of recent blood transfusion, receiving chemotherapy and radiotherapy, known cases of malignancies on chemotherapy/radiotherapy, patients with hemodilution bone marrow aspiration smears, inconclusive bone marrow reports, known case of hemoglobinopathies, history of recent surgery, not willing to give informed consent were excluded in this study.

On admission, all patients fulfilling inclusion criteria were interviewed for detailed history including the age of presentation, treatment history, family history, history of drug intake, and radiation exposure, and examined for important physical findings such as pallor, icterus, skin pigmentation, the sign of vitamin deficiencies, bone pain, bony tenderness, hepatomegaly, splenomegaly, lymphadenopathy, pedal edema, bleeding manifestation (gum bleed, epistasis, petechial rash purpura, and bleeding from any site), altered sensorium, and ascites. A relevant systemic examination is done to reach the diagnosis. Investigations at the time of admission included a complete hemogram, total and differential leukocyte counts, red blood indices mean corpuscular volume, mean corpuscular hemoglobin, and mean corpuscular hemoglobin concentration, platelets count, peripheral blood smear, reticulocyte counts, serum iron, serum ferritin, Vitamin B12, folic acids levels, MP smear, typhi dot, blood culture, serology to rule out hepatitis, typhoid, chest X-ray, ultrasonography, a neuroimaging and invasive procedure such as bone marrow examination were done to reach the diagnosis.

IBM's Statistical Package for the Social Sciences version 23 was used for the statistical study (USA). Initially, MS Excel was used to process the data and conduct the coding. Using the Shapiro– Wilk and Kolmogorov-–Smirnov tests, it was determined that the data were not regularly distributed. Frequency and proportions were utilized in the descriptive analysis for categorical variables while mean and standard deviation were employed for continuous variables.

Results

A maximum of 55% of the 65 patients between the ages of 1 and 6 years, 29% of the cases were between the ages of 7 and 12, and 16% of the cases were between the ages of 13 and 18. The gender ratio was 2.09:1, with 68% of the population being male and 32% being female. Geographically, 40% of cases were found in urban areas, and 60% were found in rural regions (Table 1).

Table 1: Distribution of study participants based on the demographic profile

Age	No. of cases (n=65)	Percentage
1–6 years	36	55.0%
7–12 years	19	29.0%
13–18 years	10	16.0%
Gender		
Male	44	68.0%
Female	21	32.0%
Study area		
Rural	39	60.0%
Urban	26	40.0%

The most common presenting complaint was easy fatigue (90%), followed by fever (54%), giddiness (40.0%), palpitation (38.0%), bleeding tendencies (24.0%), lower limb edema (19.0%), cough (18.0%), breathlessness (16.0%), decreased appetite (16.0%), bony pain (14.0%), and loose stool (8.0%). The most common physical finding was pallor (100%), followed by splenomegaly (38%), pedal edema (18%), lymphadenopathy (18.0%),

ascites (18.0%), hepatomegaly (18.0%), icterus (14.0%), glossitis (12.0%), knuckle hyperpigmentation (10.0%), and purpuric spots (6.0%) (Table 2).

Table 2: Signs and symptoms of study participants

Symptoms	No. of cases (n=65)	Percentage
Easy fatigue	58	90.0%
Fever	35	54.0%
Giddiness	26	40.0%
Palpitation	25	38.0%
Bleeding tendencies	15	24.0%
Lower limb edema	13	19.0%
Cough	12	18.0%
Breathlessness	11	16.0%
Decreased appetite	11	16.0%
Bony pain	9	14.0%
Loose stool	6	8.0%
Physical Finding		
• Pallor	65	100.0%
• Spenomegaly	25	38.0%
• Pedal edema	12	18.0%
• Lymphadenopathy	12	18.0%
• Ascites	12	18.0%
• Hepatomegaly	12	18.0%
• Icterus	9	14.0%
• Glossitis	8	12.0%
• Knuckle hyperpigmentation	7	10.0%
• Purpuric spots	4	6.0%

Bone marrow cellularity shows the majority of patients with hypocellular marrow (62%), followed by hypercellular (31%) and normocellular (7%). A total of 56% of patients had Hb levels between 6.1 and 8 g/dL, while 34% of patients with ≤6 g/ dL and 10% of patients between 8.1 and 10 g/dL. Out of the total, 66% of patients presented with a platelet count between 50,000 and 1,50,000 while 34% had a platelet count <50,000. Peripheral smears of most of the patients showed a normocytic normochromic picture (34%), followed by macrocytic normochromic (30%), dimorphic (28%), and normocytic hypochromic (8%) (Table 3).

