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Assessment of the Nutritional Status of the Children with Acute Leukemia on Chemotherapy in Karbala City

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Article Info.	Abstract
	Acute leukemia is the most cancer has frequency in children, Malnutrition is one of the common complications of children with cancer, and malnutrition has been identified as a significant factor in treatment tolerance, increased morbidity, poor prognosis, reduced quality of life, and higher healthcare expenses. The study objective was to assess the nutritional status of children with acute leukemia during chemotherapy and find any association between malnutrition and the others factor. The study Methods were a case-control study conducted in Karbala city/Iraq, for 3 months, the study sample included 140 children (70 cases and 70 controls) aged (2 to 14) years, by using convenient sampling and use special questionnaire design and measuring anthropometric measures. The results revealed that the highest percentage of patients in the age group 5-10 years (47.1%), the boys were (55.7%), (52.9%) of patients live in urban, highly significant association (p.value < 0.001) of family history of cancer, has less physical activity and psychological effects on loss of appetite. Nutritional assessment during chemotherapy (48.6%) of case groups was normal weight, The results of this study indicate that the participants who had normal weight were at likely lower risk of complication acute leukemia than those with acute malnutrition (P. value=0.022; OR=0.297). According to the mid-upper arm composition assessment, the results show the highest percentage (35.7%, 34.3%) of patients were wasted and below average muscle area, and the highest percentage (51.4%, and 88.6%) of case and control groups were normal fat respectively. Effect of dietary habits can be summarized as the children treated with chemotherapy are consuming diets of medium quality, with little quantity Conclusion: the children with acute leukemia had a high association of malnutrition with low socioeconomic status, poor dietary habits, low physical activity, psychological effects, and duration and type of cancer therapy.

1. Introduction

Malnutrition is one of the common complications of children with cancer, malnutrition has been identified as a significant factor in treatment tolerance, increased morbidity, poor prognosis, reduced quality of life, and higher healthcare expenses [1]. acute leukemia constitutes over a third (34.1%) of all childhood cancers, and acute lymphoblastic leukemia (ALL) has a frequency five times higher than that of acute myeloid leukemia (AML) [2].

Acute lymphoblastic leukemia ALL is treated often with chemotherapy. Undernutrition can raise the risk of infection and increase the occurrence and severity of treatment side effects, lowering the overall survival [1]. Iraq is experiencing an increasing burden of childhood cancers mainly acute leukemia. Ministry of health statistics shows that the disease represents the majority of the ten diseases leading causes of childhood mortality in Iraq in recent years. These statistics show that the highest incidence rate of cancer in children (0-14 years) was acute leukemia (3.71/100,000 children) [3].

Because there is a scientific gap in the assessment of nutritional status for children and teenagers with acute leukemia in Iraq's specialized oncology and hematology centers, this comparative research was conducted on children with acute leukemia and compared them to their healthy peers from the same sample of the Iraqi community. In this study, the nutritional status is assessed depending on several methods:

1. Anthropometric measurements include Weight for Age, Height for Age, Body Mass Index for Age, and Weight for Height, but they may be inaccurate in assessing the nutritional status of a child with cancer because they do not give a clear picture of the body composition affected by the disease and chemotherapy like wasted of muscle mass.

Nomenclature			
AL	Acute Leukemia	M	Meter
ALL	Acute Lymphoblastic Leukemia	MUAC	Mid Upper Arm Circumference
AML	Acute Amyloplastic Leukemia	MUAFA	Mid Upper Arm Fat Area
BMI	Body Mass Index	MUAMA	Mid Upper Arm Muscle Area
CI	Confidence intervals	OR	Odd Ratio
DXA	Dual-energy X-ray absorptiometry	PI	Percentile
HA%	Height for Age	SAM	severe acute malnutrition
Kg	Kilogram	SD	Standard Deviation
AA	The upper arm area	SPSS	Statistical Package for the Social Sciences
TSFT	Triceps Thickness of skinfold	WA%	Weight for Age %

2. The second method is to assess the muscle mass and fats area upper arm, which is derived from measurements of arm circumference and thickness of the skinfold, which reflect the body composition of components of muscle and fat that are affected by dietary habits and therapeutic pattern for the cancer patient during the chemotherapy phases.

Despite the difficulties of adequately determining the frequency of malnutrition, low nutritional status has negative consequences from the time of diagnosis until the time of death. Nutritional status upon diagnosis refers to malnutrition, however, the relationship between Nutritional status and clinical outcome is yet unknown. Malnutrition hurts children with cancer's health-related quality of life, and there is consistent evidence of low nutritional quality in pediatric cancer survivors. Given the potentially controllable nature of this risk factor, nutritional screening and early intervention in pediatric cancer patients might lower the risk of nutritional morbidity, enhance survival, and reduce the risk of morbidity with a beneficial influence on the quality of life [4]. The significance and influence of nutritional status at the time of diagnosis of pediatric acute lymphoblastic leukemia is a contentious topic. Depending on numerous circumstances, there is contradictory evidence for or against its unique effect on ALL evolution and prognosis [5].

