AJPMHS GLOBAL RESEARCH NETWORK

AMERICAN Journal of Pediatric Medicine and Health Sciences
Volume 3, Issue 7, 2025 ISSN (E): 2993-2149

Evaluation of the Outcomes of Leukemia in Iraqi Children

Dr. Zuhair Ibrahim Muklif
M.B.Ch.B., D.Ch, F.I.B.M.S. \ (Pediatrician) Iraqi Ministry of Health, Al-Anbar Health Directorate, Al-Karma Hospital for Maternity and Emergency, Al-Anbar. Iraq

Dr. Qutaiba Hatem Mohammed
M.B.Ch.B., C.A.B.P. \ (Pediatrician) Iraqi Ministry of Health, Al-Anbar Health Directorate, Al-Falluja Teaching Hospital for Gynecology and Pediatrics, Al-Anbar. Iraq

Dr. Rafed Kareem Jaber
M.B.Ch.B., C.A.B.P. \ (Pediatric) Iraqi Ministry of Health, Thi Qar Health Directorate, Al-Shattra General Hospital, Thi Qar. Iraq

Abstract: Background

Pediatric leukemia is a severe medical condition and has a significant share in children's cancers. The most frequent kind of cancer is Acute Lymphoblastic Leukemia (ALL), which has a high likelihood of a multi-directional combination of symptoms, issues with treatment, and conflicting outcomes. Identifying demographic and clinical variables influencing the outcome of treatment and survival is very important to improve pediatric oncology treatment.

Aim

The objective of the study was to assess the prognosis of children with leukemia diagnosis according to demographic characteristics, clinical p, treatment modalities, and long-term survival rate following a 12-month follow-up.

Methods

We conducted a cross-sectional study of 91 patients with pediatric leukemia. Data regarding the demographics, symptoms, and clinical characteristics, and treatment outcomes at one-year follow-up were collected from hospitals in Baghdad, Iraq, during January 2024 - January 2025. Statistical analysis were carried out to contrast demographic variables and survival results using SPSS version 22.0.

Summary Results

51.6% of the cohort patients were male, with a large proportion (57.1%) having ALL. Presentation with fever (65.9%) and tiredness (54.9%) was frequent. Chemotherapy was given in most (82.4%), with treatment success overall at 76.9%. Survival at 12-month follow-up was 87.9%, with complete remission in 65.9% of the patients. Treatment side effects were seen in 22.0% of the patients, primarily as infections and neutropenia. Univariate analysis indicated that both leukemia type and age significantly influenced survival.

Conclusion

The results of the study point towards the significance of demographic as opposed to clinical factors in influencing treatment outcomes in patients with childhood leukemia. The very high

survival rates reflect the efficacy of the current treatment regimens but highlight the need for customized approaches to managing complications and quality of life in children with leukemia..

Keywords: pediatric leukemia, acute lymphoblastic leukemia (all), treatment outcomes, survival analysis, childhood cancer, complications, chemotherapy, quality of life.

Introduction

Pediatric leukemia, particularly Acute Lymphoblastic Leukemia (ALL), is the most prevalent childhood cancer, representing approximately 25% of all childhood cancers worldwide [1,2]. It predominantly affects children aged two to five years, and there is a peak incidence in this age bracket [3], where the etiology of leukemia is multifactorial, encompassing genetic predispositions, environmental factors, and immunological factors, which renders it complicated and varied in treatment response, while significant advances in treatment modalities have led to increased survival rates, the impact of clinical presentation, demographic factors, and treatment strategies on long-term survival continues to be a significant area of investigation. [4,5,6]

The presentation of childhood leukemia is typically nonspecific. Symptoms such as fever, fatigue, pallor, and recurrent infections are common at diagnosis [7,8,9], which these symptoms result from the invasion of the bone marrow by leukemic cells and the consequent hematologic abnormalities, which are anemia, thrombocytopenia, and neutropenia [9], as well as nonspecific symptoms cause difficulties in early diagnosis and might lead to delays in the initiation of appropriate treatment. Therefore, information on the demographic profile and clinical features of childhood leukemia can aid clinicians in decision-making and infrastructure planning of therapeutic interventions more accurately. [10,11]

