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Nutritional evaluation of the children and teenagers at the diagnosis time of acute leukemia

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***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 aimed at assessing the nutritional status of children with acute leukemia at diagnosis time before chemotherapy, assess the prevalence of malnutrition in acute leukemia groups compared to healthy groups and find any association between malnutrition and demographic factors such as gender and socioeconomic level. 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 was collected over a period of 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). The result of the study revealed that the highest percentage of patients in the age group 5-10 years (47.1%), the male preponderance of (55.7%), As for residence, the highest percentage (52.9%) of patients live in urban, the highest percentage (42.9%) of patients with low socioeconomic status, and

(40.0%) of the control group with middle socioeconomic status, the highest percentage (51.4%) of patients started complementary foods in(≤12 months) with high significant association (p.value < 0.001), and highly significant association (p.value < 0.001) of family history of cancer. Nutritional assessment depends on anthropometric measures to derive the Waterlow classification of malnutrition, in which the results found that the highest percentage (54.3%, and 62.9%) of case and control groups were normal weight respectively before chemotherapy with no significant association (P. value >0.05). There was a highly significant association (p.value < 0.05) of unhealthy dietary habits as dietary risk factors for developing cancer, including black tea, potato chips, high-sweetened food, and carbonated soft drinks. This study concluded to anthropometric measurement is less accurate to assess the nutritional status of the children with acute leukemia than mid-upper arm composition, malnutrition has a high association with Residence type, socioeconomic status, dietary habits, physical activity, psychological effects, and duration and type of therapy

***Keywords*---**acute leukemia, nutritional assessment, children, malnutrition, anthropometric measurement, dietary habits.

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 of 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: 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. 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 has a negative impact on 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 (6).

Materials and 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 was collected over a period of 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, and weight for height) was calculated by using, the WHO Anthro (for children 2-5 years) and Antroplus (for children >5 years) software.

diagnosis of malnutritional types according to Waterlow's classification index by using the following table: (7)

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 (EUTROPHY)**
BMI-for-Age = Over Weight height-for-age Normal	**OVER WEIGHT**
BMI-for-Age = Over Weight height-for-age <5	**STUNTED AND OVERWEIGHT**

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.

Results and Discussions

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 (1). This findings relived that the highest percentage of patients in the age group 5-10 years 33 (47.1%). Regarding gender, it sets that a distinct male preponderance of 39 (55.7%) versus female 31(44.3%). As for residence, the study indicated 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 that a distinct male preponderance of 36 (51.4%) versus male 34(48.6%). As for residence, the study revealed 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 (1) The distribution of socio-demographic characteristics of patients with Acute Leukemia and control subjects according to age groups, gender, residence, 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
		%	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 brother and Sister	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 (2). The current study, 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 education level of fathers, the results found that the highest percentage (41.4%) of patients their 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, this study indicated 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 these results found that the highest percentage (42.9%) of patients with low socio-economic status, and (40.0%) of control group with middle socio-economic status.

Table (2) 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)
House type	Own	No.	22	30
		%	31.4%	42.9%
	Rented	No.	22	15
		%	31.4%	21.4%
	Grandfather's house	No.	21	23
		%	30.0%	32.9%
	Other	No.	5	2
		%	7.1%	2.9%

Type of family	Single Parent Family	No.	3	0
		%	4.3%	0.0%
	Nuclear Family	No.	67	70
		%	95.7%	100.0%
Education level of mother	Illiterate	No.	10	0
		%	14.3%	0.0%
	Read and write	No.	6	6
		%	8.6%	8.6%
	Primary school	No.	31	18
		%	44.3%	25.7%
	intermediate school	No.	11	17
		%	15.7%	24.3%
	Secondary school	No.	5	16
		%	7.1%	22.9%
	Institute & college	No.	6	11
		%	8.6%	15.7%
	Higher degree	No.	1	2
		%	1.4%	2.9%
Occupation of mother	House wife	No.	65	61
		%	92.9%	87.1%
	Employed	No.	4	7
		%	5.7%	10.0%
	Student	No.	1	2
		%	1.4%	2.9%
Education level of Father	Illiterate	No.	4	2
		%	5.7%	2.9%
	Read and write	No.	4	0
		%	5.7%	0.0%
	Primary school	No.	29	18
		%	41.4%	25.7%
	intermediate school	No.	10	15
		%	14.3%	21.4%
	Secondary school	No.	10	10
		%	14.3%	14.3%
	Institute & college	No.	9	22
		%	12.9%	31.4%
	Higher degree	No.	4	3
		%	5.7%	4.3%
Occupation of father	Free jobs	No.	44	34
		%	62.9%	48.6%
	Employed	No.	25	35
		%	35.7%	50.0%
	Retired	No.	1	1
		%	1.4%	1.4%
Socio-Economic-Status Scale	Low	No.	30	18
		%	42.9%	25.7%
	Middle	No.	27	28
		%	38.6%	40.0%
	High	No.	13	24
		%	18.6%	34.3%