A. One of the most crucial factors is the family's socioeconomic level, as well as their educational and cultural backgrounds.

B. Acute leukemia-specific variables (kind of leukemia (ALL, AML), age at diagnosis, and length of illness)

C. patient-related factors (pediatric age, poor nutrient intake, increased intake of food factors suspected of being carcinogens).

D. treatment-related parameters (chemotherapy type, dosage, and duration) [6].

2. Methods

A case-control study was conducted in Karbala city, The case data was collected from Imam Al-Hussain Oncology and Hematology center and a control group was collected from primary health centers in Karbala city. The data were collected over approximately 3 months starting from 2nd January 2022 to the 5th April 2022.

The study sample included 140 children (70 cases and 70 controls) whose ages were from (2 to 14) years, The study used convenient sampling (non-random sampling technique) to choose the case and control groups via direct interviews and physical examination. By using a special questionnaire design and measuring anthropometric measures include (body weight for age, height for age, BMI for age, weight for height, mid-upper arm circumference, triceps skinfold thickness, muscle mass aera for age%, fat mass aera for age %).

2.1. Diagnosis of malnutritional types

According to Waterlow's classification index [7] by using the Table 1.

Table 1 Malnutrition Waterlow's classification table

Waterlow's classification Index	Nutritional status
BMI-for-Age <5 height-for-age Normal	Acute malnutrition (wasting)
BMI-for-Age <5 height-for-age <5	Decompensated-chronic malnutrition
BMI-for-Age = Normal height-for-age <5	Chronic malnutrition (stunting)
BMI-for-Age = Normal height-for-age Normal	Normal (Eutrophic)
BMI-for-Age = Over Weight height-for-age Normal	Over Weight
BMI-for-Age = Over Weight height-for-age <5	Stunted and overweight

2.2. Mid upper Arm composition

When see the children with cancer had normal weight and BMI but maybe they suffered from protein depletion. So that must know the body composition. With which we were able to determine the quantity of lean body mass and fat in the body, to see if there is muscular depletion. With the mid-upper arm circumference (MUAC) and the Triceps Thickness of skinfold (TSFT), you can calculate the muscle and fat area by using the formula (1):

2.2.1. Midupper Arm Muscle Area cm² (MAMA)

Which was measured by the investigator by calculating from (TSFT) and (MUAC) with the use of a circular model and the formula, Fig. 1[8]:

$$\text{MAMA} = (\text{MUAC} - \pi * \text{TSFT})^2 / 4\pi \tag{1}$$

The upper arm area (AA) was derived as:

$$\text{AA} = (\pi \div 4) * D^2$$

Where D is the arm diameter, which was calculated as $D = \text{MUAC} \div \pi$
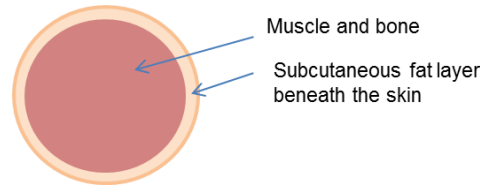

Fig 1. Illustration of components of a measure of mid-upper arm circumference [9]

2.2.2. Midupper Arm Fat Area cm^2 (MAFA)

Which was measured by the investigator by calculating from (TSFT) and (MUAC) with the use of a circular model and the formula:

MAFA (mm^2) =AA – MAMA

Then compared the score of Midupper Arm Muscle Area (MAMA) and Midupper Arm Fat Area (MAFA) for age with the Frisancho Table 2 [8].

Table 2 Percentile classification of mid-upper arm composition according to Frisancho table [8].

No.	Percentile	Muscle diagnosis	Fat diagnosis
1	0 - 5	Wasted muscle	Dangerously low fat
2	5.1 - 15	Below average muscle	Under fat
3	15.1 - 85	Average muscle	Normal
4	85.1 - 95	Above Average muscle	Overfat
5	>95.1	High muscle	Obese

2.3. Statistical Analysis

The data through the questionnaire and the information for each question were transferred to code sheets, the data was entered into the personal computer, and then the data were analyzed by the statistical package available from SPSS-26. Data were shown in simple measures of frequency, percentage, mean, standard deviation, and range (minimum and maximum values). The significance of the difference for different percentages (qualitative data) was tested using the Pearson Chi-square test (χ2-test). Statistical significance was taken into account when the P-value was equal to or less than 0.05. Univariate logistic regression analysis was used to identify the risk factors independently associated with acute leukemia or malnutrition.

