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Clinical Presentation of Acute Lymphoblastic Leukemia in Children from Rural Southern Haryana: A Tertiary Care Hospital Experience

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Abstract:

- ***Background:***

Acute Lymphoblastic Leukemia (ALL) is the most common pediatric malignancy, accounting for nearly 25–30% of all childhood cancers. Early recognition of its clinical manifestations is crucial for timely diagnosis, prompt initiation of therapy, and improved survival. Information regarding the clinical profile of childhood ALL from rural regions of Southern Haryana remains limited.

- ***Objectives:***

To evaluate the demographic characteristics, clinical presentation, physical findings, and baseline hematological parameters of children diagnosed with Acute Lymphoblastic Leukemia at a tertiary care teaching hospital serving predominantly rural Southern Haryana.

- ***Methods:***

A retrospective observational study was conducted in the Department of Pediatrics, NC Medical College & Hospital, Israna, Haryana. Medical records of children (0–18 years) diagnosed with ALL between January 2021 and December 2025 were reviewed.

- ***Results:***

A total of 28 children were included. The majority belonged to the 2–10-year age group with a male predominance (Male:Female ratio 1.5:1). Fever (78.6%), pallor (71.4%), generalized weakness (57.1%), bone pain (46.4%), bleeding manifestations (46.4%), and recurrent infections (42.9%) were the common presenting symptoms. Hepatomegaly (75%), splenomegaly (71.4%), and lymphadenopathy (60.7%) were the predominant physical findings. Severe anemia (Hb <7 g/dL) was observed in 89.3%, thrombocytopenia (<100,000/mm³) in 46.4%, and leukocytosis (>50,000/mm³) in 46.4% of patients. Delayed presentation was common, particularly among children from remote rural areas.

- ***Conclusion:***

Fever, pallor, hepatosplenomegaly, lymphadenopathy, and cytopenias remain the predominant clinical features of childhood ALL in rural Southern Haryana. Increasing awareness among primary care physicians, strengthening referral systems, and improving access to pediatric oncology services may facilitate earlier diagnosis and better treatment outcomes.

Keywords: *Acute Lymphoblastic Leukemia, Childhood Cancer, Clinical Presentation, Rural Haryana, Hematological Malignancy.*

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I. INTRODUCTION

Acute lymphoblastic leukemia (ALL) is the most common malignancy in children, accounting for nearly one-third of all pediatric cancers worldwide. It is characterized by the uncontrolled proliferation of immature lymphoid precursor cells in the bone marrow, which subsequently infiltrate the peripheral blood and various extramedullary organs. (1) Over the past few decades, remarkable advances in chemotherapy, risk stratification, immunophenotyping, cytogenetics, and supportive care have significantly improved survival rates in children with ALL. (2,3) Despite these advances, delayed diagnosis continues to be a major challenge in many low- and middle-income countries, where access to specialized healthcare remains limited. (2)

India contributes substantially to the global burden of childhood leukemia. However, the pattern of disease presentation often varies across different regions because of disparities in healthcare infrastructure, socioeconomic conditions, and accessibility to tertiary care facilities. (4) Children from rural communities are particularly vulnerable to delayed diagnosis. Early symptoms such as fever, pallor, fatigue, musculoskeletal pain, and recurrent infections are often nonspecific and may initially be mistaken for common childhood illnesses, nutritional anemia, or viral infections. As a result, appropriate referral and diagnosis are frequently delayed. (5)

Several additional factors contribute to this delay, including limited awareness among parents and primary healthcare providers, financial constraints, dependence on local healthcare practitioners, inadequate transportation facilities, and restricted availability of pediatric oncology services in rural areas. (4) Consequently, many children reach tertiary care hospitals only after developing advanced disease with significant bone marrow failure and extensive leukemic infiltration.(6)

The clinical manifestations of ALL largely reflect bone marrow suppression and infiltration of various organs by leukemic cells.(5,7) Common presenting features include prolonged fever, pallor, generalized weakness, bleeding manifestations, bone or joint pain, lymphadenopathy, hepatomegaly, and splenomegaly.(8) Hematological abnormalities such as anemia, thrombocytopenia, leukocytosis or leukopenia, and circulating blast cells are commonly observed at diagnosis. Confirmation of the disease relies on bone marrow examination together with immunophenotyping, which remains the diagnostic gold standard. (8,9) Early recognition of these clinical and laboratory features is essential because prompt initiation of appropriate chemotherapy is closely associated with improved survival and reduced treatment-related complications. (10)

Although several studies have described the clinical profile of childhood ALL in India, information from rural regions of Southern Haryana remains limited. Understanding the demographic characteristics, clinical presentation, and hematological profile of affected children in this region may help clinicians recognize the disease earlier and reduce delays in referral. With this background, the present study was undertaken to evaluate the demographic profile, clinical features, physical examination findings, and baseline hematological parameters of children diagnosed with acute lymphoblastic leukemia at a tertiary care teaching hospital serving predominantly rural Southern Haryana.

