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THE ASSOCIATION OF TRICEPS SKIN FOLD THICKNESS IN NUTRITIONAL STATUS OF CHILDREN WITH ALL AT DIAGNOSIS AND AFTER COMPLETION OF INDUCTION CHEMOTHERAPY

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ABSTRACT

Objective: To assess the association of triceps skin fold thickness in nutritional status of children with ALL at diagnosis and after completion of induction chemotherapy. **Method:** This prospective study was carried out at Department of Pediatric Hematology & oncology, Bangabandhu Sheikh Mujib Medical University, Dhaka from Six months (1st October 2014 – 31st March 2015). Where sample was selected from the population by purposive sampling technique. Sample size was 80. Detail demographic data were collected from the informant and recorded in structured case report form. Clinical examination and relevant investigation were done meticulously. **Results:** During the study, 58(72.5%) were underweight for weight-for-Age at diagnosis and 33(41.25%) after completion of induction. Prevalence of stunting was also improved after completion of induction therapy, 19(23.75%) were stunted for Height-for-Age at diagnosis and 14(17.5%) after completion of induction. Proportion of children with wasting showed reduction in wasting completion of induction therapy. 45(56.25%) were wasted for weight for height Age at diagnosis and 9(11.25%) after completion of induction. Table showed that 22(27.5%) patients malnutrition for MUAC-for-age at the time of diagnosis, and 32(40%) after induction therapy. Prevalence of isolated fat malnutrition (TSFT) was also improved after completion of induction therapy, 34(42.5%) were at diagnosis and 25(31.25%) after completion of induction. At the time of diagnosis of ALL Triceps skin fold thickness <5th centile were 34(42.5%) of cases, but after induction therapy it reduced to 25(31.25%) cases. At diagnosis Mean value of Triceps skin fold thickness (mm) were (6.58 ± 2.10), fat increased (triceps skin fold thickness) in post induction therapy patients (7.81 ± 2.63). 22(27.5%) patients malnutrition for MUAC-for-age at the time of diagnosis, and 32(40%) after induction therapy. Prevalence of isolated fat malnutrition (TSFT) was also improved after completion of induction therapy, 34(42.5%) were at diagnosis and 25(31.25%) after completion of induction. **Conclusion:** In conclusion, this study has shown that malnutrition was prevalent at diagnosis in significant portion of acute leukaemia cases. It was also concluded that best method in revealing malnutrition was TST measurement. Besides, it was obvious that more comprehensive studies are needed to determine the association of malnutrition to treatment and prognosis.

KEYWORDS: Acute Lymphoblastic Leukemia (ALL), Cancer, induction chemotherapy.

INTRODUCTION

Acute Lymphoblastic Leukemia (ALL) is the most common cancer in children, accounting for a significant proportion of pediatric malignancies worldwide. The successful management of ALL requires a comprehensive treatment approach, including chemotherapy, aimed at achieving complete remission and minimizing treatment-related complications. However, one critical aspect that can significantly impact treatment outcomes and overall well-being is the nutritional status of children with ALL.[1-3]

Nutritional status plays a pivotal role in the maintenance of overall health and immune function, particularly in children undergoing intensive chemotherapy. Malnutrition and impaired nutritional status have been observed to be common among pediatric cancer patients, leading to compromised immune function, increased treatment toxicity, reduced treatment response, and decreased overall survival rates. Therefore, monitoring and optimizing the nutritional status of children with ALL are of utmost importance throughout their treatment journey.[4-5]

Triceps skinfold thickness (TSF) is a widely used anthropometric measure to assess body fat and nutritional status. It provides valuable insights into the adequacy of energy reserves and can serve as an indicator of nutritional status changes over time. By examining TSF at diagnosis and after completion of induction chemotherapy, clinicians and researchers can gain important information about the impact of treatment on the nutritional status of children with ALL.

This study aims to investigate the association between triceps skinfold thickness and the nutritional status of children with ALL at the time of diagnosis and after the completion of induction chemotherapy. By assessing changes in TSF and correlating them with various nutritional parameters, such as weight, body mass index, and biochemical markers, we can determine the extent to which induction chemotherapy affects the nutritional status of these children.[6-8]

Understanding the relationship between triceps skinfold thickness and nutritional status in pediatric ALL patients is crucial for designing appropriate nutritional interventions and supportive care strategies. By identifying children at risk of malnutrition and monitoring changes in their nutritional status, healthcare providers can tailor nutritional support interventions to mitigate treatment-related complications and improve treatment outcomes.