Numeric data were presented as mean, standard deviation, range, and median after the performance of the Kolmogorov- Smirnov normality test and making decisions about normally and non-normally distributed variables.

3. Results

3.1. Socio-demographic characteristics of patients with Acute Leukemia and control subjects

The present study enrolled 70 patients with Acute Leukemia and 70 healthy participants. The demographic characteristics of patients are shown in Table 3. The table found that the highest percentage of patients in the age group 5-10 years was 33 (47.1%). Regarding gender, it sets a distinct male preponderance of 39 (55.7%) versus female 31(44.3%). As for residence, the study reveals that the highest percentage (52.9%) of patients live in urban areas. Whereas the highest percentage (24.3%) of patients falls within the second order among children.

As for the demographic variables of the control group, Table 1 shows the highest percentage of the control group in the age group 5-10 years 39 (55.7%). Regarding gender, it sets a distinct male preponderance of 36 (51.4%) versus male 34(48.6%). As for residence, the study reveals that the highest percentage (84.3%) of the control group live in urban areas. Whereas the highest percentage (40.0%) of the control group falls within the first order of children.

Table 3 The distribution of socio-demographic characteristics of patients with Acute Leukemia and control subjects according to age groups, gender, residence, and Child order

Categories			Cases (N=70)	control(N=70)	Total
Age groups	< 5 years	No.	19	39	58
		%	27.1%	55.7%	41.4%
	5-10 years	No.	33	24	57
		%	47.1%	34.3%	40.7%
	>10 years	No.	18	7	25

			cases	controls	total
		%	25.7%	10.0%	17.9%
	Mean ± SD (Range)		7.68 ± 3.40 (2.00-13.9)	5.51± 2.89 (2.00-12.50)	
Gender	Male	No.	39	36	75
		%	55.7%	51.4%	53.6%
	Female	No.	31	34	65
		%	44.3%	48.6%	46.4%
Residence	Urban	No.	37	59	96
		%	52.9%	84.3%	68.6%
	Rural	No.	26	10	36
		%	37.1%	14.3%	25.7%
	Slums	No.	7	1	8
		%	10.0%	1.4%	5.7%
Child order	First	No.	16	28	44
		%	22.9%	40.0%	31.4%
	Second	No.	17	18	35
		%	24.3%	25.7%	25.0%
	Third	No.	13	13	26
		%	18.6%	18.6%	18.6%
	Fourth	No.	11	7	18
		%	15.7%	10.0%	12.9%
	Fifth	No.	7	2	9
		%	10.0%	2.9%	6.4%
	Sixth	No.	3	1	4
		%	4.3%	1.4%	2.9%
	Seventh	No.	3	1	4
		%	4.3%	1.4%	2.9%
	Mean ± SD (Range)		2.96 ± 1.681 (1 -7)	2.20 ± 1.347 (1- 7)	
Birth space categories	The first child	No.	14	26	40
		%	20.0%	37.1%	28.6%
	<2 year	No.	13	8	21
		%	18.6%	11.4%	15.0%
	2-4 year	No.	32	26	58
		%	45.7%	37.1%	41.4%
	>4 years	No.	11	10	21
		%	15.7%	14.3%	15.0%
	Mean ± SD (Range)		2.46 ± 2.357 (0 -10)	2.09 ± 2.394 (0 -10)	
Number of brothers and Sisters	Non	No.	0	3	3
		%	0.0%	4.3%	2.1%
	1	No.	10	18	28
		%	14.3%	25.7%	20.0%
	2	No.	13	18	31
		%	18.6%	25.7%	22.1%
	3	No.	14	22	36
		%	20.0%	31.4%	25.7%
	4	No.	13	3	16
		%	18.6%	4.3%	11.4%
	>=5	No.	20	6	26
		%	28.6%	8.6%	18.6%
	Mean ± SD (Range)		3.54 ± 1.839 (0 -8)	2.33 ± 1.305 (0 -6)	

The demographic characteristics of the patients and the control group are shown in Table 4. The table found that the highest percentage of patients and control group house type were living in their own house (31.4%, 42.9%) respectively. A high percentage (95.7%, and 100%) of patients and the control group belonged to a nuclear family, respectively. Concerning the education level of mothers, the highest percentage (44.3%, and 25.7%) of patients and control group their mothers graduate from primary school, respectively. While the education level of fathers, the results found that the highest percentage (41.4%) of patients whose fathers graduate from primary school, and (31.4%) in the control group their fathers who graduate from institutes and college. As for the occupation of mother and father, the study reveals that a high percentage (92.9%, and 87.1%) of patients and the control group their mothers who were housewives respectively, whereas 62.9% of patient's fathers have free jobs, and 50.0% of the control group their fathers were employed. Regarding socio-economic status, the results found that the highest percentage (42.9%) of patients with low socioeconomic status, and (40.0%) of the control group with middle socioeconomic status.