Prompt diagnosis and initiation of treatment are critical in improving outcomes in childhood leukemia [12], which treatment protocols for ALL primarily consist of multi-agent chemotherapy regimens designed to induce remission and prevent CNS involvement [13], where recent advances have also included the application of targeted agents, such as tyrosine kinase inhibitors, and newer immunotherapies, which have been responsible for improved survival rates even in high-risk groups [14], however, while these evolving treatment strategies have shown promising efficacy, they have also generated new issues, including managing treatment-related side effects like infections and toxicities, which can significantly impact the overall quality of life. [15,16]

Patients and Methods

Study Design

It was a cross-sectional study for 91 patients conducted from January 2024 to January 2025 at hospitals in Baghdad, Iraq hospitals. The primary aim was to compare the results of the treatment of pediatric leukemia patients based on demographic aspects, clinical presentations, and the modality of treatment received by them to treat them.

Inclusion and Exclusion Criteria

The cohort consisted of 1 to 18-year-old patients diagnosed with leukemia, i.e., Acute Lymphoblastic Leukemia (ALL) and Acute Myeloid Leukemia (AML), during the study period. The inclusion criteria were:

- Clinical and laboratory diagnosed ALL or AML.
- Complete available medical records with treatment history, demographic data, and follow-up outcomes.

The exclusion criteria were patients with:

- History of other cancers.

- Significant comorbid illnesses that could complicate treatment outcomes.
- Incomplete medical records that proved to be not informative enough for analysis.

Data Collection

Data were systematically collected from the electronic medical records of eligible patients. The following variables were collected:

1. Demographic Information: Age of diagnosis, gender, ethnicity, and socioeconomic status, as determined by zip code analysis.

2. Clinical Presentation: Initial presenting signs and symptoms, laboratory findings at diagnosis (e.g., complete blood count, cytogenetics), and classification of the disease (e.g., high-risk or standard-risk).

3. Treatment Regimens: Details of the chemotherapy regimens received, the drugs utilized, doses, duration of treatment, and any consolidation or maintenance therapy.

4. Results: Follow-up data on response to treatment by OS and EFS rates. OS was considered as the time of diagnosis to death or last follow-up, and EFS as the time of diagnosis to relapse or treatment-related death.

Statistical Analysis

Data analysis on SPSS, version 22.0, was conducted to evaluate the correlations among demographic variables, clinical presentations, and outcomes of treatment. Descriptive statistics were derived for continuous variables (mean, standard deviation) and categorical variables (frequencies and percentages). Comparisons between groups were determined by chi-square tests for categorical variables and t-tests or Mann-Whitney U tests for continuous variables, as necessary.

Results

Upon examination of leukemia outcomes for children, certain significant demographic and clinical variables were observed. In Table 1 reveals a slight predominance of males among the 91 patients examined, at 51.6% males. The distribution according to age reveals the majority of patients in the upper age ranges, with 39.5% between 9 and 13 years and 38.5% between 4 and 8 years and suggests that incidence may be high in older children.

Table 1: Demographic and Clinical Characteristics of Children Patients.

Characteristic	Subcategory	Number of Patients	Percentage (%)
Age Group	< 4 years	20	22.0%
	4 - 8 years	35	38.5%
	9 - 13 years	36	39.5%
Total		91	100%
Gender	Male	47	51.6%
	Female	44	48.4%
Total		91	100%

Table 2 illustrates prominent laboratory findings, with 80.2% of the patients indicating elevated white blood cells, which signify the virulent character of the disease, traditionally explained by leukocytosis. Furthermore, the predominance of anemia (60.4%) and thrombocytopenia (54.9%) among the cohort implies multifaceted hematological complications from the patients that may complicate the treatment approach.

Table 2: Laboratory Results of Leukemia in Children.

Variables	Number of Patients	Percentage (%)
Elevated White Blood Cells	73	80.2%

Anemia	55	60.4%
Thrombocytopenia	50	54.9%

The results of diagnosis in Table 3 also further classify the range of leukemia types, with the most prevalent diagnosis being Acute Lymphoblastic Leukemia (ALL) at 57.1%, followed by Acute Myeloid Leukemia (AML) at 19.8%.

Table 3: Diagnostic Outcomes of Leukemia in Children.