- *Objectives:*

To evaluate the demographic characteristics, clinical presentation, physical findings, and baseline hematological parameters of children diagnosed with Acute Lymphoblastic Leukemia at a tertiary care teaching hospital serving predominantly rural Southern Haryana.

II. MATERIALS AND METHODS

- Source of data: The present study was conducted at Department of Pediatrics, N.C. Medical College, Israna, Panipat, Haryana.
- Sample Size: 28 cases**.**
- Study Design: Retrospective observational study. Study Period: January 2021–December 2025.
- Inclusion Criteria: Children aged 0–18 years with confirmed ALL.
- Exclusion criteria: Non confirmed cases of ALL but mimicking clinical presentation.
- Data Collection: Demographic, clinical and laboratory data were extracted from medical records.

- *Statistical Analysis:*

All collected data were entered into Microsoft Excel and analyzed using the Statistical Package for the Social Sciences (SPSS) software, version 26.0 (IBM Corp., Armonk, NY, USA). Continuous variables were summarized as mean ± standard deviation (SD) for normally distributed data and as median with range for non-normally distributed variables. Categorical variables were expressed as frequencies and percentages. Since the study was descriptive and retrospective in nature, only descriptive statistical methods were employed. The results were presented in the form of tables and figures to describe the demographic profile, clinical presentation, physical examination findings, and baseline hematological parameters of the study participants.

- Ethics: Institutional Ethics Committee approval obtained.

III. RESULTS

A total of 28 children were included in the study. The largest proportion of cases belonged to the 2–5 years age group, with 12 children (42.9%). This was followed by the 6–10 years age group, which included 10 children (35.7%). The <2 years and >10 years age groups each had 3 children (10.7%). Overall, the majority of the cases (78.6%) were between 2 and 10 years of age, indicating that this age range constituted the largest share of the study population. The mean age of the study participants was 5.4 ± 3.1 years. (Table no. 1, Figure 1.)

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Table 1 Age Distribution (N=28)

AGE	Number (%)
<2 years	3 (10.7)
2–5 years	12 (42.9)
6–10 years	10 (35.7)
>10 years	3 (10.7)
Mean age	**5.4 ± 3.1 years**