In conclusion, this study aims to shed light on the association between triceps skinfold thickness and the nutritional status of children with ALL. The findings will contribute to our understanding of the impact of induction chemotherapy on the nutritional status of these children, enabling healthcare professionals to develop targeted nutritional interventions and optimize treatment outcomes for this vulnerable population.[9-11]

OBJECTIVE

To find out the association of triceps skin fold thickness in nutritional status of children with ALL at diagnosis and after completion of induction chemotherapy.

METHODOLOGY

This prospective study was carried out at Department of Pediatric Hematology & oncology, Bangabandhu Sheikh Mujib Medical University, Dhaka from Six months (1st October 2014 – 31st March 2015). Where sample was selected from the population by purposive sampling technique. Sample size was 80. Detail demographic data were collected from the informant and recorded in structured case report form. Clinical examination and relevant investigation were done meticulously. The anthropometric measurements taken were body weight, height, body mass index (BMI), mid upper arm circumference (MUAC), Triceps skin fold thickness (TSFT). All the measurements were collected by the same investigator to avoid inter-observer error and to maintain uniformity and accuracy in techniques. All collected questionnaire were checked very carefully to identify the error in the data. Data processing work consist of registration schedules, editing computerization, preparation of dummy table, analyzing and matching of data.

The case definition of operational variable had been described. Patient data such as age, sex, clinical presentation of disease etc. were noted. This questionnaire was used for collection of information by interviewing patients. Collected all questionnaire checked very carefully to identify the error in collecting data. Data processing work were consisting of registration of schedules, editing, coding and computerization, preparation of dummy tables, analysis and matching data. The technical mater of editing, encoding and computerization looked by me.

Socio-demographic and clinical variables: Data for socio- demographic and clinical variables were obtained from all participants by the use of a pre- designed and easily understandable questionnaire. The socio-demographic variables studied- age, sex, place of residence and occupation. Socioeconomic levels were determined by occupation, household’s income and expenditure. After collection of all information, these data were checked, verified for consistency and edited for finalized result. After editing and coding, the coded data directly entered into the computer by using SPSS version 6. Data cleaning validation and analysis was performed using the SPSS/PC software and graph and chart by MS excel. The result was presented in tables in proportion. A “P” value <0.5 considered as significant.

RESULTS

Table-1 shows demographic status of the patients where 80 patients were taken as sample for study according to inclusion, exclusion criteria, to evaluate the value of triceps skin fold thickness in the assessment of nutritional status of children with acute lymphoblastic leukaemia at diagnosis and after induction therapy. The age group was divided into three groups: ≤2 years, 2 to 6 years, 7 to 11 years and 12 to 15 years. Most of the subjects 37(46.25%) belongs to age 02 to 06 yrs. Next group of patients 31(38.75%) observed in 7-11 yrs of age group. Out of 80 cases 58(72.5%) were male and 22(27.5%) were female. Male – female ratio was 2.63:1.

Table 1: Demographic status of the patients.

Age (years)	Number of patients(n)	Percentage(%)	Mean ± SD
≤2	5	6.25	5.7 ± 1.3
2-6	37	46.25	
7-11	31	38.75	
12-15	7	8.75	
Sex	**Number of Patients(n)**	**Percentage(%)**	
Male	58	72.5	

Female	22	27.5	
Total	**80**	**100**	

Table-2 shows comparison of malnutrition among ALL patients at the time of diagnosis and after completion of induction. Findings showed that frequency of malnutrition had a higher prevalence at the time of diagnosis (newly diagnosed case), but prevalence decreased after completion of induction therapy. Significant difference was found among newly diagnosed and after completion of induction therapy in term of underweight. The result showed that, 58(72.5%) were underweight for weight-for-Age at diagnosis and 33(41.25%) after completion of induction. Prevalence of stunting was also improved after completion of induction therapy, 19(23.75%) were stunted for Height-for-Age at diagnosis and 14(17.5%) after completion of induction. Proportion of children with wasting showed reduction in wasting completion of induction therapy. 45(56.25%) were wasted for weight for height Age at diagnosis and 9(11.25%) after completion of induction. Table showed that 22(27.5%) patients malnutrition for MUAC-for-age at the time of diagnosis, and 32(40%) after induction therapy. Prevalence of isolated fat malnutrition (TSFT) was also improved after completion of induction therapy, 34(42.5%) were at diagnosis and 25(31.25%) after completion of induction.