Table 4 The distribution of socio-demographic characteristics of patients with Acute Leukemia and control subjects according to House type, residence, Education level of mother/father, and Occupation of mother/father

			cases (N=70)	controls (N=70)	total
House type	Own	No.	22	30	52
		%	31.4%	42.9%	37%
	Rented	No.	22	15	37

		%	31.4%	21.4%	26%
	Grandfather's house	No.	21	23	44
		%	30.0%	32.9%	31%
	Other	No.	5	2	7
		%	7.1%	2.9%	5%
	Single Parent Family	No.	3	0	3
Type of family		%	4.3%	0.0%	2%
	Nuclear Family	No.	67	70	137
		%	95.7%	100.0%	98%
	Illiterate	No.	10	0	10
		%	14.3%	0.0%	7%
	Read and write	No.	6	6	12
		%	8.6%	8.6%	9%
	Primary school	No.	31	18	49
		%	44.3%	25.7%	35%
Education level of mother	intermediate school	No.	11	17	28
		%	15.7%	24.3%	20%
	Secondary school	No.	5	16	21
		%	7.1%	22.9%	15%
	Institute & college	No.	6	11	17
		%	8.6%	15.7%	12%
	Higher degree	No.	1	2	3
		%	1.4%	2.9%	2%
	Housewife	No.	65	61	126
		%	92.9%	87.1%	90%
Occupation of mother	Employed	No.	4	7	11
		%	5.7%	10.0%	8%
	Student	No.	1	2	3
		%	1.4%	2.9%	2%
	Illiterate	No.	4	2	6
		%	5.7%	2.9%	4%
	Read and write	No.	4	0	4
		%	5.7%	0.0%	3%
	Primary school	No.	29	18	47
		%	41.4%	25.7%	34%
Education level of Father	intermediate school	No.	10	15	25
		%	14.3%	21.4%	18%
	Secondary school	No.	10	10	20
		%	14.3%	14.3%	14%
	Institute & college	No.	9	22	31
		%	12.9%	31.4%	22%
	Higher degree	No.	4	3	7
		%	5.7%	4.3%	5%
	Free jobs	No.	44	34	78
		%	62.9%	48.6%	56%
Occupation of father	Employed	No.	25	35	60
		%	35.7%	50.0%	43%
	Retired	No.	1	1	2
		%	1.4%	1.4%	1%
	Low	No.	30	18	48
		%	42.9%	25.7%	34%
Socio-Economic-Status Scale	Middle	No.	27	28	55
		%	38.6%	40.0%	39%
	High	No.	13	24	37
		%	18.6%	34.3%	26%

3.2. Nutritional Assessment

Table 5 represents the distribution of nutritional diagnosis categories associated with children with Acute leukemia (during chemotherapy). The results found that the highest percentage (61.4%, and 48.6%) of control and case groups were normal weight respectively. The results of this study indicate that the participants have who normal weight were at likely lower risk of acute leukemia than those with acute malnutrition

(B= -1.216-; P. value=0.022; OR=0.297; 95% C. I = 0.105-0.839). While the participants who were overweight and obese were likely at lower risk 0.125 times with acute leukemia than those with acute malnutrition.

Table 5 The Distribution of nutritional diagnosis Waterlow categories associated with children with Acute leukemia (during chemotherapy)

Nutritional diagnosis during chemotherapy		Cases (N=70)	Control (N=70)	B	P. value	OR (95% CI)
Acute malnutrition	No	16	6	Reference	NS	
	%	22.9%	8.6%			
Chronic malnutrition	No	11	4	0.031	0.967	1.031
	%	15.7%	5.7%			
Decompensated -chronic malnutrition	No	3	0	20.222	0 .999	605803066.100
	%	4.3%	0.0%			
Normal	No	34	43	-1.216-	0.022*	0.297 (0.105-0.839)
	%	48.6%	61.4%			
Overweight	No	3	9	-2.079-	0.011*	0.125 (0.025-0.624)
	%	4.3%	12.9%			
Stunted and overweight	No	1	1	-0.981-	0.511	0.375
	%	1.4%	1.4%			
Obesity	No	2	7	-6.691-	0.009*	0.107 (0.017-0.668)
	%	2.9%	8.6%			

Table 6 represents the Distribution of Arm Muscle Area Levels associated with children with Acute leukemia (during chemotherapy). The results found that the highest percentage (35.7%) of patients were wasted muscle. While 58.6% of the control group were normal muscle. Also, the study revealed the participants have who normal muscle was likely at a lower risk of acute leukemia than those with wasted muscle (B= -1.372-; P. value=0.002; OR=0.254; 95% C. I = 0.108-0.598).