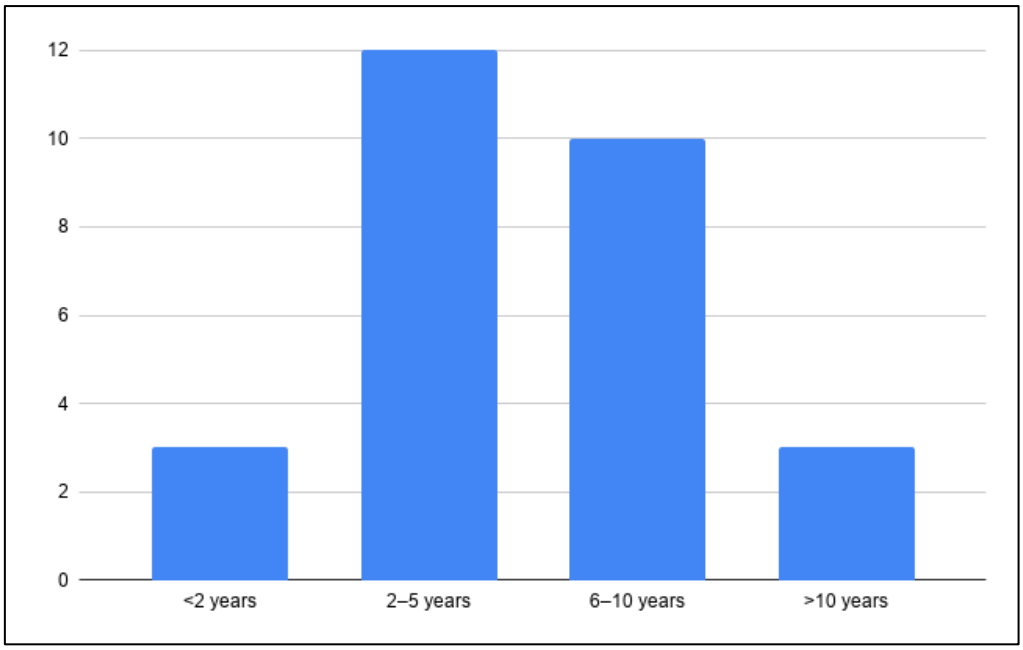

Fig 1 Age Distribution (N=28)

Out of the 28 children included in the study, 17 (60.7%) were males and 11 (39.3%) were females. Males constituted the majority of the study population, with a male-to-female ratio of approximately 1.5:1

Table 2 Gender Distribution

GENDER	Number (%)
Male	17 (60.7)
Female	11 (39.3)

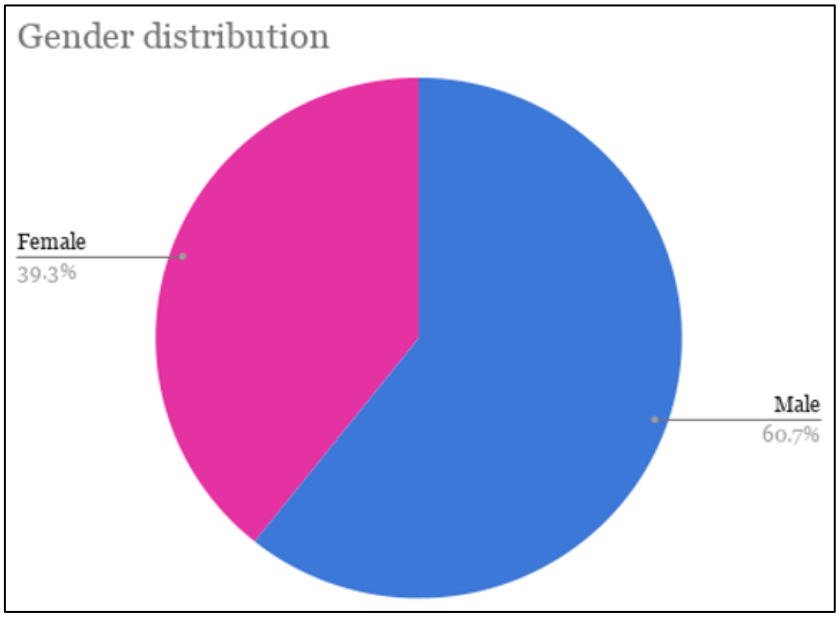

Fig 2 Gender Distribution

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Table 3 Clinical Presentation

Symptom	Number (%)
Fever	22 (78.6)
Pallor	20 (71.4)
Generalized weakness	16 (57.1)
Bone/joint pain	13 (46.4)
Bleeding manifestations	13 (46.4)
Recurrent infections	12 (42.9)
Abdominal distension	9 (32.1)
Weight loss	8 (28.6)
Dyspnea	5 (17.9)

The table shows the frequency of symptoms among the 28 children included in the study.

Fever was the most common presenting symptom, seen in 22 children (78.6%). Pallor was the second most common finding, present in 20 children (71.4%), suggesting that anemia was common in the study population.

More than half of the children had generalized weakness (16 cases, 57.1%). Bone or joint pain and bleeding manifestations were each observed in 13 children (46.4%). Recurrent infections were reported in 12 children (42.9%).

Less frequent symptoms included abdominal distension (9 cases, 32.1%) and weight loss (8 cases, 28.6%). Dyspnea was the least common symptom, occurring in 5 children (17.9%).

Overall, the findings indicate that fever, pallor, and generalized weakness were the predominant clinical features among the study cases.

