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Survival Rate of Pediatric Lymphoma in Hiwa Hospital at Sulaymaniyah City, Kurdistan Region of Iraq

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ABSTRACT

Background: Malignant lymphoma has gained popularity in various countries worldwide. Consequently, it is one of the most common malignancies of children in the Kurdistan region of Iraq.

Objective: To find the correlation between sociodemographic data, clinical characteristics, risk group classification, and laboratory findings of pediatric patients with lymphoma, together with the correlation between survival rates and survival time among both types of lymphoma.

Patients and methods:

In this retrospective, cross-sectional, hospital-based study, the recorded data of 104 pediatric lymphoma patients (aged <18 years) from Hiwa Haematology/Oncology Hospital and Shorsh Teaching Hospital, Sulaimaniyah, Iraq, were obtained from January 1, 2015, to January 1, 2025. A standard validated questionnaire was used to record the patient's sociodemographic data, including clinical data and laboratory findings. Then, the correlation between variables was determined.

Results: The patients' mean age was 12.00 ± 3.59 years, and their mean BMI was 17.20 ± 4.34 kg/m². The time from the onset of lymphoma to diagnosis ranged from 0 to 13 months. Most patients were males (70.2%), from low-income families (43.8%), living outside of the cities (65.4%), had NHL (53.8%) of stage II (28.6%), had no B symptoms (57.7%), received chemotherapy alone (55.8%), completed treatment (85.6%), and were alive (83.7%). Significant correlations were found between age group, BMI, lymphoma stage IV, lymphoma type/subtype, receipt of chemotherapy combined with radiotherapy, lactate dehydrogenase level, and survival rate of the patients. Additionally, HL patients had a longer survival rate and survival time ($p \leq 0.05$).

Conclusions: NHL was more common and predominantly of high grade, linked to a lower survival rate and shorter survival time.

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Introduction:

Lymphoma is the third most common pediatric neoplasm after leukaemia and brain tumour [1]. Globally, there are approximately 2000 new lymphoma cases diagnosed in children every year. Common pediatric lymphomas include Hodgkin lymphoma (HL) and non-Hodgkin lymphoma (NHL), which are relatively rare [2]. Advances in understanding the biology of these lymphomas have led to significantly improved therapeutic outcomes, making lymphoma one of the most curable pediatric cancers. There are several newly proposed or revised entities of lymphoma in the most recent World Health Organisation (WHO) classification, including Burkitt-like lymphoma with 11q aberration, large B-cell lymphoma with IRF4 rearrangement, pediatric-type follicular lymphoma, and systemic EBV (Epstein-Barr virus)- associated T-cell lymphoma of childhood [2].

Hodgkin lymphoma is the most common lymphoma in patients aged 10 - 19 years and is the most common malignancy among adolescents 15 - 19 years old. It is a highly curable malignancy, and it is a unique neoplasm in which the malignant cell, the Reed-Sternberg cell (RSC), represents only a small proportion of cells constituting the bulk of the tumour [3]. HL is a relatively rare malignancy in the pediatric population; however, it constitutes approximately 40% of all lymphomas that present during childhood and is the most common malignancy in adolescents and young adults. In all age groups, HL is highly sensitive to chemotherapy and irradiation. There is a male predilection for most Hodgkin lymphoma (HL) subtypes, except for nodular sclerosis classic HL (NSCHL), in which the incidence is slightly higher in females [4].

Generally, HL was the first cancer to be cured with radiation therapy alone or with a combination of several chemotherapeutic agents. The cure rate for children and adolescents with HL has steadily improved over the years, particularly with the introduction of combined radiation and multiagent chemotherapy. This therapeutic success has come at the price of severe long-term toxicities, such that a 30-year survivor of HL is more likely to die of therapy-related complications rather than from HL. Therefore, the therapeutic paradigm has shifted toward reducing treatment-associated toxicity while maintaining high cure rates. This new paradigm has led to the current risk-adapted, response-based approach to treating HL [5]. The NHL exhibits variability in incidence rates according to sex and age, with its incidence rate increasing with age, showing a greater predilection in males. Children aged 5–14 years have a higher incidence rate than those aged <5 years and adolescents [6]. Therefore, this study aimed to assess and understand the survival rate of pediatric lymphoma patients treated at Hiwa Haematology/Oncology Hospital, with the goal of improving care and treatment strategies.