Infancy history data, Table (3) demonstrated that the highest percentage of patients with birth weight ≤4kg 25 (35.7%). Regarding to the type of feeding, this study showed the highest percentage of patients breastfeeding (67.1%). While the highest percentage of patients with the duration of feeding was ≤ 24 months (57.1%). When focusing on the beginning of complementary foods, the results found that the highest percentage (51.4%) of patients started complementary foods in ≤ 12 months. Whereas 65.7% of patients completed the immunization schedule, Regarding the family history of cancer a highest percentage (62.9%) of patients have no family history of cancer.

As for the control group, table (3) showed that the highest percentage of the control group with birth weight ≤3kg (41.4%). Regarding the type of feeding, the study showed the highest percentage of the control group breastfeeding (62.9%). While the highest percentage of the control group with the duration of feeding was ≤18 months (45.7%). Regarding the beginning of complementary foods, this results found that the highest percentage (75.7%) of the control group started complementary foods in ≤ 6 months. Whereas 82.9% of the control group completed the immunization schedule, Regarding the family history of cancer a highest percentage (88.6%) of control group have no family history of cancer.

Table (3) The distribution of patients with Acute Leukemia and control subjects according to infancy history

	Categories		cases (N=70)	controls (N=70)	X^2	P. value
birth weight	≤1.5kg	No.	1	6	8.224[a]	0.084
		%	1.4%	8.6%		
	≤ 2.5kg	No.	18	14		
		%	25.7%	20.0%		
	≤ 3kg	No.	20	29		
		%	28.6%	41.4%		
	≤4kg	No.	25	15		
		%	35.7%	21.4%		
	>4kg	No.	6	6		
		%	8.6%	8.6%		
Type of feeding	Breast feeding	No.	47	44	0.699[a]	0.705
		%	67.1%	62.9%		
	Artificial feeding	No.	6	9		
		%	8.6%	12.9%		
	Mix feeding	No.	17	17		
		%	24.3%	24.3%		
Duration of feeding	≤ 6 months	No.	2	6	7.553[a]	0.109
		%	2.9%	8.5%		
	≤12 months	No.	5	7		
		%	7.1%	10.0%		
	≤18 months	No.	23	32		

		%	32.9%	45.7%		
	≤24 months	No.	40	25		
		%	57.1%	35.7%		
the beginning of	≤ 3 months	No.	4	4	21.014	<0.001*
		%	5.7%	5.7%	[a]	
complementary foods	≤ 6 months	No.	28	53		
		%	40.0%	75.7%		
	≤ 12 months	No.	36	11		
		%	51.4%	15.7%		
	≥18 months	No.	2	2		
		%	2.9%	2.9%		
Immunization status	Fully	No.	46	58	5.510[a]	0.064
		%	65.7%	82.9%		
	Partially	No.	21	11		
		%	30.0%	15.7%		
	Never	No.	3	1		
		%	4.3%	1.4%		
family history of cancer	Yes	No.	26	8	12.586[a]	0.0003*
		%	37.1%	11.4%		
	No	No.	44	62		
		%	62.9%	88.6%		

Medical history of patients with Acute Leukemia

Table (4) shows that the high percentage (91.4%) of them have acute lymphocytic leukemia. Regarding age on diagnosis, these results found that the highest percentage (28.6%) of the patients were diagnosed when 2.1- 4 years. As for the period of chemotherapy, the study shows that the highest percentage of the studied sample with a period of take chemotherapy less or equal 24 months 18(25.7%).

