Original Article

Evaluation of Some Nutrient Sodium, Potassium and Magnesium levels with Leukemia Patients in Thi-Qar Province, Iraq

Zainab S. Hamoud and Jamal Harbi Hussein Alsaadi

ABSTRACT

Objective: The study aimed to determine serum sodium (Na), potassium (K), and magnesium (Mg) levels in patients with ALL, AML and CML in Thi-Qar Governorate, and to evaluate their variations according to sex, and age. It also aimed to assess the distribution of the studied disease groups by age, sex, and residence and to determine serum Na, K, and Mg concentrations using commercial kits and an atomic absorption analyzer

Study Design: Cross-sectional study

Place and Duration of Study: This study was conducted at the Hematology Consultation Unit, Al-Nasiriya Teaching Hospital, Thi-Qar Governorate, Iraq and the "biochemistry Laboratory" at the "College of Science", University of Thi-Qar, Iraq from November 2025 to April 2026.

Methodology: The study included 99 subjects: 20 with acute lymphoblastic leukaemia, 22 with acute myeloid leukaemia, 31 with chronic myeloid leukaemia, and 26 healthy controls, aged 20–85 years. Serum sodium, potassium, and magnesium levels were measured using commercial kits and an atomic absorption analyser. The results were analysed according to age, sex, residence, and disease group.

Results: The distribution of age and sex varied significantly between the groups ($p < 0.01$). Serum sodium was significantly higher in males than females in acute lymphoblastic leukaemia and acute myeloid leukaemia. Magnesium showed a significant sex-related difference in acute lymphoblastic leukaemia, whereas potassium showed no significant difference. Serum sodium increased significantly with age in acute myeloid leukaemia patients.

Conclusion: Age and sex may influence serum micro nutrients levels in haematological malignancies, particularly sodium and magnesium, while potassium showed no significant sex-related variation. residence showed no significant difference among the group ($p>0.05$).

Key Words: Leukemia, Sodium, Potassium, Magnesium, Age, Sex, Residence.

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INTRODUCTION

The term "leukemia" refers to a group of hematological cancers that are distinguished by the uncontrolled proliferation of abnormal blood cells.[1] Different types of this cancer exist, including chronic myeloid leukemia (CML), chronic lymphocytic leukemia (CLL), acute myeloid leukemia (AML) and acute lymphoblastic leukemia (ALL). ALL is distinguished by the proliferation of immature lymphoid cells, whereas, AML is associated with the accumulation of myeloid blasts and impaired cellular differentiation.[1,2] CML originates from hematopoietic stem cells and is characterized by abnormal proliferation of myeloid-lineage cells, while CLL involves the accumulation of monoclonal mature B lymphocytes.[3,4] "Malignant WBCs of ALL are characterized via disorderly abnormal leukocyte proliferation. Thus, leading to overproduction of lymphoblast infiltration into the blood stream and bone marrow elements resulting in a distinct disease state."[5]

Micro nutrients are crucial for preserving regular physiological processes, such as fluid balance, cellular metabolism, and enzymatic activity. Alterations in micro nutrients concentrations have been reported in patients with hematological malignancies.[6] Sodium and potassium are important for normal cellular and physiological functions, and their balance may

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influence hematopoietic stem-cell proliferation and differentiation.[7] Magnesium is an essential divalent cation involved in several enzymatic processes related to energy metabolism, protein and nucleic acid synthesis, as well as cardiovascular and neuromuscular functions.[8]

"The capacity of certain minerals like magnesium to influence the immune system has drawn more attention in the recent years".[9]

METHODOLOGY

The "Al-Nasiriya Teaching Hospital in Thi-Qar Governorate" and the "biochemistry Laboratory" at the "College of Science" served as the study's locations between November (2025) to April (2026). 99 study case were included in this study, 73 patients which divided into four groups (acute leukemia were included in this study, (20 ALL, 22 AML and 31 CML) with control group of the normal healthy individuals 26 with ages ranging from 20 to 85 years.

Exclusion Criteria: Patients with cancers other than leukemia or with CLL, inflammatory or chronic diseases, active autoimmune disorders, acute or chronic infections, and those taking antioxidant, trace-element, or multivitamin supplements within the previous 4 weeks.

Blood Samples: Each participant gave around four milliliters of venous blood, which was then deposited in gel tubes and left at room temperature for 15-20 minutes before being centrifuged at 3000 rpm for 10 minutes were excluded. Pregnant or lactating women and smokers were also excluded. Serum Na, K and Mg concentrations were measured using Kits and atomic absorption analyzer

Statistical analysis was performed using SPSS-26 and Windows version 26.0.

RESULTS

1. Clinical and Characteristic Features of the:

1.1: Sex Distribution: The sex distribution differed no significantly among the examined groups ($p > 0.05$). Males predominated in CML, whereas females predominated in AML and ALL. The control group showed an equal sex distribution, as shown in Table (1).

