Assessment of The Levels of Serum Zinc and Copper Among Sudanese Patients with Sickle Cell Anemia in Khartoum State

Abstract:

Background: Sickle cell anaemia (SCA) is associated with increased risks of multiple micronutrient deficiencies. Zinc deficiency has been observed in patients with Sickle cell anaemia, due to chronic haemolysis with subsequent loss of zinc from RBCs.

Objectives: The aim of this study was to assess the level of zinc and copper among Sudanese patients with sickle cell anaemia (SCA).

Methods: Across-sectional study was conducted from March to April 2018, involving forty subjects who had been diagnosed of sickle cell anaemia (SCA), and had been admitted to Albuluk Hospital, in Khartoum State, as cases. Forty healthy individual with normal haemoglobin were recruited as controls (age was matched in the groups ranged from 4 months to 16 years). Blood samples were collected and serum was separated, then the levels of zinc and copper were measured, using atomic absorption spectrophotometer. Data analysis was carried out, using SPSS version, 21 (Independent t-test was used to compare mean values in case versus control group. Pearson's Correlation was done to study the relationship between zinc and copper and age).

Results: There was significant decreased in the mean levels of zinc and copper in patients with sickle cell anemia when compared to control groups. The (Mean ±SD; 0.137±0.079 versus0.705±0.138ng/L, p, value= 0.00) for zinc (0.512±0.290 versus 0.923±0.214ng/l, p, value =0.00) for copper. There was no significant difference between males and females in the mean levels of zinc (p = 0.345) and copper (p = 0.656). The (Mean ±SD; 0.144±0.079 versus0.127±0.080 ng/L) for zinc (0.502±0.271ng/L versus 0.525±0.321 ng/L) for copper, there was no correlation between levels of zinc , copper and ages,(r=0.052, p, value=0.750) for zinc , (r=0.122, p, value=0.452) for copper.

Conclusion: The levels of zinc and copper were decreased in patients with sickle cell anaemia, compared to healthy individuals. There was also negative correlation between the levels of zinc and copper and age of patients.

KEYWORDS: Sickle cell anemia, zinc, copper, micronutrient and Sudanese.

Introduction:

Sickle cells anaemia is a haemoglobinopathy, characterized by chronic haemolysis, chronic inflammation, immune deficiency, a heterogeneous clinical picture and organ damage.[1] SCA is associated with increased risks of multiple micro nutrient deficiencies These deficiencies may have a significant impact on SCA severity indices including growth retardation; cell-mediated immune dysfunction, and cognitive impairment with a negative impact on morbidity and mortality.[2] In addition, these nutrients have a major role in the protection of the red cell membrane against damage through free radical-mediated oxidation in SCA.[3] Sickle cell disease is common especially in Africa and among Negroid race. In sickle cell disease, there are deficiencies of some essential elements which are vital in maintenance of red cell integrity, body growth and development. [4] The sickle haemoglobin is known to interact with diverse genes and environmental factors, producing a multi-systemic disease with several phenotypes. [5]

Minerals are inorganic substances, present in all body tissues and fluids and they are necessary for the maintenance of certain physicochemical processes which are essential to life.[6,7] They are important for human,[8,9] so deficiencies or disturbances in the nutrition can cause a variety of diseases, which can arise in several ways.[10] Two most common trace metal imbalances are elevated copper and depressed zinc in SCA. Therefore, the aim of this study was to assess the level of serum zinc and copper among Sudanese patients with sickle cell anaemia.

Materials and methods:

- Study design: This was a cross-sectional case-control study.

-Study area and period of study: Blood samples were collected from Albuluk Hospital, in Khartoum State, from March to April 2018.

- Study population: Forty sickle cell anaemic patients, aged between 4 months and 16 years, were recruited as cases and forty normal children with normal haemoglobin were enrolled as controls. The cases and control were age-matc hed; 17 of sickle cell anemic patients were females and 23 were males, and 16 of controls were females and 24 of them were males.

-Inclusion criteria: Albuluk Hospital in-patients with sickle cell anemia who were treated with hydroxyurea, were included.

-Exclusion criteria: Any patients taking long term zinc supplements and patients with other chronic diseases (liver disease, renal disease and heart diseases), were excluded.

- Ethical consideration: The study was approved by ethical committee of Medical Laboratory Science, Clinical Chemistry Department-Alneelain University. A verbal informed consent was obtained from the parents of each minor participant.

-Data collection: A demographic data was collected by using questionnaire.

- Sampling: About 2.5 ml of venous blood was collected from each participant, after formation of clot in the room temperature; the samples were centrifuged for 10 minutes in 3000 rpm then the serum was obtained and analyzed.