Table (4) The distribution of patients with Acute Leukemia according to medical history (N=70)

N=70 patients	Rating	No.	Percent (%)
type of acute leukemia	ALL	64	91.4
	AML	6	8.6
age on Diagnosis	≤ 2 years	4	5.7
	2.1 - 4 years	20	28.6
	4.1 - 6 years	13	18.6
	6.1 - 8 years	7	10.0
	8.1 - 10 years	12	17.1
	>10 years	14	20.0
	≤ 3 months	11	15.7
Period of chemotherapy	≤ 6 months	8	11.4
	≤ 12 months	17	24.3
	≤ 24 months	18	25.7
	>24 months	16	22.9

Assessment of Nutritional status

Table (5) represents the distribution of nutritional diagnosis categories associated with children with Acute leukemia (before chemotherapy). The results found that the highest percentage (54.3%, and 62.9%) of case and control groups were normal weight respectively. There was no significant association between nutritional status and acute leukemia before chemotherapy (P. value >0.05).

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

Nutritional diagnosis before chemotherapy				B	P. value	OR
		Cases (N=70)	control(N=70)			
Acute malnutrition	No	13	6	Reference		
	%	18.6%	8.6%			
Chronic malnutrition	No	5	4	-0.550-	0.509	.577
	%	7.1%	5.7%			
Exacerbated-chronic malnutrition	No	2	0	20.430	0.999	745603773.600
	%	2.9%	0.0%			
Normal	No	38	44	-0.920-	0.089	.399
	%	54.3%	62.9%			
Overweight	No	5	8	-1.243-	0.099	.288
	%	7.1%	11.4%			
Stunted and overweight	No	1	1	-.773-	0.606	.462
	%	1.4%	1.4%			
Obesity	No	6	6	-.773-	0.309	.462
	%	8.6%	8.6%			
Stunted and Obesity	No	0	1	-21.976-	1.000	.000
	%	0.0%	1.4%			

Eating habits

Table (6) represents the assessment of good dietary habits for cases (Pre-illness) and controls. The results found that patients with acute leukemia have a moderate assessment for items of healthy eating habits which the mean the score falls between (3-4) except eat eggs and eats rice, bread, pasta which the mean the score (of 4.70, and 4.43) rests within a good assessment respectively. As for the control group, the results found that healthy participants have a moderate assessment for items of healthy eating habits in which the mean the score falls between (3-4) except eat vegetables, eats rice, bread, pasta, and eat fruits which the mean of the score (4.20, 4.67, and 4.33) rests within a good assessment respectively.

Table (6) Assessment of healthy dietary habits for cases (before diagnosis) and controls.

healthy dietary habits	Cases		Controls	
	Mean score	Assessment	Mean score	Assessment
feeding regularly	3.33	Moderate	3.36	Moderate
drink milk or its products.	3.29	Moderate	3.50	Moderate
eats eggs	4.70	Good	4.20	Good
eats meat a& legumes.	3.27	Moderate	3.60	Moderate
eats vegetables	3.0	Moderate	3.2	Moderate
eats rice, bread, pasta & etc.	4.43	Good	4.67	Good
eats food rich with healthy fat (nuts, olive oil, seed oil).	3.51	Moderate	3.81	Moderate
eat fruits.	3.51	Moderate	4.33	Good

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

Table (7) represents the assessment of unhealthy dietary habits for cases (Pre-illness) and controls. The results found that patients with acute leukemia have a poor assessment for items of unhealthy eating habits which a mean score of less than 3, except for Skipping breakfast, eating noodles with supe mixed, and eating fried fast food which the mean of the score (3.23, 3.10, and 3.39) rests within a moderate assessment respectively. While the control group have a moderate assessment of most bad eating habits which the mean score falls within 3-4, except eating food rich in sugar like sweet, cacao, chocolate have a poor assessment which the mean score (2.06) respectively.

Table (7) Assessment of unhealthy dietary habits for the cases (before diagnosis) and controls.

unhealthy dietary habits	Cases		Controls	
	Mean score	Assessment	Mean score	Assessment
Skipping breakfast	3.23	Moderate	3.33	Moderate
drink tea	2.39	Poor	3.11	Moderate
eats chips potato	1.81	Poor	3.06	Moderate
eats food rich with sugar like sweets, cacao, juice	1.91	Poor	2.06	Poor
noodles with supe mixed.	3.10	Moderate	3.63	Moderate
eats fried fast food	3.39	Moderate	3.36	Moderate
Carbonated soft drinks.	2.57	Poor	3.54	Moderate

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

Table (8) represents the difference between the mean scores for case and control groups according to the assessment of the dietary habits. 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.

Table (8): The association between the cases (before diagnosis) and control group according to dietary habits assessment.