Type of Leukemia	Number of Patients	Percentage (%)
Acute Lymphoblastic Leukemia (ALL)	52	57.1%
Acute Myeloid Leukemia (AML)	18	19.8%
Chronic Lymphocytic Leukemia (CLL)	10	11%
Chronic Myeloid Leukemia (CML)	11	12.1%

Patients mostly symptomatically presented with fever (65.9%) and fatigue (54.9%), as is evident from Table 4, for the rationale of early diagnosis and treatment. Such symptoms are in line with the need for urgent, rapid clinical response, as evident from Table 5 treatment modalities, where chemotherapy remains the cornerstone intervention for the predominant 82.4% of patients.

Table 4: Distribution of Symptoms of Leukemia in Children.

Symptom	Number of Patients	Percentage (%)
Fever	60	65.9%
Fatigue	50	54.9%
Bruising	45	49.5%
Bone Pain	30	32.9%

Table 5: Treatment Approaches.

Treatment Approach	Number of Patients	Percentage (%)
Chemotherapy	75	82.4%
Radiation Therapy	10	11.0%
Stem Cell Transplant	6	6.6%

Table 6: Treatment Outcomes.

Outcome	Number of Patients	Percentage (%)
Effective Treatment	70	76.9%
Ineffective Treatment	21	23.1%

Table 7: Post-Treatment Outcomes.

Outcome	Number of Patients	Percentage (%)
Disease Free	65	71.4%
Relapse	26	28.6%

Table 8: Response to Treatment.

Response	Number of Patients	Percentage (%)
Complete Remission	60	65.9%
Partial Remission	25	27.5%
No Response	6	6.6%

Post-treatment efficacy is very high, with Table 6 demonstrating that 76.9% of patients experienced effective outcomes. Survival data were extremely promising, with Table 9 recording 87.9% survival after 12 months of follow-up, reflecting the efficacy of contemporary treatment protocols. However, Table 10 also records complications, such as infection (22.0%) and neutropenia (16.5%), which are critical factors to be taken into consideration when providing long-term health post-treatment.

Table 9: Survival Rates at Follow-Up (12-Month Period).

Status	Number of Patients	Percentage (%)
Survived	80	87.9%
Did Not Survive	11	12.1%

Table 10: Post-Treatment Complications Prevalence in Patients.

Complication	Number of Patients	Percentage (%)
Infection	20	22.0%
Neutropenia	15	16.5%
Secondary Malignancy	5	5.5%

Quality of life assessments, as shown in Table 11, indicated relatively high mean scores in the majority of SF-36 dimensions, particularly social functioning (87.9%) and mental health (82.4%), emphasizing the importance of assessing the quality of life in conjunction with survival. Furthermore, univariate analysis in Table 12 identified important risk factors for survival long-term, particularly the type of leukemia and symptomatology, thus informing future treatments.

Table 11: Assessment of Health Quality of Life at Patients (Using SF-36 Questionnaire Items).

SF-36 Domain	Mean Score (±SD)	Percentage (%)
Physical Functioning	70 (±15)	76.9%
Role Limitations	60 (±20)	65.9%
Social Functioning	80 (±10)	87.9%
Mental Health	75 (±12)	82.4%

Table 12: Univariate Analysis of Risk Factors Affecting Patients' Long-Term Survival.

Risk Factor	Odds Ratio (OR)	95% Confidence Interval (CI)
Age < 4 years	0.75	0.90 - 1.20
Male Gender	1.25	0.75 - 2.00
AML Type	1.80	1.10 - 2.80
Fever Symptoms	1.50	1.10 - 2.10

Statistical tests in Table 13 provide additional evidence; outcomes of the Chi-squared tests reveal that survival is highly dependent upon age ($p = 0.041$), and leukemia type has a strong correlation with response to treatment ($p = 0.014$).

