Assessing the Nutritional Status of Children with Leukemia from Hospitals in Kuala Lumpur

Zalina AZ[1], **Suzana Shahar**[2], **A Rahman A Jamal**[3] & **Noor Aini MY**[2]

[1] *Department of Nutrition & Dietetics, Faculty of Medicine & Health Sciences, Universiti Putra Malaysia ,43400 UPM, Serdang, Selangor, Malaysia*
[2] *Department of Nutrition & Dietetics, Faculty of Allied Health Sciences, Universiti Kebangsaan Malaysia, 50300 Kuala Lumpur, Malaysia*
[3] *UKM Medical Molecular Biology Institute (UMBI) Universiti Kebangsaan Malaysia Medical Centre Bandar Tun Razak, 56000 Kuala Lumpur, Malaysia*

ABSTRACT

A cross-sectional study was carried out to evaluate the nutritional status of 51 subjects with leukemia aged 4 to 12 years from the Haematology & Oncology Paediatric Ward, Universiti Kebangsaan Malaysia Medical Centre (PPUKM) and the Paediatric Institute of Kuala Lumpur. Nutritional status was assessed using anthropometric measurements, biochemical and haematological parameters. Subjects comprised 32 (62.7%) males and 19 (27.3%) females. Most of the subjects (41.2%) were in the age group of 4 to 6 years. More than half of the children were Malays (70.6%) followed by Indians (15.7%) and Chinese (13.7%). The subjects were diagnosed as acute lymphoblastic leukemia (ALL) (84.3%) followed by acute myelogenous leukemia (AML) (13.7%) and chronic myelogenous leukemia (CML) (2.0%) respectively. Most of the children were in remission status (54.9%). Underweight (<-2 SD for weight-for-age) was observed in 37.3% of the children while 17.6% of them were stunted (<-2 SD for height-for-age), and sign(s) of malnutrition (<-2 SD) for mid upper arm circumference (MUAC)-for-age was observed in 15.7% of the subjects. Approximately 20.0% of the subjects were in the severe malnutrition category with respect to low serum albumin levels (<3.5g/dl). All subjects had hemoglobin levels of less than the normal range. While the results indicated no significant differences in the nutritional status of subjects with leukemia at different stages of treatment, it was observed that the prevalence of malnutrition was higher in children with newly diagnosed leukemia. Thus, the nutritional status of children with leukemia should be monitored closely as there is a likelihood of deterioration owing to the disease.

INTRODUCTION

The term cancer describes a group of more than 100 different diseases. It occurs when a group of cells grow uncontrollably and in an abnormal and disorderly way, and may affect almost every organ and tissue of the body (WHO, 2003; Huhmann & Cunningham, 2005). Adequate nutrition is an important concern in children with leukemia (Cornelio *et al.*, 1996) because malnutrition and weight loss are common and are due to a variety of mechanisms involving the tumour, the host response to the tumour such as infection and phamarcokinetics of chemotherapeutic drugs (Kumar *et al.,* 2000; von Meyenfeldt, 2005).

Correspondence author: Assoc Prof Dr Noor Aini Mohd Yusof; Email: *namy@medic.ukm.my*

The incidence of malnutrition at the time of diagnosis of cancer in children appears to be less than in adults. Some children were malnourished at the time of diagnosis and their malnourishment was reported to have increased during the therapy for malignancy, especially if their treatment involved intensive chemotherapy or bone marrow transplantation (Pietsch & Ford, 2000). Children treated for leukemia underwent changes in nutritional status, as manifested by a reduction in growth, weight gains and weight losses. A child with newly diagnosed cancer appears to have the same average nutritional status as seen in the population from which the child comes, if the diagnosis is made in a reasonably timely manner (Sgarberi *et al.,* 2006).

Several factors may affect weight, including drugs, diet and lack of physical exercise. The induction and re-induction (in remission) chemotherapy includes the use of high-dose steroids given over a period of weeks, resulting in the children gaining weight rapidly during this time. Glucocorticoid treatment for children, for nearly all cases, increases energy intake markedly, and this effect contributes towards excessive weight gain and obesity that are characteristic of patients undergoing treatment for lymphocytic leukemia (Sala Pencharz & Barr, 2004; Sgarberi *et al.,* 2006). Cancer or rather cancer therapy may result in anorexia, vomiting, or maldigestion/malabsorption, with the net result of a reduction in absorbed nutrient intake and malnutrition (Sgarberi *et al.,* 2006).