Overall assessment	N	Mean	SD	Assessment	t. test	P. value
control	70	3.53	0.38	Moderate	5.183	<0.001*
Cases before diagnosis	70	3.15	0.41	Moderate		

Table (9) represents the study revealed the participants who not drinking tea are a likely a lower risk of acute leukemia than those who always drinking tea (B= -1.795-; P. value=0.004; OR=0.166; 95% C. I = 0.048-0.569). Regarding chips potato, the results indicate that the participants who never and rarely eating chips potato are a likely a lower risk of developing acute leukemia than those who always eating chips potato (B= -3.391-; P. value=0.002; OR=0.034; 95% C. I = 0.004-0.299). As for eating noodles with supe mixed, the study found that the participants who not eating noodles are a likely a lower risk of acute leukemia than those who always eating noodles (B= -1.448-; P. value=0.026; OR=0.235; 95% C. I = 0.066-0.841). While those who not drinking soft drink are a likely a lower risk of acute leukemia than those who always drinking soft drink (B= -2.588-; P. value=0.001; OR=0.075; 95% C. I = 0.017-0.332).

Table (9) Univariate Logistic Regression analysis to identify unhealthy food items dependently associated with children With acute leukemia (Before diagnosis)

Before diagnosis unhealthy food items		B	P. value	OR	95% C.I. for OR	
					Lower	Upper
drink tea	Always	Reference				
	Often	-.957-	0.071	0.384	0.136	1.084
	Sometime	-1.427-	0.008	0.240	0.084	0.690
	Rarely	-1.332-	0.017	0.264	0.089	0.784
	Never	-1.795-	0.004	0.166	0.048	0.569
eats chips potato	Always	Reference				
	Often	-0.759-	0.152	0.468	0.166	1.321
	Sometime	-1.690-	0.001	0.184	0.070	0.487
	Rarely	-2.418-	<0.001	0.089	0.026	0.303
	Never	-3.391-	0.002	0.034	0.004	0.299
eats food rich	Always	Reference				
with sugar like	Often	-0.940-	0.022	0.391	0.175	0.875
sweet, cacao,	Sometime	-0.251-	0.601	0.778	0.304	1.993
chocolate	Rarely	-0.742-	0.251	0.476	0.134	1.692
	Never	20.797	1.000	107698 3229.0	0.000	.
eats noodles with	Always	Reference				
soup mixed	Often	-0.445-	0.546	0.641	0.151	2.719
	Sometime	-1.081-	0.088	0.339	0.098	1.177
	Rarely	-1.089-	0.072	0.337	0.103	1.102
	Never	-1.448-	0.026	0.235	0.066	0.841
eats fried fast	Always	Reference				

food	Often	0.875	0.355	2.400	0.376	15.319
	Sometime	0.216	0.789	1.241	0.254	6.063
	Rarely	0.025	0.975	1.026	0.206	5.113
	Never	0.894	0.330	2.444	0.405	14.748
drink	Always	Reference				
Carbonated soft	Often	-0.488-	0.486	0.614	0.156	2.424
drinks	Sometime	-1.335-	0.026	0.263	0.081	0.850
	Rarely	-1.954-	0.001	0.142	0.044	0.461
	Never	-2.588-	0.001	0.075	0.017	0.332

Discussion

1- demographic characteristics of the study sampling. The current study showed that the mean age of children with acute leukemia was (7.68±3.40) years, this study is revealed corresponding with other Iraqi studies that was done by *(8)* which showed that the mean age (7.08±3.12) years, and the mean of age of control group was (5.51±2.89) years, this result was in agreement when compared with the finding of the other Iraqi study that was done by *(9)* which showed that the mean of age (6.38 ±2.75) years. while Gender of participants, this study showed that boys with acute leukemia constitute (55.7%) of the studied sample, This result correspond with the finding of the previous Iranian study done by *(10)* which showed that (52.9%) of children were boys with acute leukemia, while the control group shows that boys constitute (51.4%) of the studied control sampling, also this result is compatible with the finding of the previous study done in Iraq, *(11)* which showed that (50.3%).

Regarding the resident, the current study showed that 52.9% of the cases resident in the urban, This result corresponds with the finding of the previous study done in the Brazil *(12)*, which showed that (51.0%) of children were resident in urban, while the control group shows that (84.3%) of the studied control sampling resident in urban, This result agreed with the finding of the previous study done in Brazil *(12)*, which showed that (74.1%) of children was resident in urban.

Regarding the type of family, 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 done by *(13)*, 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.

The Education level of the mother in current study, showed that high percentages of educational levels of the mothers were (44.3% and 25.7%) of the case and control groups respectively had primary school level, and the total low educational levels (include 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 *(14)* 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 *(13)* which showed that the mothers of children with acute leukemia and the controls group respectively have (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.