MATERIALS AND METHODS

Study design and setting

This retrospective, analytical, cross-sectional, hospital-based study collected the recorded data of pediatric lymphoma patients from Hiwa Haematology/Oncology Hospital and Shorsh Teaching Hospital, spanning from

January 1, 2015, to January 1, 2025 (10 years).

Patients

The system-based reports of 104 pediatric cases diagnosed with lymphoma at Hiwa Haematology/Oncology Hospital, together with their confirmed histopathology and immunohistochemistry (IHC) reports from Shorsh Teaching Hospital, were obtained. A tentative lymphoma diagnosis was made using the 3rd edition of the International Classification of Diseases for Oncology (ICD-O-3) [7].

Study protocol

A standard validated questionnaire has been constructed, and all the patients' (n=104) sociodemographic data, including age at diagnosis, gender, parent's economic status, height and weight to determine body mass index (BMI; Kg/m^2), and residency were recorded, together with their clinical data, such as lymphoma type/stage, risk type, time from onset of lymphoma to diagnosis, symptoms, therapy type, treatment protocol, completing treatment, and survival rate. Moreover, the patient's laboratory findings, including lactate dehydrogenase (LDH), white blood cell (WBC), and erythrocyte sedimentation rate (ESR), were collected. Then, the correlation between patients' sociodemographic data, clinical characteristics, risk group classification, and laboratory findings was investigated for survivors and non-survivors. Additionally, the correlation between survival rates and survival times among both types of lymphoma was determined.

Inclusion criteria

Pediatric patients aged <18 years old, regardless of gender, nationality, and residency, who had lymphoma (HL & NHL) been confirmed by histopathology and IHC report and received whole or part of their treatment in Hiwa Hospital.

Exclusion criteria

Patients with incomplete documents from the hospital data record.

Ethical considerations

The study protocol was approved by the Institutional Review Board (IRB) of Hiwa Haematology/Oncology Hospital and the Ethics Committee of the College of Medicine, University of Sulaimani, Sulaimaniyah, Iraq (No. 374/28, dated December 10, 2024). The study adhered to the ethical guidelines of the Declaration of Helsinki, 2008. The Hospital authority waived patient consent due to the nature of the study (retrospective).

Statistical analysis

Statistical analysis was conducted using the Statistical Package for the Social Sciences (SPSS, IBM, Chicago, USA, version 26). The Shapiro-Wilk and Kolmogorov-Smirnov tests were applied to assess the normality of continuous variables. For non-normally distributed data, the Mann-Whitney U test was used to compare differences between groups. Categorical variables were analyzed using the Chi-square test. Data were presented as frequencies and percentages for categorical variables, while continuous variables were expressed as means ± standard deviations. A P-value of <0.05 was considered significant, while $p<0.001$ was set as highly significant.

RESULTS

As shown in Table 1, the age of the patients ranged from 3 to 18 years, with a mean of 12.00 ± 3.59 years. Regarding

gender distribution, 73 patients (70.2%) were males, while 31 patients (29.8%) were females. The BMI ranged from 10 to 34 kg/m², with a mean of 17.20 ± 4.34 kg/m². With respect to economic status, 56 patients (43.8%) were from low-income families, while only one patient (1.0%) was classified as having a very good economic status. Concerning residency, 36 patients (34.6%) lived inside the city, whereas 68 (65.4%) resided outside the city.

As found in Table 2, 56 (53.8%) patients had NHL and 48 (46.2%) had HL. Among NHL patients, more cases were BL (31.7%), followed by LL (11.5%), diffuse large B-cell lymphoma (DLBCL) (7.7%), and anaplastic large cell lymphoma (ALCL) (4.8%). Whereas among HL patients, most of them had nodular lymphoma (27.9%), and the left had mixed cellularity type (16.3%).