Table 6 The Distribution of Arm Muscle Area Levels associated with children with acute leukemia (during chemotherapy)

Mid upper Arm Muscle Area - for- age %		Cases (N=70)	Control (N=70)	B	P. value	OR (95%CI)
Wasted muscle 0 – 5 %	No	25	13	Reference		
	%	35.7%	18.6%			
Below average muscle 5.1 – 15 %	No	24	12	0.039	0.936	1.040 (0.397-2.727)
	%	34.3%	17.1%			
Normal Average muscle 15.1 – 85 %	No	20	41	-1.372-	0.002*	0.254 (0.108-0.598)
	%	28.6%	58.6%			
Above Average muscle 85.1 – 95 %	No	1	4	-2.040-	0.081	0.130 (0.013-1.286)
	%	1.4%	5.7%			
Mean ± SD (Range)		18.65 ± 22.287 (1.0 -79.0)	30.25 ± 25.50 (1.0 -95.0)			

Table 7 represents the Distribution of upper Arm fat Area Levels associated with children with Acute leukemia (during chemotherapy). The results found that the highest percentage (51.4%, and 88.6%) of case and control groups were normal fat respectively. The results of this study indicate that the participants have who normal fat was at likely lower risk of acute leukemia than those with dangerous low fat (B= -2.559-; P. value=0.001; OR=0.077; 95% C. I = 0.017-0.358).

Table 7 The Distribution of upper Arm fat Area Levels associated with children with Acute leukemia (during chemotherapy)

Mid upper arm fat area - for- age %		cases (N=70)	Control (N=70)	B	P. value	OR (95% CI)
Dangerous low fat 0 – 5 %	No	15	2	Reference		
	%	21.4%	2.9%			
Under fat 5.1 – 15 %	No	12	2	-0.223-	0.835	.800 (0.098-6.545)
	%	17.1%	2.9%			
Normal fat 15.1 – 85 %	No	36	62	-2.559-	0.001*	0.077(0.017-0.358)
	%	51.4%	88.6%			
Overfat 85.1 – 95 %	No	4	3	-1.727-	0.107	0.178(0.022-1.454)
	%	5.7%	4.3%			
Obese >95 %	No	3	1	-0.916-	0.506	0.400(0.027-5.962)
	%	4.3%	1.4%			
Mean ± SD (Range)		31.78 ± 28.45 (0.40-103.0)	44.84 ± 22.35 (1.0 -96.10)			

3.3. Eating habits

Table 8 reveals that patients with acute leukemia have a good and moderate assessment for most items of healthy eating habits, except for eats meat and legumes, and eating food rich in healthy fat (nuts, olive oil, seed oil) which the mean score (2.84, and 2.97) rests within a poor assessment respectively. As for the control group, the study found that the healthy participants have a moderate assessment of most items of healthy eating habits, except for eats eggs, eats rice, bread, and pasta, and eating fruits which the mean score (was 4.20, 4.67, and 4.33) rests within a good assessment respectively.

Table 8 Assessment of healthy dietary habits for cases (during chemotherapy) and controls

healthy dietary habits	cases		controls	
	Mean score	assessment	Mean score	assessment
feeding regularly	3.37	Moderate	3.36	Moderate
drink milk or its products.	3.54	Moderate	3.50	Moderate
eats eggs	4.03	Good	4.20	Good
eats meat & legumes.	2.84	poor	3.60	moderate
eats Vegetables	3.56	moderate	3.2	moderate
eats rice, bread, pasta &, etc.	4.63	Good	4.67	Good
eats food rich in healthy fat (nuts, olive oil, seed oil).	2.97	poor	3.81	Moderate
eat fruits.	4.53	Good	4.33	Good

Mean (3), poor (mean less than 3), moderate (mean 3-4), and Good (mean more than 4).

Table 9 reveals that patients with acute leukemia have a good assessment for most items of unhealthy eating habits which a mean score of more than 4, except for Skipping breakfast and drinking tea which the mean score (was 3.47, and 3.63) rests within a moderate assessment respectively. As for the control group, the study reveals all healthy participants have a moderate assessment except for eating food rich in sugar like sweets, cacao, and chocolate which the mean score (2.06) rests within a poor assessment respectively.

Table 9 Assessment of unhealthy dietary habits for cases (during chemotherapy) and controls

unhealthy dietary habits	cases		controls	
	Mean score	assessment	Mean score	assessment
Skipping breakfast	3.47	Moderate	3.33	Moderate
drink tea	3.63	Moderate	3.11	Moderate
eats chips potato	4.41	good	3.06	Moderate
eats food rich in sugar like sweet,	4.27	good	2.06	poor
eats noodles with supe mixed.	4.77	good	3.63	moderate
eats fried fast food	4.43	good	3.36	moderate
drink Carbonated soft drinks.	4.60	good	3.54	Moderate

Mean (3), poor (mean less than 3), moderate (mean 3-4), and Good (mean more than 4).