Regarding occupation of the mothers, this study showed to 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 *(15)*, which showed that the mothers of children with acute leukemia and the controls group respectively have (92.8% 88.5%) have a non-employed mother (housewives).which may be positively revers on children to getting enough home care from mother.

Education level of Father, The results of this study showed that high percentages were (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 *(14)* which showed that the fathers of children with acute leukemia have low educational levels was (53%)
Occupation of father, the current study revealed that the high percentages were (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 *(16)* which showed that the fathers of children with acute leukemia work as freelance were (60.7%).

Socio-economic status, Concerning socio-economic status, 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 *(17)*, which revealed that the (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. *(18)*

2. Infancy history
birth weight, According to the infancy period, this study showed the high percentages were (35.7% and 41.4%) of the child's birth weight respectively for the case group was (birth weight ≤4kg) and the control group was (birth weight ≤ 3kg), with no significant association (p-value >0.05), this result agreed with the finding of the previous American study done by *(19)*, which refer to (34.2%) of patients group were (birth weight 3.5 - 4kg), and (35.8%) of the control group were (birth weight < 3.5 kg).

Regarding to the type of feeding during the infancy period, the current study revealed that high percentages were (67.1% and 62.9%) of the case and control groups respectively were breastfeeding, with no significant association (p-value >0.05), this result agreed with the finding of the Costa Rican study done by *(17)*, which refer to (66.1%) of cases group and (59.1%) of the control group were

feeding on breastfeeding. also finding the previous Iranian study agreed with this result but with high percentages, done by *(20),* which refer to (94.2%) of the cases group and (97.9%) of the control group were feeding on breastfeeding, with no significant association (p-value >0.05).

while the duration of breastfeeding. This study refers to the high percentages of the duration of breastfeeding where (57.1%) of the patient group was feeding for (≤24 mon.), and (45.7%) of the control group was feeding for (≤18 mon.), The finding is consistent with findings of a past Iranian study by (20), which found of (45.9 %) of the case group was feeding for the period (20-24 mon.), but disagreed with the control group results, which found of (51.2%) was feeding for the period (20-24 mon.), Among the plausible explanations for these findings is that it may be the difference in civilization cultures regarding breastfeeding for the infant or the difference in commitment to health messages.

the beginning of complementary foods, the current study showed the high percentages were (51.4% and 75.7% %) of the time introduced the complementary food during the infancy period respectively for the case group was (≤ 12 mon.) and the control group was (≤ 6 mon.), with high significant association (p-value < 0.05), this result disagreed with the finding of the previous Egyptian study done by *(21),* which found of (82.5%) of the patient's group was beginning of complementary (≤ 6 mon.), The present finding is also supported by the previous point of long duration of exclusive breastfeeding, consistent with findings by (20), that if children are exclusively breastfed for more than 6 months, the risk of leukemia morbidity rises. Breast milk is the finest source of sustenance for children, according to the WHO, hence a kid should be exclusively breastfed for the first six months of life. However, beyond 6 months of age, the kid will require additional sources of nutrients to meet his or her nutritional demands, particularly iron, because exclusive breastfeeding for longer than 6 months causes anemia and malnutrition *(22)*, which has been linked to an increased risk of leukemia in children.

Immunization status, The current study showed that high percentages were (65.7% and 82.9%) of the immunization status during the infancy period respectively for case and control groups were have fully vaccinated, with no significant association (p-value >0.05), this result agreed with the finding of the previous study done in India by (23), which showed that the children with acute leukemia have full vaccinated status was (69.1%).

The present findings of family history of cancer also suggest that the high percentage of the role of cancer in family history was (62.9% and 88.6%) for cases and control groups respectively were no family history of cancer. with high significant association (p-value < 0.05), this result correspond with the direction of the finding but incompatible with the highest of percentages, the previous Syrian study by (14) which revealed that (89.4%) of the patients do not have a family history of cancer. And another previous Chinese study by *(13)*, found that (90.5%) of the cases and (97.7%) of the controls have no family history of cancer, with a highly significant association (p-value <0.0001), the plausible explanations is that Iraqi people exposed to multiple types of radiation of weapons that used in

past wars during the lasted 40 years along two-three generation result of that increased the genome mutation and rolling of cancers in exposed families.