Regarding stage diagnosis, 2 HL patients (1.9%) were diagnosed at stage I (4.2%). Stage II was observed in 36 patients (34.6%) (41.7% HL, 28.6% NHL), while stage III was noted in 33 patients (31.7%) (43.8% HL, 21.4% NHL). Stage IV was found in 33 patients (31.7%), predominantly among NHL patients (50.0%) compared to HL (10.4%) ($p<0.001$). The time from the onset of lymphoma to diagnosis ranged from 0 to 13 months, with a mean of 5.19 ± 1.98 months in HL and 4.63 ± 3.26 months in NHL ($p=0.553$). In terms of risk classification, HL patients were categorized as low-risk (16.7%, n=8), intermediate-risk (50%, n=24), and high-risk (33.3%, n=16). Among NHL patients, 3 (5.4%) were in Group A, 31 (53.4%) in Group B, and 22 (39.3%) in Group C. Regarding symptoms, 42.3% of patients presented with B symptoms (45.8% HL, 39.3% NHL) non-significantly ($p=0.50$). Only 5 patients (4.8%) received targeted monotherapy or immunotherapy (8.3% of HL, 1.8% of NHL, $p = 0.120$). For treatment protocols, 58 patients (55.8%) received chemotherapy alone, significantly higher in NHL (94.6%) than in HL (10.4%). Conversely, 46 patients (44.2%) underwent chemotherapy with radiotherapy (RT), mostly those who had HL (89.6%), while only 5.4% of NHL patients received RT ($p<0.001$). A total of 89 patients (85.6%) completed treatment, with a higher completion rate in HL (97.9%) compared to NHL (75.0%) ($p = 0.001$). Regarding the survival rate, the analysis revealed that 87 patients (83.7%) were still alive, while 17 (16.3%) had passed away. The survival rate was higher in HL (95.8%) than in NHL (73.2%), with mortality significantly higher in NHL (26.8%) compared to HL (4.2%) ($p=0.002$) (Table 3).

As illustrated in Table 4, laboratory findings revealed significant differences between HL and NHL groups. Regarding LDH levels, patients with NHL had significantly higher values (742.32 ± 574.03) compared to those with HL (323.25 ± 273.15) ($p<0.001$). For WBC counts, the mean levels were 8187.50 ± 5338.17 in HL and 8885.71 ± 9311.02 in NHL, with no significant difference ($p = 0.91$Haematological, ESR levels were significantly higher in HL (37.60 ± 26.59)Hiwa HospitalNHL (27.52 ± 18.61) ($p=0.038$).

As listed in Table 5, 87 (83.7%) patients were alive, while 17 (16.3%) had died. Regarding age, the mean age was 12.38 ± 3.21 years in survivors and 10.06 ± 4.75 years in non-survivors, with a significant difference ($p=0.014$). When categorized by age group, a significantly higher

proportion of non-survivors (29.4%) were aged 1-6 years compared to survivors (3.4%). Conversely, the 13-18 age group was more prevalent among survivors (52.9%) than among non-survivors (47.0%). This age distribution showed a strongly significant difference (p=0.001). In terms of gender distribution, 26 females (29.9%) and 61 males (70.1%) were among the survivors, while five females (29.4%) and 12 males (70.6%) were in the non-survivor group. The gender-based comparison did not reveal any significant differences (p = 0.969). Regarding BMI, the mean BMI was significantly lower in survivors (7.77 ± 4.27 kg/m²) compared to non-survivors (14.29 ± 3.51 kg/m²) (p = 0.002). In terms of economic status, most patients in both groups were in the low economic category, accounting for 50.6% of survivors and 70.6% of non-survivors. A smaller proportion of survivors (17.2%) and non-survivors (5.9%) had a good economic status, while only one patient (1.1%) in the survivor group belonged to the very good economic class. However, these differences were not significant (p=0.438). Regarding residency, 63.2% of survivors and 76.5% of non-survivors lived outside the city, while 36.8% of survivors and 23.5% of non-survivors resided inside the city. This difference was not significant (p=0.294).

As shown in Table 6, 48 alive patients (55.2%) and 12 of the dead patients (70.6%) did not present with B symptoms, while 39 of the alive patients (44.8%) and 5 of the dead patients (29.4%) exhibited these symptoms. However, a slightly higher number of dead patients were asymptomatic compared to those alive (p=0.239). With respect to disease stage at diagnosis, stage II (39.1%) and stage III (33.3%) were more common in the alive group (39.1%), while stage IV was notably prevalent among the dead patients (64.7%). A significant proportion of dead patients (88.2%) received chemotherapy alone, compared to 49.4% of those who were alive. On the other hand, chemotherapy combined with radiotherapy was administered to 50.6% of the live patients but only to 11.8% of the dead patients (p=0.003). A significant association between lymphoma subtype and patient outcomes were observed (p=0.026). Burkitt lymphoma was the most common subtype among dead patients (58.8%, n=10), whereas it was less frequent among survivors (26.4%, n=23). In contrast, the nodular subtype was more common among living patients (32.2%, n=28) but was observed in only one deceased case (5.9%). Mixed cellularity subtype was observed exclusively among the alive group (19.5%, n=17). Additionally, DLBCL and LL were slightly more frequent among the dead group (11.8% and 17.6%, respectively) compared to the alive group (6.9% and 10.3%, respectively). ALCL showed a nearly close distribution between alive (4.6%, n=4) and dead patients (5.9%, n=1).