Table 10 represents the difference between the mean scores for case (during chemotherapy) and control groups according to the assessment of dietary habits. The results of this study reveal that there was a highly significant difference between the mean scores for the case and control groups according to the assessment of the dietary habits (P. value <0.001) in which both case and control groups fall within a moderate level.

Table 10 The association between the cases (during chemotherapy) and the control group according to dietary habits assessment

Overall assessment	N	Mean	SD	Assessment	t. test	P. value
control	70	3.53	0.38	Moderate	-6.356	<0.001*
Cases during chemotherapy	70	3.91	0.44	Moderate		

3.4. Lifestyle of the patients with Acute Leukemia and control subjects

Table 11 shows that there was no significant association between patients with acute leukemia and the control group according to lifestyle (P. value > 0.05) except for physical activity, and the effect of the feeling of anger, anxiety, or depression on appetite, which have a significant association between patients with acute leukemia and the control group (P. value <0.05).

Table 11 The distribution of patients with Acute Leukemia and control subjects according to Lifestyle

Lifestyle			Cases (N=70)	Control (N=70)	X^2	P. value
Duration of child sleep per night	≤ 7 h.	No.	7	8	0.345[a]	0.951
		%	10.0%	11.4%		
	8-9 h.	No.	30	32		
		%	42.9%	45.7%		
	10-11 h.	No.	29	27		

		%	41.4%	38.6%		
	≥12 h.	No.	4	3		
		%	5.7%	4.3%		
	≤ 1 h.	No.	29	5		
		%	41.4%	7.1%		
Duration of child play hours per day (physical activity)	2-3 h.	No.	26	11	47.733[a]	<0.001*
		%	37.1%	15.7%		
	4-5 h.	No.	11	24		
		%	15.7%	34.3%		
	≤ 6 h.	No.	4	30		
		%	5.7%	42.9%		
	Slow (≤ 4)	No.	37	33		
		%	52.9%	47.1%		
the speed of chewing	Moderate (4.1-6)	No.	27	23	3.749[a]	0.153
		%	38.6%	32.9%		
	Fast (> 6)	No.	6	14		
		%	8.6%	20.0%		
	Increase of appetite	No.	0	8		
		%	0.0%	11.4%		
Effect of the feeling of anger, anxiety, or depression on appetite	Loss of appetite	No.	54	42	9.944[a]	0.007*
		%	77.1%	60.0%		
	Don't affect	No.	16	20		
		%	22.9%	28.6%		

h.(hour)

4. Discussion

4.1. demographic characteristics of the study sampling.

4.1.1. Type of family

Regarding the type of family, as shown in Table 4 the current study revealed that (95.7% and 100.0%) of the case and control groups respectively live with both parents (nuclear family), this result agreed with the findings of the past Chinese study which was done by Gao et. al.[10], which showed that (95.7%, 97.1%) of the case and control groups respectively live with both parents in the same home, which was positively reversed on the emotional stability of the child that aid in avoiding the depression effect that may be the cause of loss of appetite in children which we can see in the following results.

4.1.2. The Education level of the mother

As shown in Table 4 the current study showed that high percentages of educational levels of the mothers (44.3% and 25.7%) of the case and control groups respectively had primary school level, and the total low educational levels (including literacy, read and write and primary school level) were (67.2% for cases and 34.3%for controls), this result agreed with the finding of the Syrian study done by Kakaje et. al. [11] which showed that the mothers of children with acute leukemia have low educational levels was (56.2%). but these results disagreed with the finding of the Chinese study done by Gao et. Al. [10] which showed that the mothers of children with acute leukemia and the controls group respectively (33.8%, 61.7%) of mothers' educational levels were secondary school and university levels. That is because China is a developed country and has obligatory education on different levels of the community.

4.1.3. Occupation of mother

Regarding occupation of the mothers, as shown in table (4) this study showed that the high percentages were (92.9% and 87.1%) for case and control groups respectively were housewives, this result agreed with the finding of the past Iranian study done by Rafieemehr et. al.[12], which showed that the mothers of children with acute leukemia and the controls group respectively (92.8% and 88.5%) have a non-employed mother (housewives).which may be positively revers children getting enough home care from their mother.

4.1.4. Education level of Father

As shown in Table 4 the results of this study showed that high percentages (41.4% and 31.4%) of the case and control groups respectively had primary school level and university levels, and the total low educational levels (including literacy, read and write, and primary school level) were (52.8%), this result agreed with the finding of the previous Syrian study done by Kakaje et. al. [11] which showed that the fathers of children with acute leukemia have low educational levels was (53%).