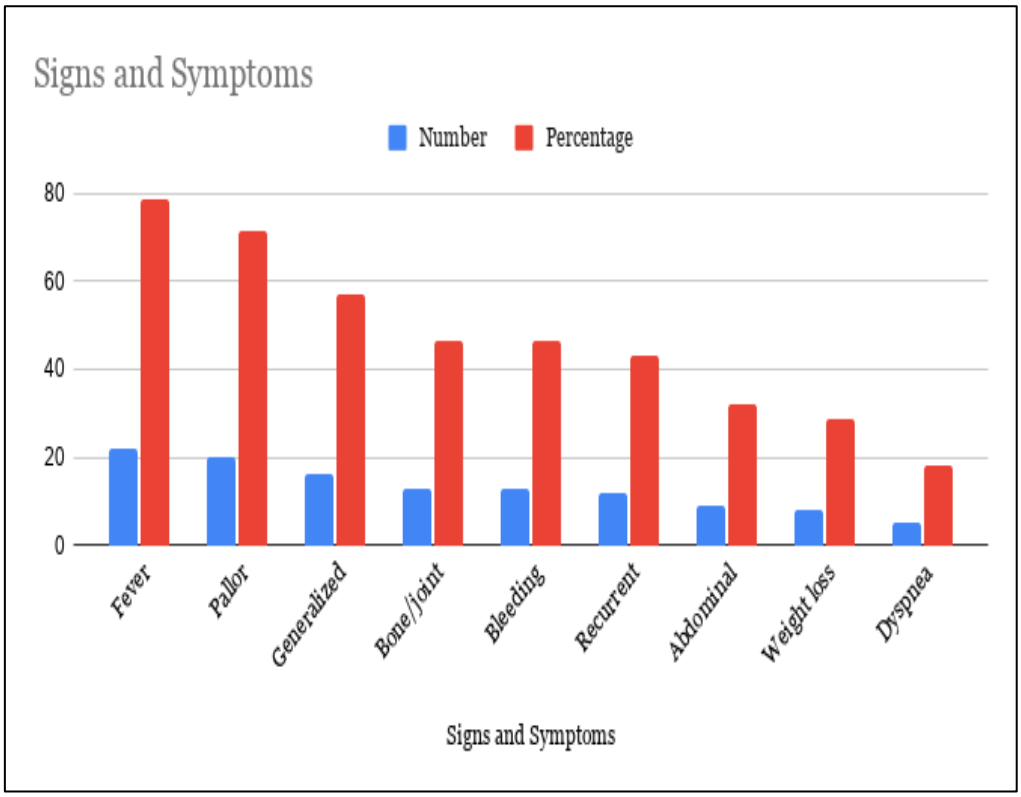

Fig 3 Signs and Symptoms

Table 4 Physical Examination Findings

Finding	**Number (%)**
Hepatomegaly	21 (75.0)
Splenomegaly	20 (71.4)
Lymphadenopathy	17 (60.7)
Hepatosplenomegaly	18 (64.3)
Sternal tenderness	6 (21.4)
CNS signs	2 (7.1)

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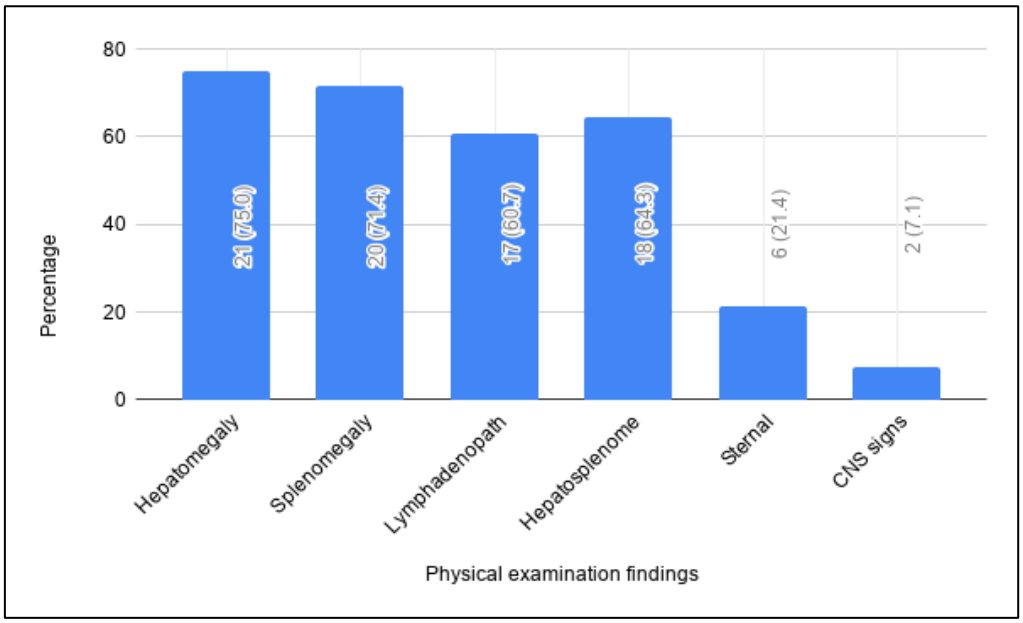