As shown in Table 7, the distribution of risk group classification was relatively similar between the patients who were alive and those who were dead. The low-risk category comprised 10.3% of the live patients and 11.8% of the dead patients, indicating minimal variation between the two groups. Similarly, the intermediate-risk group included 39.1% of the alive and 41.2% of the dead patients, showing no substantial difference in survival rates. Lastly, the high-risk group, representing the most severe disease cases, accounted for 50.6% of the live patients and 47.1% of the dead patients (p=0.962).

As shown in Table 8, a significant difference was observed between the two groups regarding LDH levels. The mean LDH level was 436.21 ± 374.63 U/L in the alive group, whereas it was higher in the dead group, reaching 1125.65 ± 677.27 U/L ($p<0.001$). The mean WBC level was 8619.54 ± 8315.77 cells/μL in the alive group and 8276.47 ± 3272.91 cells/μL in the dead group. However, the WBC count was slightly lower in the dead group ($p=0.303$). Similarly, ESR did not show a significant variation between the groups. The mean ESR was 33.05 ± 23.40 mm/hour in the alive group compared to 27.71 ± 21.58 mm/hour in the dead group ($p=0.515$).

As shown in Figure 1, the Kaplan-Meier survival analysis revealed a significant difference in survival rates between HL and NHL, as indicated by the Log-Rank test ($\chi^2 = 9.163$, $p = 0.002$). This suggests that the survival distributions of the two lymphoma types differ, with patients with HL having a longer survival rate than those with NHL. The mean survival time for HL was 11.804 years (95% CI: 10.05 – 13.56) and was 9.04 years (95% CI: 7.75 - 10.32) for NHL. This nearly 3-year difference in average survival time reflects a potential survival advantage for patients with HL. However, the wide confidence intervals indicate some variability in survival outcomes within each group.

DISCUSSION

Pediatric lymphomas exhibit worldwide variations in incidence, aetiology, risk factors, severity, symptoms, recovery rates, curative therapies, survival outcomes, and rates that may be related to immunodeficiency, family histories, genetic variants, environmental conditions, and geographical locations [8]. Thus, we aimed to determine the survival rate of pediatric lymphoma at Hiwa Hospital over 10 years, using data reported from the hospital's electronic system. In the current study, the patients were aged from 3 to 18 years (mean of 12.00 ± 3.59 years), while their BMI ranged from 10 to 34 kg/m² (mean of 17.20 ± 4.34 kg/m²). The majority of patients were males (70.2%), from low-income families (43.8%), from the countryside (65.4%), had NHL (53.8%) or stage II (28.6%), had no B symptoms (57.7%), received chemotherapy alone (55.8%), completed treatment (85.6%), and were alive (83.7%). These findings indicated that teenagers, those with higher BMI, those male sex, those low income, and those with rural residents are at risk factors for pediatric lymphoma incidence in this locality. A part of this trend likely reflects the rapid urbanization that has occurred in this region. These data are parallel to standard data found in Iraq and other countries [1,6,7,9,10].

Regarding the lymphoma subtype in the current study, among NHL patients, more cases were BL (31.7%), followed by LL (11.5%), then DLBCL (7.7%), and ALCL (4.8%). Whereas among HL patients, most of them had nodular lymphoma (27.9%), and the left had mixed cellularity type (16.3%). In parallel with these findings, Yaqo et al. in Northern Iraq [11] found that the most common NHL was DLBCL (52.2%), followed by BL (14.6%). Another study in Iraq by Mjali et al. [12] found high rates of DLBCL (54.02%), extranodal primaries (38.18%), and intestinal BL (14.02%) but also noted lower rates of follicular lymphoma and LL. The high incidence of BL in Middle Eastern countries may be attributed to exposure to EBV infection in this region. However, genetics, race, cancer stage, comorbidities, and environmental factors

may be responsible for the disparities among studies.

