BANGLADESH J CHILD HEALTH 2016; VOL 40 (1): 12-15

# Nutritional Assessment and Serum Zinc Level in Children with Acute Lymphoblastic Leukaemia

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**Abstract**

***Background:*** *Acute lymphoblastic leukaemia (ALL) is a common malignancy in children which may cause significant nutritional problem as well as micronutrient deficiency like zinc. These deficiencies ultimately affect the outcome of the patient.*

***Objective****: The present study was done to identify the relationship of height, weight and serum zinc with acute lymphocytic leukemia in pediatric patients.*

***Methods:*** *This observational study was carried out in the Department of Pediatric Haematology and Oncology, Dhaka Medical College Hospital, Dhaka over a period of one year from July 2013 to June 2014. All children ranging from 1-10 years with newly diagnosed acute lymphocytic leukaemia were enrolled as case. An equal number of healthy children of similar age and sex were also included as control. The outcome measures were weight for height (wasting) and height for age (stunting) in children 5 or below 5 years of age and BMI in children > 5 years of age. The serum zinc level was also studied as a measure of micronutrient status.*

***Result:*** *Majority (80%) of the cases and 60% of the controls were 5 or < 5 years old. The mean ages of the children of cases and controls were almost similar (4.2 ± 2.3 vs. 4.8 ± 1.8 years, p >0.05). The groups were significantly different in terms of sex with male children being more prone to develop leukaemia than the females (p <0.05). Anaemia was invariably present. Majority (83.3%) of the children in the case group was wasted (weight for height Z-score lie below -2SD) as opposed 22.2% in the control group (p < 0.001). About 37% the children in the case group were stunted (height for age Z-score lies -2SD) as opposed to 16.7% in the control group (p< 0.05). The mean BMI was significantly lower in the case group than that in the control group (8.8 ± 2.7 vs. 17.1 ± 1.8, p < 0.001). Serum zinc level was also significantly lower in the former group than that in the latter group (0.7 ± 0.1 vs. 1.5 ± 0.5 mg/dl, p< 0.05).*

***Conclusion:*** *A good number leukaemia patients present with wasting and stunting and low BMI. Serum zinc level is significantly reduced which, in turn, may hamper various enzymatic functions in the body thereby reducing growth.*

***Key words:*** *Nutritional assessment, serum zinc level, Acute lymphoblastic leukaemia*

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## Introduction

Children with cancer are at risk of suffering from under nutrition that, if severe, affects tolerance and may influence the patient's overall survival.[1] Cancer or cancer therapy may result in anorexia, vomiting or maldigestion or malabsorption, with the net result of reductions in absorbed nutrient intake.[2] However, controversy exists regarding the influence of chemotherapy or radiotherapy on nutritional status.[3] Cancer patients usually have inadequate energy and protein intakes, increased metabolic rate and

abnormalities in energy, carbohydrate, lipid and protein metabolism.[4] Over the last decade, improved chemotherapy strategies for childhood leukemia have resulted in a dramatic improvement in survival rates, such that most children are now definitively cured.[5] The evolution of supportive care strategies has also contributed towards the advances obtained by chemotherapy intensification.[6] Different authors have tried to establish a relationship between trace elements, especially zinc and copper, and malignant diseases. Changes in blood zinc and copper have been found in lymphoproliferative disorders.[7,8]

The general trend towards slightly decreased zinc concentrations in malignant diseases supports the experimental results obtained by Mayland C and colleagues[9] thus suggesting that zinc deficiency is associated with the etiology of cancer. Zinc is an important element in the preservation of immune resistance and both Zn and Cu are required for numerous biochemical functions and for optimal activity of the immune system. [10]

Cancer, like other chronic diseases, can have an adverse effect on the nutrient balance because of a combination of factors.[2] Children with cancer are at risk of suffering from under nutrition that, if severe, affects tolerance and may influence the patient's overall survival.[1] Cancer or cancer therapy may result in anorexia, vomiting or maldigestion / malabsorption, with the net result of reductions in absorbed nutrient intake. However, controversy exists regarding the influence of chemotherapy or radiotherapy on nutritional status.[3] With regard to ALL, some studies have shown a significant reduction of plasma zinc values only at the onset of the diseases. Assessment of nutritional status and serum zinc level in leukaemic children are essential for management and of therapy and evaluation of prognosis. The data generated from the study might be useful for paediatric hematologists for managing leukaemic children.