1.2: Age Distribution: Age distribution showed no significant difference among the studied groups ($P > 0.05$). The 36–60 years age group was predominant in CML, AML, and the control group, while the 20–35 years group was predominant in ALL. Among patients, a significant difference in age distribution was observed ($P < 0.05$). A significant difference in mean age was observed between ALL patients, with the lowest mean age in ALL patients (Table 2).

Table No. 1: Distribution of subjects according to sex.

Groups	Male		Female		Total	
	No.	%	No.	%	No.	%
CML	18	58.06	13	41.94	31	25.41
AML	6	27.27	16	72.73	22	18.03
ALL	9	45.00	11	55.00	20	16.39
Control	13	50.00	13	50.00	26	21.32
Total	55	45.08	67	54.92	122	100
Between groups $CalX^2$= 5.082 $TabX^2$= 7.815 DF= 3 p. value >0.01**						
Between patients $CalX^2$= 4.926 $TabX^2$= 5.991 DF= 2 p. value >0.01**						

Table No. 2: Distribution of subjects according to age.

Groups	20 - 35 years		36 – 60 years		≥ 61 years	
	No.	%	No.	%	No.	%
CML	7	22.58	18	58.06	6	19.35
AML	4	18.18	11	50.00	7	31.82
ALL	10	50.00	10	50.00	0	0.00
Control	5	19.23	12	46.15	9	34.62
Total	28	22.95	63	51.64	31	25.41
Between groups $CalX^2$= 3.298 $TabX^2$= 15.51 DF= 6 p. value >0.01**						
Between patients $CalX^2$= 10.649 $TabX^2$= 12.59 DF= 4 p. value <0.01**						

Groups	Mean ± S. D + Range	
CML	48.2 ± 13.4 (21 - 67)[a]	p. value <0.01** LSD 8.55
AML	53.6 ± 17.0 (23 - 85)[a]	
ALL	36.8 ± 13.1 (20 - 58)[b]	
Control	51.4 ± 16.1 (20 - 75)[a]	

P-value ≤ 0.05 considered significant*

At the 0.05 level, the mean difference is significant*

(a, b): Different letters in the same column indicate a significant difference ($P < 0.05$), whereas identical letters indicate a non-significant difference ($P > 0.05$)

LSD: Least Significant Difference

2. Evaluation of Serum Nutritional Elements Levels in Relation to Sex: As shown in Table (3), serum Na levels showed a significant difference in AML and ALL patients ($p < 0.05$), with higher levels in males than females, while the other groups showed non-significant differences. Serum K levels showed no noticeable variations between the groups studied ($p > 0.05$). Serum Mg levels showed no significant differences in CML and AML ($p > 0.05$), whereas ALL showed a significant difference, with higher levels in females than males.

3. Evaluation of Serum Na Level in Relation to Age: The results showed a significant age-related increase in serum Na levels in AML patients, while a non-significant increase was observed in ALL. In contrast, CML patients showed a non-significant decrease with increasing age, as shown in Table (4).

4. A Spearman correlation between involved parameters in Patients groups: Significant correlations ($P < 0.05$) were observed between age and selected mineral elements, as well as among several minerals in leukemia groups, with both positive and negative associations. These findings suggest variations in mineral relationships with age and across leukemia types as shown in Table (5).

5. Distribution of subjects according to Residence: As shown in Table (6), Residence distribution showed no significant difference among the studied groups ($P > 0.05$). Rural residents were more frequent in CML and the control group, whereas urban residents were more frequent in AML and ALL.

Table No. 3: Serum Na, K and Mg levels of studied groups to sex.

Groups	Sex	Na Median + Range	K Median + Range	Mg Median + Range	p-value Mann–Whitney U
CML	M	0.17 (0.10–1.74)	0.020 (0.00–0.13)	0.002 (0.00–0.01)	Na: 0.211
	F	0.19 (0.16–0.30)	0.013 (0.00–0.11)	0.001 (0.00–0.01)	K: 0.514
					Mg: 0.465
AML	M	0.80 (0.01–0.12)	0.036 (0.00–0.08)	0.022 (0.00–0.03)	Na: 0.014*
	F	0.02 (0.01–0.23)	0.022 (0.00–0.07)	0.003 (0.00–0.01)	K: 0.407
					Mg: 0.115
ALL	M	0.52 (0.02–0.08)	0.007 (0.00–0.03)	0.003 (0.00–0.01)	Na: 0.021*
	F	0.05 (0.02–0.08)	0.007 (0.00–0.09)	0.006 (0.00–0.01)	K: 0.824
					Mg: 0.025*

Table No. 4: Serum Na levels of studied groups to age groups.

Groups	Age Groups	Na Median + Range	p. value Kruskal-Waillis H Mann-Whitney U
CML	**20-35 years**	0.204 (0.18 – 0.51)	0.266
	36-60 years	0.187 (0.10 – 1.74)	
	≥ 61 years	0.185 (0.19 – 0.21)	
AML	**20-35 years**	0.018 (0.01 – 0.12)^{b}	0.024*
	36-60 years	0.038 (0.01 – 0.16)^{ab}	
	≥ 61 years	0.059 (0.01 – 0.23)^{a}	
ALL	**20-35 years**	0.046 (0.02 – 0.09)	0.218
	36-60 years	0.075 (0.03 – 0.09)	

Table No. 5: A Spearman correlation between involved parameters in Patients groups.