Fig 4 Physical Examination Findings

The clinical examination findings of the 28 children are presented in the table. Hepatomegaly was the most frequently observed finding, present in 21 children (75.0%). Splenomegaly was seen in 20 children (71.4%), while hepatosplenomegaly was noted in 18 children (64.3%). Lymphadenopathy was also a common finding and was observed in 17 children (60.7%).

In contrast, sternal tenderness was present in only 6 children (21.4%), and central nervous system (CNS) signs were the least common finding, seen in 2 children (7.1%). Overall, enlargement of the liver and spleen, either alone or together, along with lymphadenopathy, constituted the predominant clinical examination findings among the study participants.

Table 5 Baseline Hematological Parameters

Parameter	Finding
Hemoglobin <7 g/dL	25 (89.3)
Hemoglobin 7–10 g/dL	3 (10.7)
TLC <4,000/mm³	5 (17.9)
TLC 4,000–50,000/mm³	10 (35.7)
TLC >50,000/mm³	13 (46.4)
Platelets <100,000/mm³	13 (46.4)
Peripheral blasts	25 (89.3)
Median symptom duration	28 days (7–90)

This table summarizes the baseline hematological profile of the study participants at the time of diagnosis. Severe anemia was a prominent finding, with 25 out of 28 children (89.3%) having a hemoglobin level below 7 g/dL, while only 3 children (10.7%) had hemoglobin levels between 7 and 10 g/dL.

The total leukocyte count showed considerable variation among the patients. Nearly half of the children (46.4%) presented with marked leukocytosis, with a TLC greater than 50,000/mm³. About one-third (35.7%) had TLC values between 4,000 and 50,000/mm³, whereas 17.9% had leukopenia at presentation.

Thrombocytopenia, with a platelet count below 100,000/mm³, was observed in 46.4% of the children. Peripheral blood blasts were detected in 89.3% of the cases, indicating that circulating blast cells were present in the majority of patients at diagnosis.

The median duration of symptoms before presentation was 28 days, with a range of 7 to 90 days. This suggests that although some children sought medical attention within the first week of symptom onset, others experienced symptoms for as long as three months before being diagnosed.

IV. DISCUSSION

In the present study, the highest proportion of children (42.9%) belonged to the 2–5-year age group. This finding is comparable to that reported by Siddaiahgari et al., who observed that 58.2% of children with ALL were between 2 and 5 years of age.[14] Similarly, landmark reviews by Hunger and Mullighan and by Inaba et al. have consistently identified early childhood, particularly between 2 and 5 years, as the peak age for the occurrence of ALL, which is attributed to the biology of precursor B-cell leukemia.[6,7]

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The present study demonstrated a male predominance, with males accounting for 60.7% of the study population. Comparable findings have been reported by Siddaiahgari et al. (70.9% males) and Garg et al., both of whom also observed a higher frequency of ALL among boys. These findings are consistent with the established epidemiological pattern reported in both Indian and international literature. [14,9]

Fever was the commonest presenting symptom in our study and was observed in 78.6% of the children. This finding is comparable with previous studies, although the prevalence has varied across different populations. Siddaiahgari et al. reported a higher frequency of fever (92.3%), while lower frequencies were reported by Jaime-Pérez et al (60%) and by Clarke et al. in their systematic review (53%). [14, 16] Such variations are expected and may reflect differences in patient demographics, referral patterns, duration of illness before diagnosis and access to specialized healthcare services. Nevertheless, these studies consistently highlight fever as an important early clinical manifestation of childhood ALL.