**Materials and Methods**

This observational study was carried out in the Department of Pediatric Haematology and Oncology, Dhaka Medical College Hospital, Dhaka over a period of one year from July 2013 to June 2014. All 30 children ranging from 1–10 years with newly diagnosed acute lymphocytic leukemia were enrolled as case diagnosed by bone marrow smears and immuno phenotyping. An equal number of healthy children of similar age and sex were also included as control. After enrolment the child examined thoroughly and weight, height and BMI recorded. The clinical parameters like anaemia, swollen lymph node, ascites, enlarged liver and spleen, bony tenderness and mucosal bleeding was meticulously examined. Nutritional status was assessed using weight for height and height for age Z-score for younger children and BMI for older children. Blood sample (2ml) send to Chemistry Division of Atomic Energy Centre, Ramna, Dhaka for estimation of zinc level from both group. Zinc was estimated by Varian (Varian, DuoAA240FS and AA280Z) atomic absorption spectrometer (AAS) equipped with fully integrated atomizers (viz. a burner system for flame atomization)**.**Using computer software SPSS version 16, data were processed and analyzed. The protocol was dully evaluated and permitted by ethical committee of Dhaka medical college. Written consent was taken from guardian after explain the objectives of the study. Data was collected by investigators with well prepared questionarre.

**Result**

The outcome measures were weight for height Z score (WHZ) (wasting) and height for age Z score(HAZ) (stunting) in children 5 or below 5 years of age and BMI in children > 5 years of age. The mean ages of the children of cases and controls were almost similar (4.2 ± 2.3 vs. 4.8 ± 1.8 years, p = 0.265). Male children were a bit higher in the case group (80%) than that in the control group (53.3%).(Table -I)

**Table I**

*Age and sex distribution between case and control group*

| | Group | | |
|---|---|---|---|
| | Case (n=30) | Control (n=30) | P-Value |
| Age (Years) | | | |
| ≤5 | 24(80.0) | 18(60.0) | |
| >5 | 6(20.0) | 12(40.0) | |
| Mean ± SD | 4.2 ± 2.3 | 4.8 ± 1.8 | 0.265 |
| Sex | | | |
| Male | 24(80.0) | 16(53.3) | 0.028 |
| Female | 6(20.0) | 14(47.7) | |

The clinical presentation shows that fever and anaemia were invariably present. Majority of the children had bony tenderness (86.7%), enlarged liver (80%), palpable spleen (60%) and mucosal bleeding (60%). Less common signs and symptoms were swollen lymph node (40%), ascites (26.7%) [Table II].

**Table-II**
*Distribution of cases by their clinical presentation (n = 30)*

| Clinical Presentation | Frequency | Percentage |
|---|---|---|
| Anaemia | | |
| Mild | 2 | 6.0 |
| Moderate | 22 | 73.3 |
| Severe | 4 | 20.0 |
| Swollen lymph node | 12 | 40.0 |
| Ascites | 8 | 26.7 |
| Enlarged liver | 24 | 80.0 |
| Palpable spleen | 18 | 60.0 |
| Bony tenderness | 26 | 80.7 |
| Mucosal bleeding | 8 | 26.7 |

Twenty four cases and 18 controls were 5 or below 5 years of age and were assessed for weight for height Z-score (wasting) and height for age Z-score (stunting), while 6 cases and 12 controls were over 5 years of age and were assessed for BMI. Serum zinc level was assessed for all cases and controls. Majority (83.3%) of the children in the case group was wasted (weight for height Z-score lie below -2 SD) as opposed 22.2% in the control group ($p < 0.001$) [Table III].