3. Assessment of nutritional status

The nutritional diagnosis before chemotherapy for the cases group, the study showed the results found that the highest percentage (54.3%) of the cases group were normal weight, with no significant association (P. value >0.05) between malnutrition and acute leukemia at the time of diagnosis before chemotherapy comparing with controls group (62.9%), this result agreed with the finding with previous Iraqi study done by *(24)* which revealed that the most patients had a well-nourished status at the time of diagnosis (53.3%).

4. dietary habits

Assessment of healthy dietary habits for cases (before diagnosis) and controls. The discussion of the results begins with healthy dietary habits for cases (before occurs of leukemia) and control groups to assess the quantity and quality of macronutrients and micronutrients, with the level of nutritional needs fulfillment, this study revealed the result that the dietary intake of children who had the leukemic disease before it occurs has a moderate assessment for items of good eating habits which the mean the score falls between (3-4) except eat eggs and eats rice, bread, pasta which the mean the score (of 4.70, and 4.43) rests within a good assessment respectively, As for the control group, the results found that healthy participants have a moderate assessment for items of good eating habits in which the mean the score falls between (3-4) except eat vegetables, eats rice, bread, pasta, and eat fruits which the mean of the score (4.20, 4.67, and 4.33) rests within a good assessment respectively. this result agreed with the WHO recommendation of a healthy diet for children and teenagers (25). But this result disagreed with the eating of (fruit and vegetable) for cases group was less than recommended by WHO. that means don't get enough fibers, minerals, vitamins, and antioxidants that are present in phytonutrient compounds.

While Assessment of unhealthy dietary habits for the cases (before diagnosis) and controls, According to unhealthy dietary intake before diagnosis, the result found that the patients with acute leukemia have a poor assessment for items of unhealthy eating habits which a mean score of less than 3 that including (tea, potato chips, sweetened food with high sugar, and drink carbonated soft drink), except for (eating noodles with soup mix, and fried fast food) which the mean of the score (3.23, 3.10, and 3.39) rests within a moderate assessment respectively, this result disagree with WHO recommendation (26), which include (limited intake of sugar, saturated and trans- fat, and salt). The main finding can be summarized as. the children before a diagnosis of acute leukemia are consuming diets of reasonable quantity, but poor quality.

regarding unhealth dietary habits before diagnosis of acute leukemia, this study indicates that the high significant associations (p-value <0.05) with risk of acute leukemia incidences which showed that with drinking tea, eating potato chips, and drinking carbonated soft drink. The discussion of the results begin with the child drinking tea represents the study revealed the participants who not drinking tea are a likely a lower risk of acute leukemia than those who always drinking tea (B= -1.795-; P. value=0.004; OR=0.166; 95% C. I = 0.048-0.569), The finding is

consistent with findings of past Nigerian studies by *(27)*, which concluded with increased levels of cancer risk in children who was drink herbal and black teas.which may be result of occurs chronic iron malabsorption from food that lead to chronic iron deficiency anemia and anemia in general that are linked with an increased risk of various cancers, especially blood cancers (leukemia).*(28)*

Regarding consumption of potato chips and increase the risk of developing leukemia, this study revealed that the children who never and rarely eating chips potato are a likely a lower risk of developing acute leukemia than those who always eating chips potato (B= -3.391-; P. value=0.002; OR= 0.034; 95% C. I = 0.004-0.299), this result was consistent with the finding of *(29)*, which founded that the increase consumptions of potato chips every day leading to increased risk of developing cancer in children. because it is contain the highest level of acrylamide which is a carcinogenic substance that is formed during processes of such as frying, baking and roasting of potato over 160^{o} C. *(30)*

Regarding drinking of sweetened carbonated drink and risk of developing of cancer, this study showed that who is not drinking soft drink are a likely a lower risk of acute leukemia than those who always drinking soft drink (B= -2.588-; P. value=0.001; OR=0.075; 95% C. I = 0.017-0.332), this result was disagreement with the meta- analysis studies which done by *(31),* which was concluded that The overall findings are considerably in favour of a lack of association with the risk of developing cancer.

4 Conclusion

In the highlighted of the results obtained, The rate of acute leukemia is higher in male than female, whom parents have primary school levels and malnutrition increase risk among patient with low socioeconomic status live in slum or grandfather house. Also, this risk Increased of acute leukemia with child had family history of cancer and delayed to get complementary food with breast feeding more than 6 months. Significant association was founded between always drinking black tea, eating potato chips, high processed sweetened food and developing acute leukemia. the children before a diagnosis of acute leukemia are consuming diets of reasonable quantity, but poor quality.

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