

## Review Article

# Association of Low Height with Low Weight Presented During Chemotherapy Treatment in Pediatric Patients in Remission of Acute Lymphoblastic Leukemia (ALL)

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## Abstract

Childhood Acute Lymphoblastic Leukemia (ALL) is the most common pediatric cancer in the world, but especially in developed countries, it is a malignant disease of the white blood cells with a multifactorial etiology that involves an interaction of environmental, genetic and nutritional factors. It is estimated that more than 60%

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of the patients diagnosed with ALL are children under 15 years of age, with an incidence at 2-5 years. One of the most important aspects that should be considered in pediatric patients receiving antineoplastic treatment for ALL is to take care of their nutrition, since it is known that various factors such as the disease itself or the treatment, can induce the patient to suffer due to low weight or even malnutrition and consequently, this can make your body more susceptible to decompensation caused by; illness, trauma, or infection. At present we know that cancer centers and hospitals treat that this type of patients have a series of protocols to take care of the nutrition of the cancer patient, this in order to reduce the risk of concomitant infections aggravated by the already serious situation of the disease. On the other hand, it is of interest to know once the patient has concluded the treatment and is in remission in the surveillance stage, how this situation of low weight or malnutrition in pediatric age that we know is a stage of development that could be affected and especially the height of your body. In this study, we compared 39 patients with ALL in the surveillance stage, who during their chemotherapy protocol (120 weeks for girls and 146 weeks for boys) had low weight 39 healthy patients without ALL and without any disease and matched by age and sex. Patients who were underweight during their chemotherapy protocol were found to have a significant reduction in body height when under surveillance compared to healthy child volunteers. The results show that patients with ALL have a higher risk of having short stature after completing treatment: In addition, the multivariate analysis showed that patients with ALL and low weight were associated with short stature, female sex, and low BMI.

**Keywords:** Acute Lymphoblastic Leukemia (ALL); Chemotherapy; Low height; Malnutrition

## Introduction

Childhood Acute Lymphoblastic Leukemia (ALL) is the most common pediatric cancer in the world, but especially in developed countries, it is a malignant disease of the white blood cells with a multifactorial etiology that involves an interaction of environmental, genetic and nutritional factors. It is estimated that more than 60% of the patients diagnosed with ALL are children under 15 years of age, with an incidence at 2-5 years [1-3].

Currently ALL treatments use several antineoplastic drugs that have greatly improved survival rates because of more effective treatments for childhood cancer. Unfortunately, the improved prognosis has been accompanied by the development of late complications related to treatment [4].

One of the most important aspects that must be taken into account during the treatment of ALL is the nutritional status and low weight of the patients, this is a condition that results from the balance between food intake and the body's expenditure to provide energy. In developing countries [5], such as Mexico, around 50% of pediatric patients with some type of cancer at the time of diagnosis have malnutrition and of all diagnosed cancers, ALL stands out with 20 to 50% of patients with malnutrition or underweight [6,7].

Adequate nutrition during cancer plays a decisive role in several measures of clinical outcome, such as response to treatment and quality of life after illness [8]. In childhood cancer patients, malnutrition

has been proposed to increase infection rates and reduce survival [9]. There is evidence that malnutrition or underweight at early age can cause a child's loss of development. Some studies explore the implications of suffering from childhood malnutrition and growth recovery for adult body size, but also for bone strength [10,11].

It is well known that the mechanism of action of some antineoplastic and cytotoxic agents used in the treatment of ALL can be altered in their pharmacokinetic behavior due to malnutrition or nutritional status [12,13] and as a consequence can cause negative effects and lead underweight or even malnutrition of the patient [14]. Malnutrition is a critical predictor of toxicity and outcome in cancer patients and may be perceived differently by patients, family members, and physicians [15,16].

Poor nutrition during growth and development in the pediatric stage can cause short stature as a consequence of the arrest of growth and development [17-19], therefore we decided to carry out this study, which is focused on determining if the short stature of a group of 39 patients under surveillance could be associated with the low weight and disease status they suffered during their ALL chemotherapy protocol.