Pallor was observed in 71.4% of children in our study. This finding is comparable to that reported by Siddaiahgari et al. (87.4%) and falls between the prevalence reported in their study and the 54% reported by Clarke et al. in a systematic review. Pallor remains one of the common clinical manifestations of childhood ALL and reflects the underlying anemia associated with bone marrow infiltration. [14,17]

Hepatomegaly was observed in 75% of children in the present study, making it one of the most frequent clinical findings. This is comparable to the 78% prevalence reported by by Jaime-Pérez et al., although Siddaiahgari et al. documented a slightly higher prevalence of 85%. [14,16] In contrast, Clarke et al., in their systematic review, reported hepatomegaly in 64% of children with newly diagnosed ALL. The high frequency of hepatomegaly in our study is likely attributable to leukemic infiltration of the liver and reflects the advanced disease burden at presentation. The variation in prevalence across different studies may be explained by differences in study populations, disease stage at diagnosis and referral patterns. [17]

Similarly, splenomegaly was present in 71.4% of our patients, which is comparable to the findings of by Jaime-Pérez et al. (63%) and the systematic review by Clarke et al. (61%). [16.17] However, Siddaiahgari et al. reported a higher prevalence of 83.5%. Splenomegaly is a well-recognized feature of childhood ALL and results from infiltration of leukemic cells into the reticuloendothelial system. The relatively higher frequency observed in our study compared with some reports may indicate delayed presentation, allowing greater disease progression before diagnosis. [14]

Lymphadenopathy was observed in 60.7% of children in our study. This finding is similar to the 57% reported by Jaime-Pérez but higher than the 41% prevalence reported in the systematic review by Clarke et al. Enlargement of lymph nodes is a common manifestation of leukemic infiltration and often serves as an important clinical clue to the diagnosis. Differences in the reported prevalence may be related to variations in patient demographics, disease biology and the stage of illness at the time of presentation. [16]

Central nervous system signs were identified in 7.1% of the study population, which closely corresponds to the 6.8% reported by Siddaiahgari et al. This similarity suggests that overt CNS involvement at diagnosis remains relatively uncommon in children with ALL. Nevertheless, early identification of CNS disease is important because it has significant implications for risk stratification and treatment planning. [14]

With regard to hematological parameters, severe anemia (hemoglobin <7 g/dL) was present in 89.3% of the children in our study, which is slightly higher than the overall anemia prevalence of 82.9% reported by Jaime-Pérez. The high prevalence of severe anemia in our patients reflects extensive bone marrow infiltration by leukemic blasts, resulting in suppression of normal erythropoiesis. Delayed presentation to a tertiary care center may also have contributed to the greater severity of anemia observed in our study. [16]

Marked leukocytosis (TLC >50,000/mm³) was observed in 46.4% of the study population. This proportion was higher than that reported by Siddaiahgari et al. (20.4%) and the Mexican study (36.6%). Hyperleukocytosis is considered an adverse prognostic feature in childhood ALL and may reflect a high leukemic burden at diagnosis. The higher prevalence in our study could be due to referral bias, as tertiary care centers often receive patients with more advanced disease, or because of delayed diagnosis resulting in progression of the disease before presentation. [14]

Thrombocytopenia, defined as a platelet count below 100,000/mm³, was observed in 46.4% of our patients. Although Siddaiahgari et al. used a lower platelet cut-off (<50,000/mm³), they reported thrombocytopenia in 48.5% of cases, indicating that platelet abnormalities are a common feature at diagnosis. The thrombocytopenia observed in our study is consistent with the underlying pathophysiology of ALL, where replacement of normal bone marrow by leukemic blasts leads to impaired platelet production, thereby increasing the risk of bleeding manifestations. [14]

V. CONCLUSION

The present study demonstrates that childhood acute lymphoblastic leukemia in rural Southern Haryana most commonly affects children between 2 and 10 years of age and shows a male predominance. Fever, pallor, generalized weakness, bone pain, bleeding manifestations, hepatomegaly, splenomegaly, and lymphadenopathy were the predominant clinical features at presentation. Severe anemia, thrombocytopenia, leukocytosis, and the presence of peripheral blasts constituted the major hematological abnormalities. The relatively prolonged duration of symptoms before diagnosis suggests delayed healthcare-seeking behavior and referral, particularly among children from rural communities.

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These findings emphasize the importance of maintaining a high index of suspicion for ALL in children presenting with persistent fever, unexplained pallor, bleeding manifestations, bone pain, or organomegaly. Early recognition by primary care physicians and pediatricians, coupled with timely referral to specialized oncology centers, may reduce diagnostic delay and improve treatment outcomes. Further prospective multicentric studies with larger sample sizes incorporating immunophenotypic, cytogenetic, and survival data are recommended to provide a more comprehensive understanding of childhood ALL in this region.

- *Conflicts of Interest*

None.

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