Table 2: Correlation of nutritional status of ALL patients at diagnosis and after completion of induction therapy (n=80).

Indicator	**Nutritional status**	**At diagnosis**	**After completion of induction**
Weight-for-Age < -2SD	Underweight	58 (72.5%)	33(41.25%)
Height-for-Age < -2SD	Stunting	19 (23.75%)	14(17.5%)
Weight-for-Height < -2SD	Wasting	45 (56.25%)	9(11.25%)
MUAC-for-age < -2SD	Malnutrition	22 (27.5%)	32 (40%)
Triceps skin fold thickness <5th centile	isolated fat malnutrition	34 (42.5%)	25 (31.25%)
Haemoglobin < 11.5 mg/dl	Anaemia	80 (100%)	76(95%)
Serum albumin < 2.1 gm/dl	Severe malnutrition	3 (3.75%)	0

Table-3 shows Changes in body composition (triceps skin fold thickness) at the time of diagnosis and after induction therapy. At the time of diagnosis of ALL Triceps skin fold thickness <5th centile were 34(42.5%) of cases, but after induction therapy it reduced to 25(31.25%) cases. At diagnosis Mean value of Triceps skin fold thickness (mm) were (6.58 ± 2.10), fat increased (triceps skin fold thickness) in post induction therapy patients (7.81 ± 2.63).

Table 3: Triceps skin fold thickness (mm) at diagnosis and after completion of induction therapy (n=80).

Indicator	**At diagnosis (Mean ± SD)**	**After completion of induction therapy (Mean ± SD)**
Triceps skin fold thickness (mm)	6.58 ± 2.10	7.81 ± 2.63

Table-4 shows correlation had TSFT and MUAC examination findings. Table showed that 22(27.5%) patients malnutrition for MUAC-for-age at the time of diagnosis, and 32(40%) after induction therapy. Prevalence of isolated fat malnutrition (TSFT) was also improved after completion of induction therapy, 34(42.5%) were at diagnosis and 25(31.25%) after completion of induction.

Table 4: Distribution of the cases according to MUAC and TSFT examination findings (n=80).

	TSFT (no. of patients)	**MUAC(no. of patients)**
At diagnosis (malnutrition)	34(42.5%)	22(27.5%)
After induction (malnutrition)	25(31.25%)	32(40%)

From the above table, following values were calculated as-
(Where, a = 34, b = 22, c = 25, d = 32)

Sensitivity

$$= \frac{a}{a + c} = \frac{34}{34 + 25} = 57.62\%$$

Therefore, sensitivity of TSFT in assessment of nutritional status of ALL patients was 57.62%.

Specificity

$$= \frac{d}{b + d} = \frac{32}{22 + 32} = 59.25\%$$

Therefore, specificity of TSFT in assessment of nutritional status of ALL patients was 59.25%.

DISCUSSION

The prevalence of malnutrition (weight-for-age) among this category of subjects (72.5%) was higher than the prevalence of malnutrition among 51 cancer affected children in Universiti Kebangsaan Malaysia Medical Centre study (37.3%) as reported by Zalina AZ et al.[19] On the other hand, the prevalence of malnutrition among this category of subjects was nearer compared to the study in Bangladesh.[12]

Further, prevalence of stunting (23.75%) in this study was comparable to the figures reported by other study, 17.6% of ALL were stunted (<-2 SD for height-for-age) in Malaysia and Kumar R et al.[1,13] in a tertiary care teaching hospital India reported malnutrition (weight for age <80%) was evident in 13 cases (52%), but cumulative incidence of malnutrition (weight for age <80%, weight for height <90%, height for age <95%[1]. However, the prevalence of malnutrition in this study quietly differ with western study e.g. M.A.H. de Hoed et al[15], prospective in seven pediatric oncology centers in the Netherlands revealed that of the 859 patients, median age at diagnosis of the patients included was 5.0 years (range, 1.5-17.3). Complete remission was achieved after induction in 744 (98%) patients. BMI data at diagnosis were 584 patients (79%) had a normal weight, 59 (8%) were underweight, and 95 (13%) were overweight or obese. Younger patients (<10 years) more often had a normal weight, while older patients were more likely to be over- or underweight.[15]