## Methods

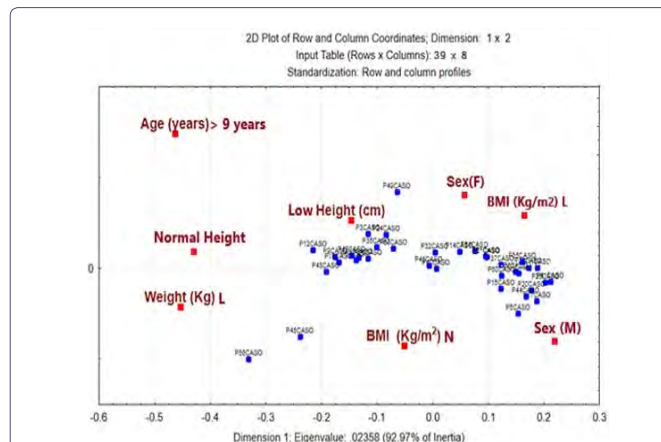
The Research Ethics Committee and the Research Committee of the General Hospital of Durango Torre Materno-Infantil, Mexico, approved and validated the study in accordance with the Declaration of Helsinki and the General Health Law of Mexico. 39 pediatric patients of both sexes were studied at the Pediatric Hemato-Oncology Service of the State Oncology Center (CECAN) of the Ministry of Health of Durango, Mexico. All patients were diagnosed with ALL according to the criteria of the French-American-British Hematology Association [20]. Each patient underwent chemotherapy treatment according to the St Jude TOTAL XV protocol [21], none had craniospinal radiotherapy. Children who had completed their treatment protocol, that is, they were on surveillance. In addition, a group of 39 children without ALL were matched for age and sex and were evaluated as a control group. All the parents of the patients were asked to sign the informed consent, in addition to the children older than 8 years, they were asked to accept the informed consent.

## Statistical Analysis

The associations of the demographic aspects between the groups of cases (patients with ALL) and the controls (patients without ALL) were compared using the Chi-square test, the value  $<0.05$  was considered significant. Comparison between patients with ALL with and without short stature was carried out by means of a chi-square test ( $\chi^2$ ) where a value of  $p < 0.05$  was considered significant. The determination of the risk of patients with leukemia to have short height was determined by means of an Odds Ratio test,  $p < 0.05$  was considered significant. Finally, the multivariate analysis was performed with a correspondence test, using the TIBCO Statistica 13.3 software [22,23] (Graph 1).

## Results

Tables 1 shows the comparison of the demographic aspects of children with ALL with and without short stature. We can see that there are no significant differences in the age of the patients ( $p=0.8$ ), on another hand, we can see that there are a significant differences in the weight ( $p=0.002$ ), height ( $p < 0.00001$ ) and BMI ( $p=0.00009$ ).



**Graph 1:** Two-dimensional graph that includes the cases (patients with low height) (■), as well as the 8 variables (■).

**Note:** The variables that presented the greatest association are low height (relative inertia: 0.19944), male gender (Sex F) (relative inertia: 0.17984) and low BMI (relative inertia: 0.10641).

Variables	Cases (n=39)	Controls (n=39)	p*
Age (years)	13.67±4.5	13.29±4.7	0.8
Sex (♀/♂)	28/11	28/11	
Weight (kg)	39.9±14.6	49.4±16.8	0.002602
Height (cm)	121.8±22.3	137.7±24.7	<0.00001
BMI (kg/m <sup>2</sup> )	17.4±3.3	19.7±2.8	0.000099

**Table 1:** Comparison of the demographic aspects of children with ALL with and without low height.

**Note:** \*t Student test.

	Low height	Normal	Patients	p*
With ALL	28	11	39	0.0006
Without ALL	12	27		

**Table 2:** Comparison between patients with ALL with and without low height.

**Note:** \*Chi-square

Table 2 shows us the comparison between patients with ALL and without ALL with low height, we can see that there is a significant difference between the patients with ALL and without ALL with low height  $p=0.0006$ .

The case-control study shows us that patients with ALL have a higher risk of being short (OR: 5.7273, 95% CI: 2.1623 to 15.1701,  $p=0.004$ ).

Finally, with the multivariate analysis we can observe that of the different variables that patients with ALL present, the ones that were most associated with them were: low height (relative inertia: 0.19944), female sex (Sex F) (relative inertia: 0.17984) and low BMI (relative inertia: 0.10641).