Regarding the lymphoma subtype and survival rates among our patients, a significant association was observed between the lymphoma subtype and patient outcomes (p=0.026). Specifically, most deceased patients had BL (58.8%), while most living patients had nodular lymphoma (32.2%). These findings suggest a potential prognostic role of the lymphoma subtype in correlation to the survival rate and confirm that patients with NHL have a lower survival rate than HL. These outcomes align with WHO findings and international standards [13,14].

Regarding the correlation between patients' age and survival rate, a significantly higher proportion of non-survivors (29.4%) were aged 1-6 years compared to survivors (3.4%) (p=0.001). Another study mentioned that adolescents (≥15 years) with HL trials had worse event-free survival and increased risk of death compared with children (<15 years) [15]. Additionally, Burnelli et al. stated that adolescent characteristics differed significantly from those of children according to sex and the presence of symptoms [16], which agrees with this study. Moreover, Karalexi et al. noted that, despite significant survival rates in developed countries, substantial geographic, disease subtype-specific, and age-specific outcome disparities persist, indicating gaps in the implementation of new treatment modalities and necessitating further research [17]. The mean BMI was significantly lower in survivors (7.77 ± 4.27 kg/m²) than in non-survivors (14.29 ± 3.51 kg/m²) (p=0.002), indicating that a high BMI has a negative impact on the prognostic value of pediatric lymphoma. Parallel to this, Zeng et al. demonstrated that obese or emaciated BMI at diagnosis was associated with an increased risk of death (p=0.04) and was identified as an independent adverse prognostic factor in pediatric HG B-NHL that can be used for risk stratification [18]. However, gender, family economic status, and residency did not correlate with the survival rate (p ≥ 0.05).

Both HL and NHL are now highly treatable malignancies, especially non-advanced stages that are diagnosed early (at the onset of the disease). Diagnostic delay causes unfavourable outcomes among lymphoma patients; however, data regarding diagnostic delay are scarce in the literature. Diagnosis delay might be related to living in big cities, patients' anxiety/depression, self-medication, absence of health insurance, having no comorbid disease, or not visiting Hemato-oncology specialists. Longer diagnostic intervals resulted in higher incidences of complications (lymphadenopathies, weight loss, or prolonged fever) and more advanced lymphoma stages that might result in complex treatment and a higher fatality rate [19]. In this study, the time from onset of lymphoma to diagnosis ranged from 0 to 13 months (mean, 4.89 ± 2.74 months). Notably, 46.2% of the patients were diagnosed with HL, while 53.8% were diagnosed with NHL. Concerning disease stage at diagnosis, an apparent disparity was observed between the alive and dead groups. Stage II lymphoma reported the highest incidence (34.6% of which 41.7% were HL and 28.6% were NHL), followed by stage III (31.7%, of which 43.8% were HL and 21.4% were NHL), and stage IV (31.7% of which predominantly were NHL (50.0%) than HL (10.4%)). Moreover, stage IV was significantly more prevalent among the dead patients (64.7%) than the alive group

(25.3%) (p=0.013). These findings emphasize that the lymphoma stage at diagnosis had a prognostic impact on disease progression as delayed diagnosis of >4.5 months might be a cause of the high prevalence of stage IV aggressive type lymphoma (NHL). Similar outcomes were reported by Dapkevičiūtė et al., who stated that the median overall diagnostic delay was nearly 5 months; however, there was still room for improvement [20]. At the same time, Gardie et al. found a median delay in diagnosis of 68 days among pediatric lymphoma patients [19]. Additionally, in this study, most patients were in the intermediate-risk group (HL of 50.0% and NHL of 53.4%), followed by the high-risk group (HL of 33.3% and NHL of 39.3%), and then the least were in a low-risk group. The high-risk group demonstrated the most severe disease cases, accounting for 50.6% of the live patients and 47.1% of the dead patients (p=0.962). These findings suggest that risk classification alone may not be a strong predictor of survival outcomes. In this regard, Jeon et al. found the same outcomes in pediatric patients with B-NHL and suggested an improvement in survival for high-risk patients [21]. Hence, adding rituximab to the standard Lymphomes Malins B 89 chemotherapy has shown efficacy in children and adolescents with high-grade, high-risk, mature B-NHL [22].