In the last decade, improved chemotherapy strategies for children with leukemia have resulted in a dramatic improvement in the survival rates, with most children being definitely cured (Cornelio *et al.,* 1996) with their nutritional status found to be similar to the normal population. Malnutrition more often develops during intensive induction therapy but is less commonly apparent at diagnosis. The aim of this study is to evaluate and compare the nutritional status of children with leukemia at different stages of treatment: newly diagnosed, during remission and relapsed. By obtaining this baseline data, it would be helpful to evaluate preventive nutritional strategies that should be undertaken to enhance the quality of life of children with leukemia.

METHODOLOGY

Study design

A cross-sectional study design was used. Informed consent was obtained from the patients and their parents. The study was performed at the Haematology & Oncology Paediatric Ward, Universiti Kebangsaan Malaysia Medical Centre and Paediatric Institute of Kuala Lumpur. The study protocol was approved by the Ethics Committee of the Universiti Kebangsaan Malaysia Medical Centre.

Study subjects

Fifty-one children with leukemia (32 boys and 19 girls) aged 4 to 12 years were enrolled in this study. Data were collected from 1 January 2006 to 30 November 2006. Inclusion criteria were children with leukemia aged 4 to 12 years old and able to consume diet orally. Exclusion criteria were patients receiving nutrition support on tube feeding or parenteral nutrition and those on nutrient supplementation.

Anthropometric measurements

The anthropometric measurements taken were body weight, height and mid-upper arm circumference (MUAC). All the measurements were collected by the same investigator to avoid inter-observer error and to maintain uniformity and accuracy in techniques. Heights of the children were measured (by) using SECA Stadiometer Model 220 (Germany). The reading was taken to the nearest 0.1 cm. Electronic scales

(SECA, Germany) were used to measure weight of the children wearing minimum clothing and recorded to the nearest 0.1 kg. The anthropometric indices were calculated using reference median as recommended by the National Centre for Health Statistics (NCHS) (WHO, 1995) and classified according to standard deviation units (termed as Z-scores) based on World Health Organization (WHO) criterion (WHO, 1995). Children who were less than two standard deviations below the reference median (<-2 SD) were considered as underweight (weight-for-age), stunted (height-for-age) and wasted (weight-for-height) respectively.

A non-stretchable tape made of fibreglass was used to measure the circumference of the mid-upper arm. The circumference was measured at the mid-point of the upper left arm between the acromion process and the tip of the olecranon. After locating the mid-point, the left arm was extended and hung loosely by the side with the palm facing inwards. The tape was wrapped gently but firmly around the arm at the mid-point and the measurement was recorded (Gibson, 1990 as reported in Mirnalini *et al.,* 2007). This was repeated three times, and the mid-upper arm circumference was obtained by averaging the three values. The classification of malnutrition (<-2 SD) based on MUAC-for-age was determined using the NCHS references (WHO, 1995)

Biochemical profiles

Biochemical profiles of serum albumin and haemoglobin levels were obtained from patients' medical records. Serum albumin cut-off point for malnutrition was according to van Bokhorst-de van der Schueren *et al.* (1997). Children who were below 21 g/dl were considered as severely malnourished. The haemoglobin values of the subjects were compared with normal values by age using Oski, Brugnara &Nathan (2003) reference.

Statistical analysis

Descriptive and statistical analyses were done using SPSS version 13.0. Values were expressed as percentage and mean values $\pm$ SD. Normally distributed data were analysed using ANOVA followed by LSD to compare the differences between and among group means respectively. The differences were considered significant if $p<0.05$.