## Discussion

There are several studies that talk about the importance of good nutrition for proper development, as well as how significant it can be for a child to have low weight since it is in full development, this becomes especially important in pediatric patients with some type Of cancer. Rogers PC [24], shows this in his study where he points out

the importance of this aspect since childhood is a moment of total development in a person's life.

Iniesta RR et al. [25] and Arpaci T et al. [26], make it clear that if a child suffers from malnutrition or underweight, it may suffer certain adverse effects on its development, which is evidenced in our work by making it clear that low weight possibly caused by ALL and treatment for this disease affected the development of height in patients who have completed their treatment.

The influence of sex on nutritional status has been mentioned by different authors. Castel H et al. [27], Nätt D et al. [28], y Marino M et al. [29], point out in their different studies the influence of sex on malnutrition, they mention that for different causes such as the ovarian cycle and physiological differences, women indicated that they were more prone to malnutrition, however these studies were conducted in healthy patients without any disease. Tazi I et al. [30], Joffe L et al. [31], y Aarnivala H et al. [32], point out in their studies the association of patients with malnutrition and low weight who suffered from different types of cancer including ALL, mostly women, this coincides we found this in our study, since although the population of patients with ALL has more men than women, women had a greater risk of being underweight, so special attention is recommended.

## Conclusion

According to the results obtained, it was found that patients with ALL have a higher risk of having low height after concluding treatment; In addition, the multivariate analysis showed that patients with ALL and low weight were associated with short stature, female sex, and low BMI.

Therefore, we assume that low weight may be caused by the disease and/ or antineoplastic treatment and consequently the short stature of patients with ALL.

Therefore, it is necessary to evaluate more variables to know if patients suffer from some type of malnutrition, since the diagnosis of ALL before the pubertal outbreak, the use of steroids and the development of metabolic disorder can be decisive for the final short stature.