B symptoms refer to fever, drenching night sweats, and loss of >10% of body weight over 6 months, which are significant in aiding early diagnosis, prognosis, and staging of the disease [23]. In this study, 45.8% of HL and 39.3% of NHL patients presented with B symptoms, although this difference was not statistically significant (p≥0.05). Similarly, 44.8% of alive and 29.4% of deceased patients presented with B symptoms, also without a statistically significant difference (p≥0.05). These findings indicate that most patients with both types of lymphoma and across both groups (alive and dead) do not present with symptoms. Accordingly, B symptoms are not correlated to the lymphoma prognosis. On the contrary, Zheng et al. realized that B symptoms, LDH level, and clinical stage significantly correlated with lymphoma prognosis [24].

Advancements in lymphoma treatments have significantly extended the life expectancy of patients, creating a growing concern, especially for the pediatric population, with the emergence of recurrence [7]. Thus, in the present study, only 4.8% of patients received targeted therapy or immunotherapy (8.3% had HL and 1.8% had NHL). In comparison, 55.8% of patients received chemotherapy alone (94.6% had NHL and 10.4% had HL), while 44.2% received chemotherapy with radiotherapy (89.6% had HL and 5.4% had NHL) (p<0.001). Receiving chemotherapy alone underscores the potential role of multimodal therapy in improving survival outcomes, as a significant proportion of dead patients (88.2%) received chemotherapy alone (only 49.4% of alive patients). Chemotherapy/radiotherapy potentially affects the patients' survival rate and prognosis that was administered to 50.6% of the live patients but only to 11.8% of the dead patients (p=0.003). About 97.9% of HL patients (95.8% were alive) and 75.0% of NHL patients (73.2% were alive) completed treatments (p=0.001), which is in agreement with Zheng et al., who found that complete remission after induction chemotherapy significantly correlated with prognosis [24].

Only LDH levels were significantly different (p<0.001) between the two

groups, with the highest level reported in the dead group (436.21 ± 374.63 U/L), especially in patients with NHL (742.32 ± 574.03 U/L), highlighting the potential role of LDH as a diagnostic and prognostic biomarker. Similar results were reported by Zheng et al. [24]. ESR levels were significantly higher in HL (37.60 ± 26.59 mm/hour) than in NHL (27.52 ± 18.61 mm/hour) (p=0.038), but the mean WBC were non-significantly (p=0.919) lower in HL (8187.50 ± 5338.17 cells/μL) than NHL (8885.71 ± 9311.02 cells/μL). However, neither WBC nor ESR was significantly correlated (p≥0.05) with the survival rate, indicating that neither may be a reliable predictor of survival in pediatric lymphoma. NHLs are mainly high-grade neoplasms that are rare in infancy and early childhood, accounting for 7.0% of all malignancies among children aged <19 years. Males have a higher incidence of NHL than females [25]. In this study, 83.7% of patients were alive (95.8% of HL patients and 73.2% of NHL patients), and 16.3% had died, which means the mortality rate was significantly higher in NHL (26.8%) than HL (4.2%) (p=0.002).

The limitation of this study includes single-centred research that cannot give accurate population-based data, data about the cytogenetics and molecular genetics for pediatric patients were not available due to the shortage in funds and hospital facilities, inability to provide detailed treatment information, encompassing cumulative doses of chemotherapeutic drugs or radiation, and not studying the second primary malignancies after pediatric HL and NHL.

CONCLUSION

Pediatric lymphoma was more common among teenagers, especially males, from low-income families and those who lived outside of the cities. The NHL was the predominant type, with a lower survival rate and shorter survival time than HL. Age group, BMI, lymphoma stage, treatment protocol, and LDH were significantly correlated to the survival rate of the patients. Gender, residency, family economic status, lymphoma symptoms, risk classification group, WBC, and ESR did not affect the survival rate among patients. We recommend optimising the treatment strategy and protocol to increase the survival rate by enhancing patient follow-up and ensuring they complete their treatment regimens correctly, thereby reducing the fatality level. Additionally, improving the therapeutic outcomes of these diseases can be achieved by providing better hospital facilities, medications, and patient care.