**Table III**
*Comparison of weight for height Z-score between groups.*

| Weight for height Z-score | Group | | p-value |
|---|---|---|---|
| | Case (n = 24) | Control (n = 18) | |
| < -2 SD | 20(83.3) | 4(22.2) | |
| -2SD to +2SD | 2(8.3) | 12(66.7) | <0.001 |
| >+2 SD | 2(8.3) | 2(11.1) | |

Figures in the parentheses indicate corresponding percentage

About 38% the children in the case group were stunted (height for age Z-score lies < -2SD) as opposed to 16.7% in the control group ($p = 0.031$) [Table IV].

**Table-IV**
*Comparison of height for age Z-score between groups*

| Height for age Z-score | Group | | p-value |
|---|---|---|---|
| | Case (n = 24) | Control (n = 18) | |
| < -2 SD | 9(37.4) | 3(16.7) | |
| 2 SD to +2SD | 15(62.6) | 13(72.2) | 0.031 |
| >+2SD | 0(0.0) | 2(11.1) | |

Figures in the parentheses indicate corresponding percentage

The mean BMI was significantly lower in the case group than that in the control group ($8.8 \pm 2.7$ vs. $17.1 \pm 1.8$, $p < 0.001$). Serum zinc level was also much lower in the former group than that in the latter group ($0.7 \pm 0.1$ vs. $1.5 \pm 0.5$ mg/dl, $p = 0.003$) [Table V].

**Table V**
*Comparison of serum zinc level between groups*

| Serum zinc level(mg/L) | Group | | p-value |
|---|---|---|---|
| | Case (n = 30) | Control (n = 30) | |
| Serum zinc level (mg/L) | $0.7 \pm 0.1$ | $1.5 \pm 0.5$ | 0.003 |

Data were analysed using Unpaired t-Test and were presented as mean ± SD

**Discussion**

Nutritional status is multidimensional and can be assessed by methods that are anthropometric, biochemical, dietary, clinical and functional. [11]Weight, height and body mass index are used for most clinical purposes in pediatrics, and are particularly suitable for patients with ALL because height and weight are measured routinely and carefully.[12]

The frequency of malnutrition at diagnosis in the study (83% wasted and 37.4% stunted) was staggeringly high as found by Viana et al[13] who found that 21.2% of children with newly diagnosed ALL had a weight-for-age score of less than - 2SD and 17.4% had a

height-for-age score of less than –2SD. Sgarbieri and colleagues[14] demonstrated even lower rate malnutrition in their children with newly diagnosed leukaemia. They found that 45 children enrolled in the study only 5(12.1%) children were malnourished. Three patients had a weight-for-height score of less than –2SD and two had height-for-age score of less than -2SD. In the present study the older children (> 5 years) were measured for their BMI and the leukaemic children exhibited a much lower BMI (8.8 kg/$m^2$) compared to their control (17.1 kg/$m^2$) which also indicates wasting among the older children. The high number of malnourished children at diagnosis in this study might be that most of the children in Dhaka Medical College Hospital come from low socioeconomic status and remain usually malnourished to some extent which aggravated during leukaemia.

Changes in copper and zinc concentrations have been found in lymphoproliferative disorders and also in ovarian, breast, lung and gastrointestinal tumors.[8] However, there is contradictory data regarding the degree of usefulness of copper and zinc for cancer diagnosis and prognosis.[15] In this study serum zinc level was much lower in the leukaemic children than that in the normal healthy children (0.7 ± 0.1 vs. 1.5 ± 0.5 mg/dl, p = 0.003). Sgarbieri and colleagues[16] reported that serum zinc concentration was significantly decreased in the leukemic group, compared to the control group [109 (SD 45) µg/dl vs. 122 (SD 25)µg/dl] (p< 0.05). In another study serum zinc concentration was significantly lower in leukemic patients than in healthy children.[17] Nadeiri indicated that zinc level was lower than normal before chemotherapy and further decrease was seen after chemotherapy in all types of cancer among participating children. Therefore, it is recommended to add zinc supplement to chemotherapy protocols especially for malnourished patients.[18]

**Conclusion**

The findings of the study concluded that children with leukaemia present wasting, stunting and low BMI. Serum zinc level is also reduced. Early and close attention to nutritional status is essential for an optimal outcome of children with leukaemia.

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