- Method of assay of zinc and copper: The levels of serum zinc and copper was measured by using atomic absorption spectrophotometer (BUCK SCINTIFIC 210/211 VGP VER3.94C).

- Quality Control: Pathological and normal control sera were also used for the measurement of the metals, to assure accuracy and precision of results.

-Data analysis: Data was analyzed using SPSS, version 21.The results were expressed as percentages, mean and SD. Independent t-test was used to compare mean values in case versus control group. Pearson's correlation test was done to study the relationship between study zinc and copper and age, p-value less than 0.05 considered significant.

Results:

Eighty participants were enrolled in this study; 40 patients (17 females and 23 males) with age mean± SD 6.67± 4.16 years and 40 controls (16 female and 24 males) with age mean± SD 6.37± 4.16 years, age was matched in both groups and ranged from 4 months to 16 years. Statistical analysis showed a significant decrease in the levels of zinc and copper among patients with sickle cell anemia (SCA), when compared to healthy individuals (table1), also statistical analysis showed insignificant variation in the levels of zinc and copper among patients with sickle cell anemia when compared according to gender (table2) ,and also statistical analysis showed no correlation between the level of zinc and copper with ages among patients with sickle cell anemia, (figure 1 and figure 2).

Table (1): Comparison the levels of zinc and copper in case versus control:

Parameters	Case (Mean±SD)	Control (Mean±SD)	*P-value*
Copper mg/l	0.512±0.290 (0.03-0.372)*	0.923±0.214 (0.474-1.01)*	0.000
Zinc mg/l	0.137±0.079 (0.122-1.154)*	0.705±0.138 (0.704-1.346)*	0.000

P - values less than 0.05 were considered as significant. * indicates **the range of values (lowest and highest) of copper and zinc.**

Table (2): Comparison the levels of copper and zinc in case group according to gender.

Parameters	Male (Mean±SD)	Female (Mean±SD)	*P-value*

Copper mg/l	0.502±0.271	0.525±0.321	0.656
Zinc mg/l	0.144±0.079	0.127±0.080	0.345

P - values less than 0.05 were considered as significant.

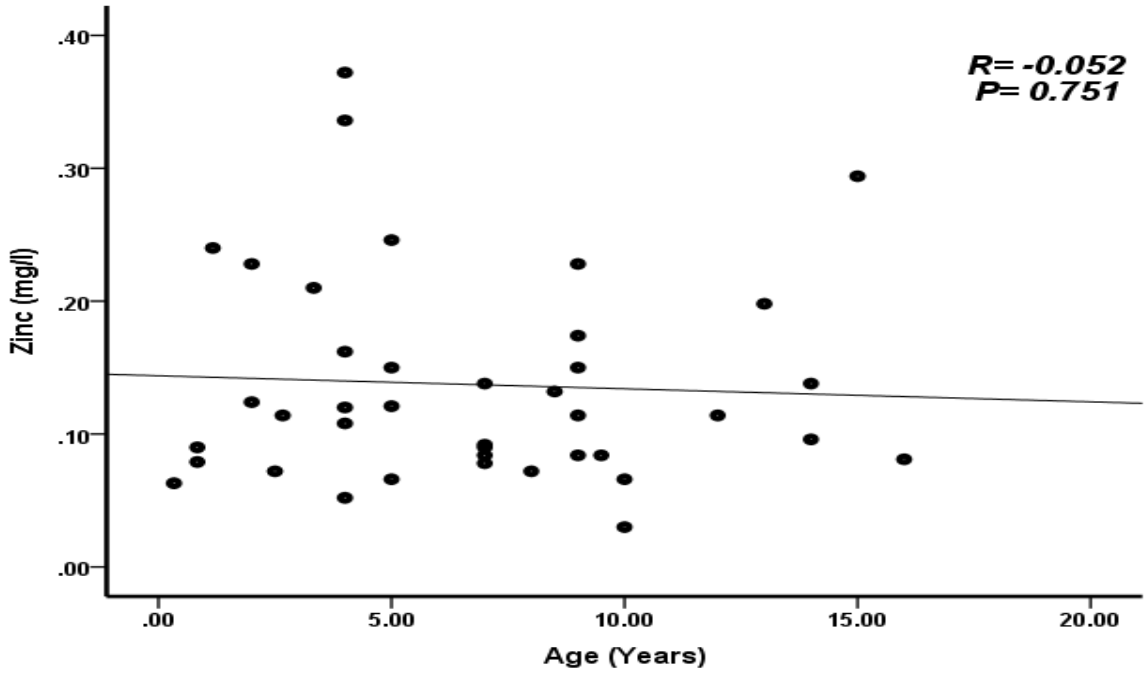

Figure (1): Correlation between zinc levels and ages.