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TABLES

Table 1. Sociodemographic characteristics of pediatric lymphoma patients at Hiwa Hospital.

Demographic characteristics		Value
Age (Years)	Minimum/Maximum	3/18
	Mean ± SD	12.00 ± 3.59
Gender	Female	31 (29.8%)
	Male	73 (70.2%)
Body Mass Index (kg/m^2)	Minimum/Maximum	10/34
	Mean ± SD	17.20 ± 4.34
Parents' economic status	Low	56 (43.8%)
	Moderate	31 (29.8%)
	Good	16 (15.4%)
	Very good	1 (1.0%)
Residency	Inside City	36 (34.6%)
	Outside city	68 (65.4%)

Table 2. Pediatric Lymphoma Subtypes Among Patients at Hiwa Hospital.

Lymphoma Type	Lymphoma Subtype	Frequency (Percentage)
NHL (n=56)	ALL	5 (4.8%)
	BL	33 (31.7%)
	DLBCL	8 (7.7%)
	LL	12 (11.5%)
HL (n=48)	Mixed cellularity	17 (16.3%)
	Nodular	29 (27.9%)
Total		104 (100)

Table 3. Clinical characteristics of pediatric lymphoma patients at Hiwa Hospital.

Clinical Characteristics		Hodgkin Lymphoma (n=48)	Non-Hodgkin Lymphoma (n=56)	Total (n=104)	p-value
		Number (Percentage)			
Stage at diagnosis	Stage I	2 (4.2%)	0 (0.0%)	2 (1.9%)	<0.001**
	Stage II	20 (41.7%)	16 (28.6%)	36 (34.6%)	
	Stage III	21 (43.8%)	12 (21.4%)	33 (31.7%)	
	Stage IV	5 (10.4%)	28 (50.0%)	33 (31.7%)	
Time from onset of lymphoma to diagnosis (Months)	Minimum/Maximum	2/13	0/13	0/13	0.553
	Mean ± SD	5.19 ± 1.98	4.63 ± 3.26	4.89 ± 2.74	
B symptoms	No	26 (54.2%)	34 (60.7%)	60 (57.7%)	0.500
	Yes	22 (45.8%)	22 (39.3%)	44 (42.3%)	
Targeted therapy or immunotherapy	No	44 (91.7%)	55 (98.2%)	99 (95.2%)	0.120
	Yes	4 (8.3%)	1 (1.8%)	5 (4.8%)	
Treatment protocol	Chemotherapy	5 (10.4%)	53 (94.6%)	58 (55.8%)	<0.001**
	Chemotherapy with radiotherapy	43 (89.6%)	3 (5.4%)	46 (44.2%)	
Completing treatment	No	1 (2.1%)	14 (25.0%)	15 (14.4%)	0.001**
	Yes	47 (97.9%)	42 (75.0%)	89 (85.6%)	
Survival rate	Alive	46 (95.8%)	41 (73.2%)	87 (83.7%)	0.002*
	Dead	2 (4.2%)	15 (26.8%)	17 (16.3%)	

*: Significant difference, **: Highly significant difference using Mann-Whitney U test and Chi-square test

Table 4. Hematological and inflammatory markers in pediatric lymphoma patients at hiwa hospital.

Clinical Characteristics	Hodgkin Lymphoma (n=48)	Non-Hodgkin Lymphoma (n=56)	Total (n=104)	p-value
	Mean ± SD			
LDH (U/L)	323.25 ± 273.15	742.32 ± 574.03	548.90 ± 504.05	<0.001**
WBC (cells/µL)	8187.50 ± 5338.17	8885.71 ± 9311.02	8563.46 ± 7708.36	0.919
ESR (mm/hour)	37.60 ± 26.59	27.52 ± 18.61	32.17 ± 23.09	0.038*

Table 5. Comparison of sociodemographic characteristics between survivors and non-survivors of pediatric lymphoma at hiwa hospital.