## References

1. Secretaría de Salud (2012) Subsecretaría de Prevención y Promoción de la Salud. Dirección General de Epidemiología.
2. Rivera-Luna R, Cárdenas-Cardos R, Olaya-Vargas A, Shalkow-Klincovstein J (2005) El niño de población abierta con cáncer en México. Consideraciones epidemiológicas. *An Med (Mex)* 60: 91-97.
3. Pérez-Saldívar ML, Fajardo-Gutiérrez A, Bernáldez-Ríos RM, Martínez-Avalos A, Medina-Sanson A, et al. (2011) Childhood acute leukemias are frequent in Mexico city: Descriptive epidemiology. *BMC Cancer* 11: 355.
4. Mulder RL, Bresters D, Van den Hof M, Gp Koot B, Castellino SM, et al. (2019) Hepatic late adverse effects after antineoplastic treatment for childhood cancer. *Cochrane Database Syst Rev* 4: 008205.
5. Hurley KM, Yousafzai AK, Lopez-Boo F (2016) Early child development and nutrition: A review of the benefits and challenges of implementing integrated interventions. *Adv Nutr* 7: 357-363.
6. Mohar-Betancourt A, Reynoso-Noverón N, Armas-Texta D, Gutiérrez-Delgado C, Torres-Domínguez JA (2017) Cancer trends in Mexico: Essential data for the creation and follow-up of public policies. *J Glob Oncol* 3: 740-748.
7. Padilla-Raygoza N, Monroy-Torres R, Sandoval-Salazar C, Vera-Becerra LE, Patiño-López ME, et al. (2020) Cancer prevention programmes in Mexico: Are we doing enough? *Ecancermedicalscience* 14: 997.
8. Bauer J, Jürgens H, Frühwald MC (2011) Important aspects of nutrition in children with cancer. *Advances in Nutrition* 2: 67-77.
9. Loeffen EAH, Brinksma A, Miedema KGE, de Bock GH, Tissing WJE (2015) Clinical implications of malnutrition in childhood cancer patients--infections and mortality. *Support Care Cancer* 23: 143-150.
10. Jee YH, Baron J, Phillip M, Bhutta ZA (2014) Malnutrition and catch-up growth during childhood and puberty. *World Rev Nutr Diet* 109: 89-100.
11. Kyle UG, Shekerdemian LS, Coss-Bu JA (2015) Growth failure and nutrition considerations in chronic childhood wasting diseases. *Nutr Clin Pract* 30: 227-238.
12. Lares-Asseff I, Flores-Pérez J, Juárez-Olguín H, Ramírez-Lacayo M, Loredo-Abdalá A, et al. (1999) Influence of nutritional status on the pharmacokinetics of acetylsalicylic acid and its metabolites in children with autoimmune disease. *Am J Clin Nutr* 69: 318-324.
13. Gómez F, Ramos GR, Joaquín CM (1998) Studies about malnutrition children. VIII. Nutritional recuperation syndrome. *Bol Méd Hosp Infant Méx* 55: 297-304.
14. Von Meyenfeldt M (2005) Cancer-associated malnutrition: An introduction. *Eur J Oncol Nurs* 2: 35-38.
15. Gyan E, Raynard B, Durand JP, Guily JLS, Gouy S, et al. (2018) Malnutrition in patients with cancer: Comparison of perceptions by patients, relatives, and physicians-results of the nutri cancer 2012 study. *JPEN J Parenter Enteral Nutr* 42: 255-260.
16. Wie GA, Cho YA, Kim SY, Kim SM, Bae JM, et al. (2009) Prevalence, and risk factors of malnutrition among cancer patients according to tumor location and stage in the National Cancer Center in Korea. *Nutrition* 26: 263-268.
17. Perkins JM, Subramanian SV, Smith GD, Özalpin E (2016) Adult height, nutrition, and population health. *Nutr Rev* 74: 149-165.
18. Wells J (2019) Body composition of children with moderate and severe under nutrition and after treatment: A narrative review. *BMC Med* 17: 215.
19. Maleta K (2006) Undernutrition. *Malawi Med J* 18: 189-205.
20. Bennett JM, Catovsky D, Daniel MT, Flandrin G, Galton DA, et al. (1976) Proposals for the classification of the acute leukaemias. French-American-British (FAB) co-operative group. *Br J Haematol* 33: 451-458.
21. Pui CH, Pei D, Sandlund JT, Ribeiro RC, Rubnitz JE, et al. (2010) Long-term results of St Jude total therapy studies 11, 12, 13A, 13B, and 14 for childhood acute lymphoblastic leukemia. *Leukemia* 24: 381-382.
22. Christian H (2008) Weiss "Commercial meets Open Source: Tuning STATISTICA with R" R-Project.
23. TIBCO Statistica® 13.3.0.
24. Rogers PC (2015) Importance of nutrition in pediatric oncology. *Indian J Cancer* 52: 176-178.
25. Iniesta RR, Paciarotti I, Brougham MF, McKenzie JM, Wilson DC (2015) Effects of pediatric cancer and its treatment on nutritional status: A systematic review. *Nutr Rev* 73: 276-95.
26. Arpaci T, Toruner EK, Altay N (2018) Assessment of nutritional problems in pediatric patients with cancer and the information needs of their parents: A parental perspective. *Asia Pac J Oncol Nurs* 5: 231-236.
27. Castel H, Shahar D, Harman-Boehm I (2006) Gender differences in factors associated with nutritional status of older medical patients. *J Am Coll Nutr* 25: 128-134.

28. Nätt D, Barchiesi R, Murad J, Feng J, Nestler EJ, et al. (2017) Perinatal malnutrition leads to sexually dimorphic behavioral responses with associated epigenetic changes in the mouse brain. *Scientific Reports* 7: 11082.
29. Marino M, Masella R, Bulzomi P, Campesi I, Malorni W, et al. (2011) Nutrition and human health from a sex-gender perspective. *Mol Aspects Med* 32: 1-70.
30. Taz I, Hidane Z, Zafad S, Harif M, Benchekroun S, et al. (2008) Nutritional status at diagnosis of children with malignancies in Casablanca. *Pediatr Blood Cancer* 51: 495-498.
31. Joffe L, Ladas EJ (2020) Nutrition during childhood cancer treatment: current understanding and a path for future research. *Lancet Child Adolesc Health* 4: 465-475.
32. Aarnivala H, Pokka T, Soininen R, Möttönen M, Harila-Saari A, et al. (2020) Trends in age- and sex-adjusted body mass index and the prevalence of malnutrition in children with cancer over 42 months after diagnosis: A single-center cohort study. *Eur J Pediatr* 179: 91-98.



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