Group	Parameter / Correlation	r.value	P.Value
CML	Ag vs Na	-0.422	0.018
	Ag vs Mg	0.376	0.037
AML	K vs Mg	0.626	0.002
	Ag vs Mg	-0.484	0.022
ALL	Ag vs K	0.512	0.021

r :Spearman correlation coefficients

Table No. 6: Distribution of subjects according to Residence

Groups	Rural		Urban		Total	
	No.	%	No.	%	No.	%
CML	15	48.39	16	51.61	31	25.41
AML	8	36.36	14	63.64	22	18.03
MM	14	60.87	9	39.13	23	18.85
ALL	7	35.00	13	65.00	20	16.39
Control	17	65.38	9	34.62	26	21.32
Total	61	50.00	61	50.00	122	100
Between groups $CalX^2$= 30.6 $TabX^2$= 9.41 DF= 4 p. value <0.01**						
Between patients $CalX^2$= 18.0 $TabX^2$= 7.81 DF= 3 p. value <0.01**						

DISCUSSION

Sex Distribution: Sex-related biological differences, including chromosomal and epigenetic mechanisms, may influence gene expression and illness risk.[10] In line with the current investigation, females had greater rates of AML.[11]According to Munroe et al. (2025)[12] females also had greater rates of ALL. This discrepancy could be due to biological variables linked to sex, sample size and demographics.[13]

Age Distribution: According to Mohammad and Nadim (2024)[14] the second age group had the greatest number of patients, with the highest rates of CML, AML, and ALL, whereas the third group had the lowest rates of CML and ALL. According to Hu et al. (2024)[15], There was a substantial age difference, with the lowest mean age in ALL (36.8 ± 13.1 years). According to Aljabban and Alalsaidissa (2024)[16], there was a notable age-related variance in AML classifications. Leukemia age distribution may be influenced by genetic, environmental, radiation, chemical, and therapy-related factors; nonetheless, treatment costs and follow-up issues continue to be problems in underdeveloped nations.[17]

Evaluation of Serum Micro nutritional Elements Levels in Relation to Sex: The findings revealed that serum sodium levels among ALL and AML patients differed significantly by gender, with males having greater levels. possibly as a result of sex-related variations in hormone regulation, renal sodium processing, and body water balance.[18] Furthermore, "hormone act as work on Fluid retention, the kidney start to keep high amount of Na and high amount of water"[19] While females showed a small non-significant rise, no significant differences were found in the other groups. Due to sex-related variations in hormone control, magnesium absorption, renal processing, and estrogen-mediated metabolism, female patients with ALL exhibited considerably higher serum magnesium levels than male patients.[20] The greater serum magnesium levels seen in females may be explained by sex-related variations in magnesium metabolism.

Evaluation of Serum Na Level in Relation to Age: Age-related changes in renal function, thirst, and ADH control may explain the significant increase in serum Na levels with age in AML patients.[21] This increase may be related to comorbidities and decreased functional reserve in older AML patients.[22]

A Spearman correlation between involved parameters in Patients groups: The positive correlation between K and Mg may reflect their interdependent roles in electrolyte homeostasis, as magnesium contributes to cellular potassium regulation and its deficiency can enhance potassium loss. The observed mineral correlations may also reflect leukemia-associated disturbances in mineral metabolism and cellular homeostasis, which can vary among leukemia types.[23]

Distribution of subjects according to Residence. The variation in residence distribution may be related to differences in environmental exposure, population distribution, and access to healthcare services. Similar finding have been reported by Papandreou (2025).[24]

Abbreviations:

Asymbol	Interpretation
ALL	Acute Lymphoblastic Leukemia
AML	Acute Myeloid Leukemia
$CalX^2$	Calculated Chi-Square Value
CLL	Chronic Lymphocytic Leukemia
CML	Chronic Myeloid Leukemia
Control	Normal healthy group
DF	Degrees of Freedom
F	Female
K	Potassium
LSD	Least significant difference
M	Male
Mg	Magnesium
Na	Sodium
No	Number of subjects
SPPS	Statistical Package for the Social Sciences
$TabX^2$	Tabulated(Critical) Chi-Square
WBCs	White Blood Cells

CONCLUSION

This study concluded that significant sex-related differences were observed in ALL, AML and CML. The mean age also differed significantly, with the lowest mean age in ALL Serum Na showed significant differences by sex in AML and ALL and increased significantly with age in AML. Serum K showed no significant differences, while serum Mg showed a significant sex-related difference in ALL.

Author's Contribution:

Concept & Design or acquisition of analysis or interpretation of data:	Zainab S. Hamoud, Jamal Harbi Hussein Alsaadi
Drafting or Revising Critically:	Zainab S. Hamoud, Jamal Harbi Hussein Alsaadi
Final Approval of version:	All the above authors
Agreement to accountable for all aspects of work:	All the above authors

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