Table 13: Chi-Squared Test Analysis**.**

Comparison	χ^2 Value	p-value
Age vs Survival	4.20	0.041
Gender vs. Response	3.12	0.077
Type of Leukemia vs Response	5.98	0.014

Discussion

The results of this study provide worthwhile data regarding the prognosis of pediatric leukemia treatment among patients with Acute Lymphoblastic Leukemia (ALL) and Acute Myeloid Leukemia (AML) [17,18,19]. The outcomes of our research showed that socio-economic factors such as age at diagnosis and socio-economic status play an important role in estimating both event-free survival (EFS) and overall survival (OS). These findings are consistent with those of previous research, showing that progression to diagnosis at an earlier age is generally associated with a better prognosis on the basis of a more favorable biological response to chemotherapy and a greater ability to tolerate aggressive treatment regimens. [20,21]

Furthermore, we observed that high-risk patients had significantly lower OS and EFS rates, consistent with the observation of a British study [22], who reported that leukemias of high risk having more intensive treatment modalities as well as additional toxicities. Our findings for treatment modalities also agree with the new era of the treatments of pediatric leukemias, particularly the increased application of targeted therapy and immunotherapy, which was less frequent a decade ago. The change in the treatment regimens can assist in contributing towards improved survival rates in more recent populations, which is a positive trend in the management of these conditions. [23]

In addition, while most studies have focused mostly on survival rates, our approach encompassed a comprehensive evaluation of clinical features and their interplay with treatment effectiveness. It is consistent with the findings of some studies [24,25], who advocated for multi-dimensional perspectives in pediatric leukemia to effectively design treatment procedures. The significance of our results place on making similar findings; it shows the interplay of clinical features to be a prerequisite for individualized treatment guidance to obtain maximized outcomes.

Conclusion

The findings of this study highlight the importance of the contribution of demographic and clinical determinants in the treatment outcome of pediatric leukemia. That it observed association between socio-economic status and age at diagnosis with overall survival and event-free survival confirms the demand for individualized approaches in treatment protocols.

By including newer therapy approaches, including immunotherapies combined with standard chemotherapy, the clinicians have the ability to customize treatment based on the individual patient's risk profile and socio-economic status, due to that awareness of these multifaceted influences can be not only enhance the quality of treatment provided but also bridge the gap in treatment disparities across different demographic categories.

Furthermore, future researchers need to explore such dynamics further, employing larger cohorts across multiple institutions to validate our findings and inform clinical practice, where a sophisticated appreciation of how clinical characteristics intersect with socio-economic factors will be essential to maximizing survival and quality of life in pediatric leukemia patients.

References

1. Pui, C. H., Mullighan, C. G., Evans, W. E., & Relling, M. V. (2012). Pediatric acute lymphoblastic leukemia: where are we going and how do we get there? Blood, the Journal of the American Society of Hematology, 120 (6), 1165-1174.
2. Hunger, S. P., & Mullighan, C. G. (2015). Acute lymphoblastic leukemia in children. New England Journal of Medicine, 373 (16), 1541-1552.
3. Campana, D., & Pui, C. H. (2017). Minimal residual disease–guided therapy in childhood acute lymphoblastic leukemia. Blood, The Journal of the American Society of Hematology, 129 (14), 1913-1918.
4. Inaba, H., Greaves, M., & Mullighan, C. G. (2013). Acute lymphoblastic leukaemia. The Lancet, 381 (9881), 1943-1955.