4.1.5. Occupation of father

As shown in Table 4 the current study revealed that the high percentages (62.9% and 50.0%) of the occupation of fathers respectively for the case group was free jobs (freelance) and the control group was employed, this result agreed with the finding of the previous Chinese study done by Cai et. al. [13] which showed that the fathers of children with acute leukemia work as freelance were (60.7%).

4.1.6. Socio-economic status

Concerning socio-economic status, as shown in Table 4 this study indicated that (42.9%) of the patient-group family were low-income status, while founded (40%) of the control group were middle-income status, this result disagreed with the finding of the previous Costa Rican study

done by Hyland et. al.[14], which revealed that (69.7%) of the patient group were middle income and, (76.9%) of the control group were middle income. Among the plausible explanations for these findings is that it may be because of the stability of Costa Rican economic status and vice versa from unstable Iraqi economic status and increased poverty level in the last years [15].

4.2. Assessment of nutritional status

4.2.1. Nutritional diagnosis during chemotherapy according to Waterlow classification

Regarding the nutritional diagnosis during chemotherapy for the cases group, As shown in Table 5 this study showed results found that the highest percentage (48.6%) of the cases group were normal weight, this result agreed with the finding of a previous Nepalin study done by Koirala [1], which showed that the most patients had a non-malnutrition status during chemotherapy (56.3%), also the study shows the Participants who have a normal nutritional condition are the less development of complications for of acute leukemia than the participants who have acute malnutrition (B= -1.216-; P. value=0.022; OR=0.297; 95% C. I = 0.105-0.839).

4.2.2. Mid upper Arm Muscle Area for age percentile (during chemotherapy)

Skeletal muscle health is an important indicator of physical health and metabolic integrity and is affected by diet, exercise, disease, and treatment. Where muscles are the largest source of protein for the body and the main store of amino acids, which it uses for regeneration and repair of body tissue and support immunity. To assess body composition and muscle mass we can use different methods, like Dual-energy X-ray absorptiometry (DXA) [16] and measuring the mid-upper arm muscle area for age in percentile, to evaluate the status of malnutrition more accurately than physical measures such as weight and height, because the child may appear with normal weight and height, but he was may suffer from the wasted muscle in the body mass due to malnutrition. As shown in Table 6 the study shows the results found that the highest percentage (35.7%) of patients were wasted muscle, followed by the below-average muscle (34.3%), this result agreed with the finding of a previous study done in Shanghai, China by Dubuc [17] which showed that the most patients with acute leukemia had to develop a wasted muscle during chemotherapy, and also the study result agreed with the finding of the previous study done in Japan by Suzuki et. al [18] which showed that the muscle loss was observed in all patients during and after induction therapy, and severe adverse events during induction therapy were significantly more common in patients with acute leukemia.

4.2.3. Mid-upper arm fat Area for age in percentile (during chemotherapy)

Assessment of body fat considers more important to evaluate the fat storage in the body, which reflects the nutritional status of the children, As shown in Table 7 the study shows the results found that the highest percentage (51.4%, and 88.6%) of case and control groups were normal fat respectively. The results of this study found that the participants have who normal fat was at likely lower risk of complications of acute leukemia than those with dangerous low fat (B= -2.559-; P. value=0.001; OR=0.077; 95% C. I = 0.017-0.358). there is no previous study that used mid-upper arm fat Area measure on children with leukemia, but most studies have used DXA scan "dual-energy X-ray absorptiometry" to assess body composition in children with acute leukemia. so, this result agreed with the finding of a previous American study done by Orgel et. al. [16] which showed that most patients with acute leukemia had excess fat reserves during chemotherapy, which is a result of corticosteroid therapy that causes alteration in fat metabolism, which had a net effect of increasing body fat and redistribution of body fat causing truncal obesity [19].

One of the limitations of this study DXA was not used for the assessment of body composition, not available in this center.

4.3. Dietary habits

4.3.1. Assessment of healthy dietary habits for cases (during chemotherapy) and controls.

Regarding healthy dietary habits, As shown in Table 8 this study revealed that patients with acute leukemia have a good and moderate assessment for most items of healthy eating habits, except for eating meat and legumes as the main source of protein, and eating food rich in healthy fat (nuts, olive oil, seed oil) as a source of healthy fat and energy which the mean score (2.84, and 2.97) rests within a poor assessment respectively with highly significant difference between the mean scores for case and control groups according to the assessment of the dietary habits (P. value <0.001), this result agreed with the finding of a previous Malaysian study done by Tan et. al.[20], which showed that most patients had a poor quantity of protein (50.0%) of daily requirement and healthy fat (43.6%) of daily requirement during chemotherapy, which summarized of intakes of patients were significantly lower than controls (P. value < 0.001).