P-value less than 0.05 consider as significant:

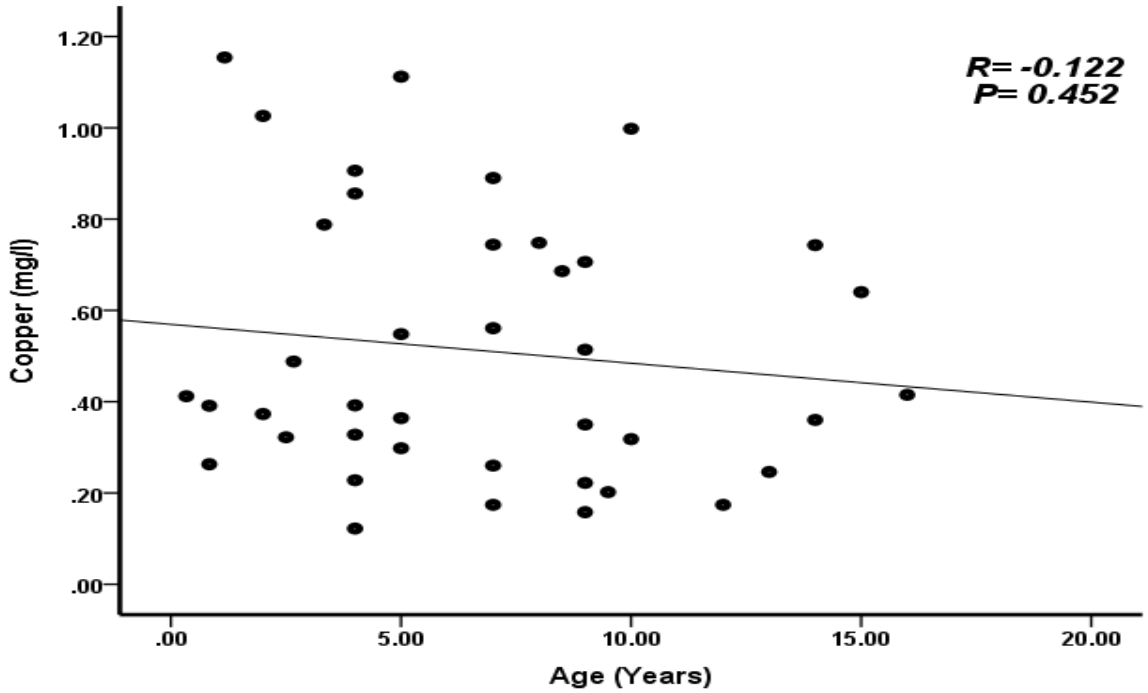

Figure (2): Correlation between copper levels and ages.

P-value less than 0.05 consider as significant:

Discussion:

In sickle cell anaemia, there are deficiencies of some essential elements which are vital in maintenance of red cell integrity, body growth and development. In the current study the levels of zinc and copper showed a significant decrease in patients with sickle cell anaemia, compared to healthy individuals (p value 0.000). This might have occurred due to chronic haemolysis with subsequent loss of zinc from RBCs. Zinc deficiency can also be the result of the adverse effect of hydroxyurea which increase zinc excretion. [11]

This finding was in agreement with results of some previous studies [12,13,14] in Central Africa and Nigeria , which related zinc deficiency in sickle cell disease to manifestations such as growth retardation, hypogonadism in males, hyperammonemia, abnormal dark adaptation and cell mediated immune disorder. Similarly, the biochemical evidence for zinc deficiency in patients with SCA include low zinc concentrations in plasma, erythrocytes, hair, lymphocytes and granulocytes.[15] This biochemical difference appears to be due to various mechanisms such as chronic haemolysis, renal lost due to repeated sickling leading to abnormal renal tubular reabsorption of zinc, abnormal binding of zinc to tissue proteins, disturbed metabolism of zinc metalloenzymes. [14] Also, the results revealed that there was non-significant

difference between males and females, in the levels of zinc and copper in patients with sickle cell anaemia. Furthermore, there was negative correlation between levels of zinc and copper and age of the patients (r= -0.603, p-value= 0.000) and (r= -0.443 p- value= 0.004) respectively.

Conclusion:

The levels of blood zinc and copper were decreased in patients with sickle cell anaemia, compared to healthy individuals. There was also negative correlation between the levels of zinc and copper and zinc.

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