Table 3: Distribution of study participants based on peripheral smear and bone marrow cellularity

Bone marrow cellularity	No. of cases (n=65)	Percentage
Hypo/acellular	40	62.0%
Hypercellular	20	31.0%
Normocellular	5	7.0%
Peripheral smear		
Normocytic normochromic	22	34.0%
Macrocytic hypochromic	20	30.0%
Dimorphic picture	18	28.0%
Normocytic hypochromic	5	8.0%

Megaloblastic anemia (30%) came out as the most common cause of pancytopenia, followed by aplastic anemia (14%). Other causes of pancytopenia include myelodysplastic syndrome (9%) acute lymphocytic leukemia (ALL) (9%), AML (9%), and sepsis (8%). The study also revealed other rare causes of pancytopenia such as disseminated tuberculosis (6%), hypersplenism (9%), multiple myeloma (3%), and dengue (3%) (Table 4).

Table 4: Etiological diagnosis of the study population

Etiology	No. of cases (n=65)	Percentage
Aplastic anemia	9	14.0%
Acute leukemia	6	9.0%
Acute myeloid leukemia	6	9.0%
Disseminated tuberculosis	4	6.0%
Hypersplenism	4	6.0%
Megaloblastic anemia	19	30.0%
Malaria	2	3.0%

Myelodysplastic syndrome	6	9.0%
Multiple myeloma	2	3.0%
Sepsis	5	8.0%
Dengue	2	3.0%

Discussion

A prevalent characteristic of several diseases is pancytopenia. The majority (55.0%) of the 65 children with pancytopenia in our study were between the ages of 1 and 6 years, followed by those between the ages of 7 and 12 (29.0%), indicating that the patients in this study had the highest prevalence of pancytopenia. This result is comparable to research by Singh et al. [8] and Gupta et al. [9], in which 51.6% and 58% of the patients were in the 1–5 age range, respectively. According to Rathod et al. [10], 39% of the patients were in the age range of 6 months to 5 years. However, Chouthai and Kulkarni [11] showed a majority of patients between the 10 and 12 years of age group (31%) presenting as pancytopenia followed by the 7–9 years of age group (24%) and 13–15 years of age group (23%). The explanation for this difference may be due to different geographical and sociocultural practices. The present study shows male preponderance over female with a ratio of 2.09:1, various studies showed similar observation, that is, Gayathri and Rao [4], 1.2:1. Santra and Das 1.47:1 [12], Reddy and Rao et al. [13], 1.2:1 and Khungeret al. [14], 1.2:1. This outcome is in contrast to the study conducted by Pathak et al. [15], where male-to-female ratio was 1:1.04. In the present study, the most common presenting symptoms in children with pancytopenia were easy fatigue (90%) and fever (54%), followed by giddiness (40%) and palpitations (38%). Gayathri et al. [4] also showed generalized weakness 100% as the most common presenting symptom. Deshpande et al. [16] showed generalized weakness at 46.7% as the first most common symptom followed by fever at 24.2%. While study by Santra and Das. [12] Showed fever as the most common presenting symptom 50.45%, followed by weakness 45.04%, bleeding manifestation 41.44%, and breathlessness 32.43%.

In the present study, pallor was present in all children (100%), followed by splenomegaly (38%), pedal edema (18%), and lymphadenopathy (18%), which is similar to the study done by Deshpande et al. [16], in which all children with pancytopenia had pallor (100%), followed by icterus 24.16%, splenomegaly 15%, and hepatomegaly 11.6%. In our study, the nutritional cause came out to be the most frequent etiology of pancytopenia, that is, megaloblastic anemia that was discovered to be 30% (19 out of 65 participants studied). This was followed by aplastic anemia, myelodysplastic syndrome, ALL, AML, and sepsis. A similar finding was observed in a study conducted by Gayathri et al. [4], which reported megaloblastic anemia (74.04%) as the most common cause followed by aplastic anemia (18.26%). A study by Deshpande et al. [16] found megaloblastic anemia (72%) as the first-most common cause followed by aplastic anemia (14%). Similar results were reported by Reddy and Rao [13] and Deshpande et al. [16], that is, megaloblastic anemia was found in 38.1% and 72.6% of cases. In contrast to our study, a study done by Santraet al. [12] found aplastic anemia as the most common cause (22.72%).

Conclusion

The prevalence of pancytopenia causes in various populations may be influenced by demographic factors. Early diagnosis and evaluation may be aided by knowledge of the cause of pancytopenia in a specific geographic location. According to the current study, the most frequent cause of pancytopenia in children who are primarily from rural regions is nutritional insufficiency, specifically megaloblastic anemia. Given that the nutritional reason is avoidable and treatable, this study recommends that food fortification, vitamin B12, and folic acid supplements be used to enhance the nutritional status of children and adolescents in this area. Morbidity and death are further reduced by early identification and efficient treatment of reversible causes.

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