4.3.2. Assessment of unhealthy dietary habits for cases (during chemotherapy) and controls.

According to unhealthy dietary intake during chemotherapy, As shown in Table 9 the result found that the patient has a big shift in his eating habits by reducing the unhealthy food groups, and has a good assessment for most items of unhealthy eating habits which a mean score of more than 4, except for Skipping breakfast and drinking tea which the mean score (was 3.47, and 3.63) rests within a moderate assessment respectively, this result disagreed with the finding of Australian study done by Cohen et al. [21], which showed that the most patients are consuming diets of reasonable quantity, but poor quality, As shown in table (10) The results of this study reveal that there was a highly significant difference between the mean scores for case and control groups according to the assessment of the dietary habits (P. value <0.001) in which both case and control groups falls within a moderate level. Which summarized the children treated with chemotherapy are consuming diets of medium quality, but less quantity. that was the result of the doctor's advice about eating healthy food and avoiding unhealthy food during treatment phases.

4.4. The lifestyle of the patients with Acute Leukemia and control subjects

4.4.1. Sleeping time per night:

As shown in Table 11 the current study revealed that both participant groups take enough sleeping time, the result found that high percentages for the case group were (42.9% and 41.4%) for sleeping time (8-9 h and 10-11h) respectively, with no significant association (p-value >0.05) with the control group. The present finding also supports Steur et. al.[22] the study concluded that the range of sleeping time was (506.76 to 663.64) minutes per night (8.44 – 11.06) hours, with repeated nighttime awakenings.

4.4.2. Period of the child's play (physical activity) per day

The main components of maintaining appropriate body conditions are a well nutritional approach with adequate physical exercise (all body activity), as shown in Table 11 the current study revealed the highest percentage (41.4%) of the case group had (< 1 hour/day) period of physical activity on the contrary of the control group with the highest percentage (42.9%) for the period (≥ **6** hour/day) of physical activity, with highly significant association (p-value = 0.001), there was no previous study used the same scale to assess physical activity, but some studies refer to the most children with acute leukemia has less physical activity than other healthy children, with high significant association (p-value < 0.05) this result finding of a previous Polandian study done by Słowik et al.[23] and other previous Italian studies were done by Bianco et. al.[24].that it was an expected result depending on the previous anthropometric assessment that refers to the loss of muscle mass during chemotherapy, which is responsible for decreased body movement and activity.

4.4.3. Effect of the feeling of depression, anger, or anxiety on appetite

Depression is one of the most frequent psychological disorders among cancer patients. Depression can strike at any age. Among kids and teenagers. Feeling sad, despondent, or hopeless, appetite effects, as well as a loss of interest in hobbies or activities, are all signs of depression. As shown in Table 11 the current study showed that (77.1%) of the cases group suffered from (loss of appetite) when feeling depressed and anxiety during stages of chemotherapy, with the highest significant association (p-value = 0.007), which is leading to decreased dietary intake during the period of cancer therapy, thus, it may be a cause of malnutrition in children and teenager with acute leukemia. this result agreed with the finding of a previous Indonesian study done by Hariyanto & Kurniawan [25], which revealed that (76%) of cancer patients reported feelings of loss of appetite and other symptoms including loss of weight.

5. Conclusions

In the highlighted results obtained, the study concluded the following:
1. The rate of acute leukemia is higher in males than in females, whose parents have low educational levels.
2. Increased risk of malnutrition among patients with low socioeconomic status living in slums or grandfather houses.
3. there was a significant association found between wasted muscle**,** low fat, very low physical activity, and malnutrition result of induction chemotherapy and dietary habits.
4. A significant association was founded between acute malnutrition, psychological effects on loss of appetite, and induction chemotherapy.
5. The effect of dietary habits can be summarized as the children treated with chemotherapy are consuming diets of medium quality, with little quantity.

6. Recommendations

1- Government Health education should institute by using TV, social media, and health educators in a remote area about eating healthy food and avoiding unhealthy habits.
2- Health promotion should provide Health education about healthy diet and physical activity for parents of children who are a risk population for acute leukemia and malnutrition.
3- Instituting a nutrition unit in oncologist centers for providing the Primary and periodic nutritional assessment for children who have newly diagnosed with acute leukemia or cancer general during chemotherapy stages.
4- Treat advanced cases of malnutrition with nutritional supplements according to standard requirements.
5- Provide food supplements and vitamins, food rich with proteins, healthy fat, antioxidants, fiber, and food rich in quantity and quality.
6- Instituting programs for physical activity and entertainment activities for patients to decrease the risk of muscle wasting and loss of Appetite which relates to depression.

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