Sociodemographic Characteristics		Alive (n=87)	Dead (n=17)	Total (n=104)	p-value
		Number (Percentage)			
Age class (Year)	1-6	3 (3.4%)	5 (29.4%)	8 (7.7%)	0.001**
	7-12	38 (43.7%)	4 (23.5%)	42 (40.4%)	
	13-18	46 (52.9%)	8 (47.0%)	54 (51.9%)	
Gender	Female	26 (29.9%)	5 (29.4%)	31 (29.8%)	0.969
	Male	61 (70.1%)	12 (70.6%)	73 (70.2%)	
Economical status	Good	15 (17.2%)	1 (5.9%)	16 (15.4%)	0.438
	Low	44 (50.6%)	12 (70.6%)	56 (53.8%)	
	Moderate	27 (31.0%)	4 (23.5%)	31 (29.8%)	
	Very good	1 (1.1%)	0 (0.0%)	1 (1.0%)	
Residency	Inside City	32 (36.8%)	4 (23.5%)	36 (34.6%)	0.294
	Outside city	55 (63.2%)	13 (76.5%)	68 (65.4%)	

**: Highly significant difference, using Mann-Whitney U test and Chi-square test

Table 6. Comparison of clinical characteristics between survivors and non-survivors of pediatric lymphoma at Hiwa Hospital.

Clinical Characteristics		Alive (n=87)	Dead (n=17)	Total (n=104)	p-value
		Number (Percentage)			
B symptoms	No	48 (55.2%)	12 (70.6%)	60 (57.7%)	0.239
	Yes	39 (44.8%)	5 (29.4%)	44 (42.3%)	
Stage at diagnosis	Stage I	2 (2.3%)	0 (0.0%)	2 (1.9%)	0.013*
	Stage II	34 (39.1%)	2 (11.8%)	36 (34.6%)	
	Stage III	29 (33.3%)	4 (23.5%)	33 (31.7%)	
	Stage IV	22 (25.3%)	11 (64.7%)	33 (31.7%)	
Treatment protocol	Chemotherapy	43 (49.4%)	15 (88.2%)	58 (55.8%)	0.003*
	Chemotherapy with radiotherapy	44 (50.6%)	2 (11.8%)	46 (44.2%)	
Lymphoma subtype	ALL	4 (4.6%)	1 (5.9%)	5 (4.8%)	0.026*
	Burkitt lymphoma	23 (26.4%)	10 (58.8%)	33 (31.7%)	
	DLBCL	6 (6.9%)	2 (11.8%)	8 (7.7%)	
	LL	9 (10.3%)	3 (17.6%)	12 (11.5%)	
	Mixed cellularity	17 (19.5%)	0 (0.0%)	17 (16.3%)	
	Nodular	28 (32.2%)	1 (5.9%)	29 (27.9%)	

Table 7. Risk stratification among pediatric lymphoma.

Risk Group	Alive (n=87)	Dead (n=17)	Total (n=104)	p-value (Chi-Square test)
	Number (Percentage)			
Low	9 (10.3%)	2 (11.8%)	11 (10.6%)	0.962
Intermediate	34 (39.1%)	7 (41.2%)	41 (39.4%)	
High	44 (50.6%)	8 (47.1%)	52 (50.0%)	

Table 8. Hematological and biochemical markers in pediatric lymphoma.

Variables	Alive (n=87)	Dead (n=17)	Total (n=104)	p-value
	Number (Percentage)			
LDH (U/L)	436.21 ± 374.63	1125.65 ± 677.27	548.90 ± 504.05	<0.001**
WBC (cells/µL)	8619.54 ± 8315.77	8276.47 ± 3272.91	8563.46 ± 7708.36	0.303
ESR (mm/hour)	33.05 ± 23.40	27.71 ± 21.58	32.17 ± 23.09	0.515

FIGURES

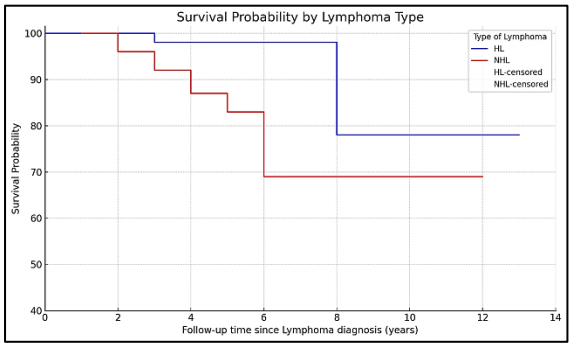

Figure 1. Kaplan-Meier survival analysis of pediatric Hodgkin and non-Hodgkin lymphoma