RESULTS

Table 1 shows characteristics of 51 leukemia subjects by sex, age group and ethnicity. Of the 51 subjects, 62.7% of the subjects were males and 37.3% females. The age group was divided into three groups: 4 to 6 years, 7 to 9 years and 10 to 12 years. Most of the subjects (41.2%) were in the age group of 4 to 6 years. Classification by ethnicity showed that a majority of the subjects were Malays (70.6%) followed by Indians (15.7%) and Chinese (13.7%). Using the classification of leukemia by Lightfood & Roman (2004), the majority of the subjects were diagnosed as acute lymphoblastic leukemia (ALL) (84.3%) followed by acute myelogenous leukemia (AML) (13.7%) and chronic myelogenous leukemia (CML) (2.0%). More than half of the subjects were in remission status (54.9%) during the study period.

Table 2 shows the incidence of malnutrition among leukemia subjects based on anthropometric measurement using NCHS references (WHO, 1995). The results showed that of the 51 subjects, 19 (37.3%) were underweight for weight-for-age, 9 (17.6%) were stunted for height-for-age, 16 (31.4%) were wasted for weight-for-height and 8 (15.7%) showed malnutrition for MUAC-for-age. Only 2 (20%) showed severe malnutrition based on the cut-off point for serum albumin. All the subjects (100%) had less than normal range hemoglobin levels.

Figure 1 shows the incidence of malnutrition among leukemia subjects

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Table 1. Characteristics of study subjects

Characteristics	Frequency (n)	Percent (%)
Sex		
Male	32	62.7
Female	19	37.3
Age group		
4 – 6 years	21	41.2
7 – 9 years	12	23.5
10 – 12 years	18	35.3
Ethnicity		
Malay	36	70.6
Chinese	7	13.7
Indian	8	15.7
Diagnosis		
Acute Lymphoblastic Leukemia (ALL)	43	84.3
Acute Myelogenous Leukemia (AML)	7	13.7
Chronic Myelogenous Leukemia (CML)	1	2.0
Status		
Newly diagnosed	14	27.5
In remission	28	54.9
Relapsed	9	17.6

Table2. Prevalence of malnutrition in children with leukemia

Indicators	Nutritional status	Frequency	Percent (%)
Weight-for-age <-2 SD	Underweight	19	37.3
Height-for-age <-2 SD	Stunting	9	17.6
Weight-for-height <-2 SD	Wasting	16	31.4
MUAC-for-age <-2SD	Malnutrition	8	15.7
Serum albumin <21g/dl	Severe malnutrition	2	20.0
Hemoglobin <11.5 mg/dl	Anemia	51	100

according to stages of treatment. The results showed that subjects in the newly diagnosed stage had a higher prevalence of malnutrition: 50% (weight-for-age), 28.6% (height-for-age), 42.9% (weight-for-height), 28.6% (MUAC-for-age) and 7.1% (severe malnutrition) as compared to subjects in remission and relapsed stages. However, no statistically significant difference in the nutritional status was found among children with leukemia at different stages of treatment ($p>0.05$) (Figure 2).