This study reports that 22(27.5%) showed malnutrition for MUAC-for-age and only 3(3.75%) of the subjects showed severe malnutrition. Serum albumin has been used in the past as an indicator of nutritional status. Another study demonstrated that sign(s) of malnutrition (<-2 SD) for mid upper arm circumference (MUAC)-for-age was observed in 15.7% of the subjects.[14] Approximately 20.0% of the subjects were in the severe malnutrition category with respect to low serum albumin levels (< 3.5g/dl). In addition, a study reported that serum albumin was not a sensitive indicator of nutritional status as it had a 14-to 20-day half-life and might be affected by other factors. Therefore, serum albumin does not clearly reflect the nutritional status among children with leukaemia.

We found that, prevalence of malnutrition among ALL patients after completion of induction. The result showed that 33(41.25%) patients were underweight for weight-for-Age, 14(17.5%) were stunted for Height-for-Age, 9(11.25%) were wasted for weight for height and 32(40%) showed malnutrition for MUAC-for-age, no patients showed severe malnutrition based on estimation of serum albumin after completion of induction. 76(95%) of ALL patients had less than normal range hemoglobin levels. In this study, overall prevalence of malnutrition among subjects was higher in newly diagnosed stage, compared to subjects after induction of therapy. It is possible that most of these patients were malnourished at the time of diagnosis and this condition could affect the success of cancer therapy. However, the prevalence of malnutrition in this study did not affect the outcome of therapy adversely; this may suggest that children with cancer treatment protocols were designed to provide optimal therapy as health care systems become better equipped to treat children with cancer. The changes may reduce or eliminate malnutrition among children with cancer. One study demonstrated that all subjects had hemoglobin levels of less than the normal range. It was observed that the prevalence of malnutrition was higher in children with newly diagnosed leukaemia. Thus, the nutritional status of children with leukaemia should be monitored closely as there is a likelihood of deterioration owing to the disease.[14]

Our study showed that frequency of malnutrition had a higher prevalence at the time of diagnosis of ALL (newly diagnosed case), gradually decreased after completion of induction therapy. Significant difference was found among newly diagnosed and after completion of induction therapy in term of underweight. Proportion of children with wasting showed reduction in wasting completion of induction therapy. Prevalence of stunting was also improved after completion of induction therapy. Changes in body composition (triceps skin fold thickness) at the time of diagnosis and after induction therapy are shown in table (3.7,3.8.3.10). At the time of diagnosis of ALL Triceps skin fold thickness <5th centile were 34(42.5%) of cases, but after induction therapy it reduced to 25(31.25%) cases. At diagnosis Mean value of Triceps skin fold thickness (mm) were (6.58 ± 2.10), fat increased (triceps skin fold thickness) in post induction therapy patients (7.81 ± 2.63). Study in hematology-oncology unit of the advanced pediatric center, Indiar[1], reported that of the 25 cases with ALL, skin fold thickness <5th centile, mid-arm muscle circumference <5th centile) was 88%. Six (24%) had isolated fat malnutrition (triceps skin fold thickness <5th centile). Two (9%) cases had evidence of acute malnutrition, i.e., wasting alone, 6 (27.2%) cases had chronic malnutrition (stunting alone). Nine children lost weight during induction (range: 0.2-5.8 kg; means ± SD: 1.9 ± 1.8 kg). All these cases had a complicated course during induction chemotherapy. Fourteen children (56%) had skeletal muscle wasting during induction chemotherapy. All those children who had lost weight also had skeletal muscle wasting. Subcutaneous fat, in contrast increased in 24 cases (96%). Changes in body composition after remission-induction chemotherapy are, most of the patients (64%) gained weight but 9 children demonstrated a weight loss ranging between 0.2 to 5.8 kg with a mean (± SD) of 1.9 (± 1.8) kg. The latter cases had a complicated course during induction chemo-therapy (febrile neutopenia and/or bleeding manifestations, etc.). All result is consistent with our findings.

A longitudinal study in Brazil showed that during induction and reinduction chemotherapy, the children gained weight and this was probably due to the use of high-dose steroids given over a period of weeks.15 During maintenance chemotherapy, the children presented weight loss, and specially among the group of children with low-risk ALL. The dietary intakes during treatment showed that the children increased their intakes of calories, protein, zinc and copper during induction and reinduction therapy and decreased their intakes during maintenance chemotherapy.