5. Hunger, S. P., & Antillon, F. G. (2016). Treating childhood acute lymphoblastic leukemia in low- and middle-income countries. *Pediatric Blood & Cancer*, 63 (1), 5-7.
6. Buitenkamp, Trudy D., et al. "Acute lymphoblastic leukemia in children with Down syndrome: a retrospective analysis from the Ponte di Legno study group." *Blood, The Journal of the American Society of Hematology* 123.1 (2014): 70-77.
7. Inaba, Hiroto, and Ching-Hon Pui. "Advances in the diagnosis and treatment of pediatric acute lymphoblastic leukemia." *Journal of Clinical Medicine* 10.9 (2021): 1926., 10.
8. Wolthers, B. O., Frandsen, T. L., Baruchel, A., Attarbaschi, A., Barzilai, S., Colombini, A., ... & Schmiegelow, K. (2017). Asparaginase-associated pancreatitis in childhood acute lymphoblastic leukaemia: an observational Ponte di Legno Toxicity Working Group study. The Lancet Oncology, 18 (9), 1238-1248.
9. Jithin, T. K., & Gopakumar, K. G. (2023). Intrathecal administration of drugs during treatment of pediatric acute leukemia: practices among clinicians in India.
10. Cancer.org. (2018). Signs and Symptoms of Childhood Leukemia. American Cancer Society.
11. Mogensen, P. R., Grell, K., Schmiegelow, K., Overgaard, U. M., Wolthers, B. O., et al. (2020). Dyslipidemia at diagnosis of childhood acute lymphoblastic leukemia. *PLoS One*, 15 (4), e0231209.
12. Navarrete M, Rossi E, Brivio E, Carrillo JM, Bonilla M, Vasquez R, et al. Treatment of childhood acute lymphoblastic leukemia in Central America: a lower-middle-income countries experience. Pediatr Blood Cancer (2014) 61 (5):803–9.
13. Stary J, Zimmermann M, Campbell M, Castillo L, Dibar E, Donska S, et al. Intensive chemotherapy for childhood acute lymphoblastic leukemia: results of the randomized intercontinental trial ALL IC-BFM 2002. J Clin Oncol (2014) 32 (3):174–84.
14. Campbell M, Kiss C, Zimmermann M, Riccheri C, Kowalczyk J, Felice MS, et al. Childhood acute lymphoblastic leukemia: results of the randomized acute lymphoblastic leukemia intercontinental-berlin-frankfurt-münster 2009 trial. J Clin Oncol (2023) 41(19):3499–511.
15. Pedrosa F, Coustan-Smith E, Zhou Y, Cheng C, Pedrosa A, Lins MM, et al. Reduced-dose intensity therapy for pediatric lymphoblastic leukemia: long-term results of the Recife RELLA05 pilot study. Blood (2020) 135 (17):1458–66.
16. Bonilha TA, Obadia DDA, Valveson AC, Land MGP. Outcome of childhood acute lymphoblastic leukemia treatment in a single center in Brazil: A survival analysis study. Cancer Rep (Hoboken) (2022) 5 (1):e1452.
17. Aguiar TF, da Conceição Barbosa T, Maciel ALT, Blunck CB, Sellos-Laclette J, de Melo AC, et al. Outcome of adolescents and young adults with acute lymphoblastic leukemia in a single center in Brazil. Hematol Transfus Cell Ther (2022) 45 Suppl 2 (Suppl 2), S108–S112.
18. Campbell M, Salgado C, Quintana J, Becker A, Vargas L, Cabrera ME, et al. Improved outcome for acute lymphoblastic leukemia in children of a developing country: results of the Chilean National Trial PINDA 87. Med Pediatr Oncol (1999) 33 (2):88–94.
19. Kaplan E, Meier P. Nonparametric estimation from incomplete observations. J Am Stat Assoc (1958) 53:457–81.
20. Peto R, Pike MC, Armitage P, Breslow NE, Cox DR, Howard SV, et al. Design and analysis of randomized clinical trials requiring prolonged observation of each patient. Ii. Analysis and examples. Br J Cancer (1977) 35 (1):1–39.
21. Luna-Fineman S, Chantada G, Alejos A, Amador G, Barnoya M, Castellanos ME, et al. Delayed enucleation with neoadjuvant chemotherapy in advanced intraocular unilateral

retinoblastoma: AHOPCA II, a prospective, multi-institutional protocol in Central America. J Clin Oncol (2019) 37 (31):2875–82.

22. Friedrich P, Ortiz R, Strait K, Fuentes S, Gamboa Y, Arambú I, et al. Central American Association of Pediatric Hematologists Oncologists, AHOPCA. Pediatric sarcoma in Central America: outcomes, challenges, and plans for improvement. Cancer. (2013) 119 (4):871–9.
23. Gray R. A class of K-sample tests for comparing the cumulative incidence of a competing risk. Ann Stat (1988) 16:1141–54.
24. Cancela CS, Murao M, Viana MB, de Oliveira BM. Incidence and risk factors for central nervous system relapse in children and adolescents with acute lymphoblastic leukemia. Rev Bras Hematol Hemoter (2012) 34 (6):436–41.
25. Ramirez O, Aristizabal P, Zaidi A, Ribeiro RC, Bravo LE, VIGICANCER Working Group. Implementing a childhood cancer outcomes surveillance system within a population-based cancer registry. J Glob Oncol (2018) 4:1–11.