DISCUSSION

In this study, the overall prevalence of malnutrition among children with leukemia aged between 4 and 12 years, based on anthropometric measurements was 17.6% stunted, 37.3% underweight and 31.4% wasted. Approximately 15.7% showed signs of malnutrition for MUAC-for–age criterion. However, the prevalence of malnutrition (weight-for-age) among this category of subjects (37.3%) was lower than the prevalence of malnutrition among 17 cancer
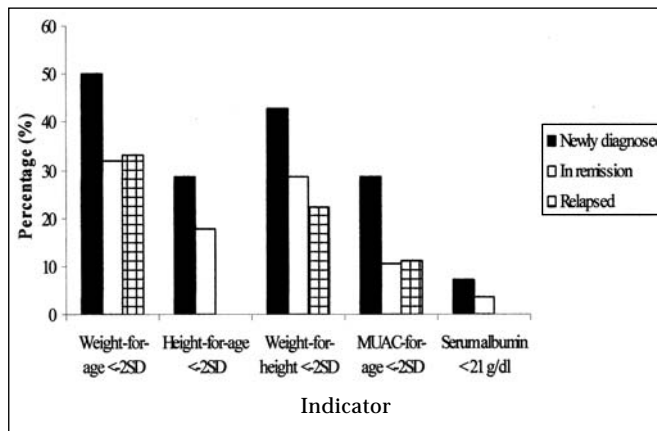
Figure 1. Percentage of subjects classified as malnourished according to stages of treatment
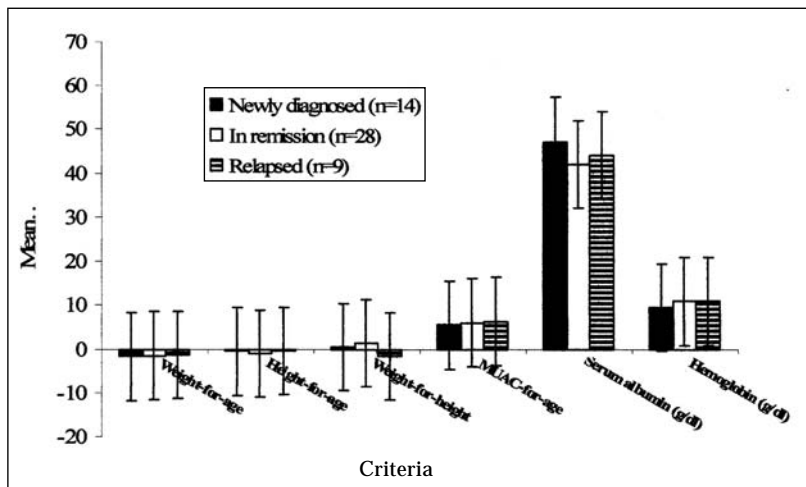

Figure 2. Differences in classification of malnutrition in children with leukemia at different stages of treatment

afflicted children in PPUKM (70.6%) as reported by Noor Aini *et al.* (2007), among 44 children in India (75%) as reported by Jain,Dubey & Gupta (2003) and in another study on 25 children in India (52%) reported by Kumar *et al.(*2000). On the other hand, the prevalence of malnutrition among this category of subjects was higher compared to the study by Pedrosa *et al.* (2000) among 292 cancer children in Brazil (20.9%) and 151 subjects (28.5%) in El Salvador.

Further, prevalence of stunting (17.6%) in this study was comparable to the figures reported by Jain *et al.*(2003) among 44 (of)

cancer afflicted children (25%) in India and 292 cancer afflicted children (18.5%) in Brazil (Pedrosa *et al.,* 2000). However, the prevalence of stunting in this study was lower compared to a study by Noor Aini *et al.* (2007) (76.5%) among 17 children with cancer in PPUKM and to another study by Pedrosa *et al.* (2000) (31.1%) among 151 children with cancer in El Salvador.

In this study, overall prevalence of malnutrition among subjects was higher in newly diagnosed stage, compared to subjects in remission and in the relapsed stage. 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.

This study reports that only 20% of the subjects showed severe malnutrition. Serum albumin has been used in the past as an indicator of nutritional status (Cooper *et al.,*1993; Rombeau & Rolandelli, 2001). In addition, a study by Huhmann & Cunningham (2005) 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 leukemia.

The results showed that haemoglobin was low in children with leukemia compared with the normal range based on Oski *et al.* (2003). This suggests that the deficiency may be related directly to the disease. The serum haemoglobin will return to normal if a patient responds to treatment as reported by Carter *et al.* (1983).

Since leukemia is the most common cancer in children and is now a curable disease, it is therefore important for health care staff to identify alterations in nutritional status early to ensure optimal treatment and outcome.

Further studies with larger sample sizes are required for a better understanding of the effect of cancer on the nutritional status of children with leukemia. Follow-up longitudinal studies of children with cancer are essential to validate the usefulness of these anthropometric measures of malnutrition during therapy.

CONCLUSION

This study did not find significant differences in the nutritional status among a sample of children with leukemia at different stages of treatment. However, the prevalence of malnutrition was higher in children with newly diagnosed leukemia. In view of this, the nutritional status of children with leukemia should be monitored periodically as malnourished children are more prone to infections and complications during treatment and their nutritional status may deteriorate, compared to leukemia children with normal nutritional status.

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