Acute lymphoblastic leukaemia (ALL) is a malignant proliferation of lymphoid cells blocked at an early stage of differentiation and accounts for ¾ of all cases of childhood leukaemia. The peak incidence of ALL occurs between age 2 and 5 years. ALL may be either asymptomatic or acute with life threatening hemorrhage, infection, or episode of respiratory distress. Although ALL is a disease primarily of the bone marrow and peripheral blood, any organ or tissue may be infiltrated by the abnormal cells. The most frequent signs are lymphadenopathies, hepatosplenomegaly, fever, signs of hemorrhage, and bone pain. Biological findings include hyperleukocytosis due to circulating lymphoblasts, anemia and thrombocytopenia.[9] In our study, anemia, abnormal leukocyte and differential counts, and thrombocytopenia are usually present at diagnosis, reflecting the degree to which bone marrow has been replaced with leukemic lymphoblasts. The presenting leukocyte counts range widely, from 0.1 to 1500 x 10^9/L (median 15 x 10^9/L) and are increased (>10x10^9/L) in slightly over one half of the patients (Table2). Hyperleukocytosis (> 100x10^9/L) occurs in 10% to 15% of the patients. The degree of leukocyte count elevation at diagnosis is a very strong predictor of prognosis in ALL. Decreased platelet counts (median, 50x10^9/L) are usually present at diagnosis and can be readily distinguished from immune thrombocytopenia, as isolated thrombocytopenia is rare in leukaemia. All the features are significantly improves after completion of induction.

Another study in the hematology, oncology unit of the central teaching hospital for pediatric (Baghdad)[10] showed that complete blood picture showed only 4 cases had WBC higher than 50000/cc & cases had hepatosplenomegaly >5 cm, and study show 16 cases (45.7%) had isolated fat malnutrition (triceps skin fold thickness <5th centile). There is a great effect of prednisolone during the weeks of induction by increase food intake, which is related to relieve of symptoms and euphoria, over caring for children during illness period. A complicated cases (infection, bleeding, febrile neutropinea stomatitis) can decrease oral intake and lead to weight loss. In our study there was a significant increase in triceps skin fold thickness, at the time of diagnosis of ALL Triceps skin fold thickness <5th centile were 34(42.5%) of cases, but after induction therapy it reduced to 25(31.25%) cases. At diagnosis Mean value of Triceps skin fold thickness (mm) were (6.58 ± 2.10), fat increased (triceps skin fold thickness) in post induction therapy patients (7.81 ± 2.63).

Patients workup and clinical management done meticulously. Among the 80 cases of ALL, 58(72.5%) Adherence to chemotherapy, 10(12.5%) cases developed complication e.g. bleeding, infection, 7(8.75%) cases Abandonment of therapy and 5(6.25%) children died because of infection, central nervous system bleeding, septicemia. Patient with malnutrition had a tendency for infection related complication during initial therapy in comparison to normal nutritional status. Anthropometric & biochemical parameter are prone to error & often reflect past rather than current nutritional status.[10,9] So the nutrition status of child with cancer is ongoing from the time of diagnosis to many years of treatment, but still arm anthropometrics may be more sensitive indicator of under nutrition than wt & ht. In conclusion malnutrition exists in a significant proportion of children with ALL. If induction chemotherapy is complicated, children lose significant weight with muscle wasting & increase in subcutaneous fat occurs in almost all patients due to therapy with steroid, larger scale prospective studies are essential for planning nutrition interventions.

CONCLUSION

Early diagnosis of nutritional disorders in cancer patients and consequent initiation of appropriate nutrition support plays important role for increasing the response rates to chemotherapy, reducing infection rates, and prolonging the clinical response and survival. Though assessment of nutrition in cancer cases frequently include BMI and anthropometric measurements such as TST and MUAC; albumin, and 24-hour urinary creatinine-height index may also be used for such assessment. In conclusion, this study has shown that malnutrition was prevalent at diagnosis in significant portion of acute leukaemia cases. It was also concluded that best method in revealing malnutrition was TST measurement. Besides, it was obvious that more comprehensive studies are needed to determine the association of malnutrition to treatment and prognosis.

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