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Araştırma Makalesi /Research Article

Values for Plasma Cu, Zn, Mg, and Erythrocyte Zn and Mg in Çukurova Population in Carriers of HbS and Thalassemia

Çukurova Popülasyonunda HbS ve Talasemi Taşıyıcılarında Plazma Cu, Zn, Mg ve Eritrosit Zn ve Mg Değerleri

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Öz

Amaç: Bu çalışmada, Türkiye'nin güney kesiminde yaygın olan orak hücre ve talaseminin normal ve taşıyıcıları arasında plazmadaki Cu, Zn ve Mg ile eritrositlerdeki Zn ve Mg değerleri arasında fark olup olmadığının araştırılması amaçlanmıştır.
Gereç ve Yöntemler: Bu amaçla Sağlıklı popülasyonda (n:2067), Hemoglobin S taşıyıcılarında (n:431) ve Talasemik gen taşıyıcılarında (n: 229) plazmadaki Cu, Zn ve Mg ile eritrositteki Zn, Mg seviyeleri atomik absorpsiyon spektrofotometrisi ile belirlendi ve sonuçlar istatistiksel olarak analiz edildi.
Bulgular: HbS ve talasemi taşıyıcılarında plazma Cu, Zn, Mg ile eritrosit Zn ve Mg için sonuçlar ve istatistiksel değerlendirmeleri şu şekildedir: HbS taşıyıcılarında Zn_e ve Mg_e normal değerlere göre önemli bir düşüş göstermiştir. Öte yandan talasemi taşıyıcılarında Zn_e ve Mg_e değerlerinde ($p<0.05$) normal değerlere göre anlamlı bir düşüş gözlendi.
Sonuç: HbS ve talasemi taşıyıcılarında enzim katalizinde kofaktör olarak kullanılan eser element eksikliğinden dolayı enzim metabolizma bozuklukları görülmesi muhtemeldir.
Anahtar Kelimeler: Eser Element, Cu, Zn, Mg, Orak Hücre ve Talasemi Taşıyıcıları

Abstract

Objectives: This work aimed to investigate whether there is any difference in values for Cu, Zn, and Mg in plasma and Zn and Mg in erythrocytes between the normal and the carriers of sickle cell and thalassemia, which are prevalent in the population of the southern part of Turkey.
Material and Methods: For this purpose, the values for Cu, Zn, and Mg in plasma and Zn, Mg levels in erythrocyte were determined by atomic absorption spectrophotometry in Healthy population (n:2067), in Hemoglobin S carriers (n: 431), and Thalassemic gene carriers (n: 229) and the results were statistically analyzed.
Results: The results and their statistical evaluation for the plasma Cu, Zn, Mg, and erythrocyte Zn and Mg in carriers of HbS and thalassemia as follows: In HbS carriers Zn_e and Mg_e showed a significant decrease as compared to the normal values. On the other hand a significant decrease in Zn_e and Mg_e ($p<0.05$) was observed in thalassemia carriers in comparison to the normal values.
Conclusion: Enzyme metabolism disorders are likely to be seen in HbS and thalassemia carriers due to the lack of trace elements used as cofactors in enzyme catalysis.
Key Words: Trace Elements, Cu, Zn, Mg, Sickle Cell, and Thalassemia Carriers

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INTRODUCTION

Trace elements occur in biological tissues and fluids in minute quantities from microgram to nanogram levels[1]. They play an extremely important function in metabolism, growth tissue repair and are essential for life. Among these trace elements, copper, zinc, and magnesium have been the subject of comprehensive studies and their role in the pathway of various disease processes have been elucidated[2, 3].

Copper is an essential element for many enzymatic reactions' basis on erythropoiesis. In cases of copper deficiency, refractory anemia and neutropenia may be developed[4]. Zinc also plays an important role in many cellular enzymatic reactions especially in protein synthesis and erythrocyte survival[5]. The role of magnesium in cardiovascular diseases, renal diseases, and others is being studied to a great extent[6].

It was also found that that the level of Cu, Zn, and Mg is important for sickle cell diseases, thalassemia, and hemoglobinopathies[7].

Though there is work on the level of trace elements in sickle cell trait and thalassemia trait in comparison to the normal population, no comprehensive work has been observed that compared the results of trait cases with levels of normal extracted from the same population.

This work aimed to investigate whether there is any difference in values for Cu, Zn, and Mg in plasma and Zn and Mg in erythrocytes (Zn_e and Mg_e) between the normal and carriers of sickle cell and thalassemia which are prevalent in the population of the southern part of Turkey.

MATERIALS AND METHODS

The chemicals used were all of reagent quality and obtained from BDH (England), Merck (Germany), or Sigma (USA). All reagents were prepared by using glass-distilled water.

Venous blood was collected randomly from the population of the southern part of Turkey, which encompasses the provinces of Hatay, Adana, Gaziantep, Kahramanmaraş, and İçel
(Figure 1). In this region, the high prevalence of thalassemia and hemoglobin S (HbS) is well documented. Random sampling was done in the Health Centers, which are distributed in each province with the help of the district health personnel. Carrier status of HbS (n:431), thalassemia (n:229), and healthy normal cases (n:2067) of the same population were established after analysis of hematological parameters and hemoglobin types according to Kattamis. Blood samples taken into EDTA were stored at +4°C until tested. For the preparation of hemolysates, whole blood was centrifuged at 1000 rpm for 5 minutes and the red cells were the addition of cold distilled water.

Hemoglobin was determined in the lysates by the cyanomethoglobin method. Erythrocyte Mg and Zn and plasma Cu, Zn and Mg were determined by Absorption techniques using the Perkin-Elmer Model 2380 Atomic Absorption Spectrophotometer.

Standard curves, using commercial standards for Cu, Zn, and Mg were determined for each set of samples. Triplicate measurements were made for each element in each sample and the results were averaged.

The results are given as the mean ± standard deviations. Statistical differences were determined by one-way variance analysis of Scheffe test and p was considered significant at <0.05.

RESULTS

Figure 1 shows the map of the southern part of Turkey and the regions investigated.

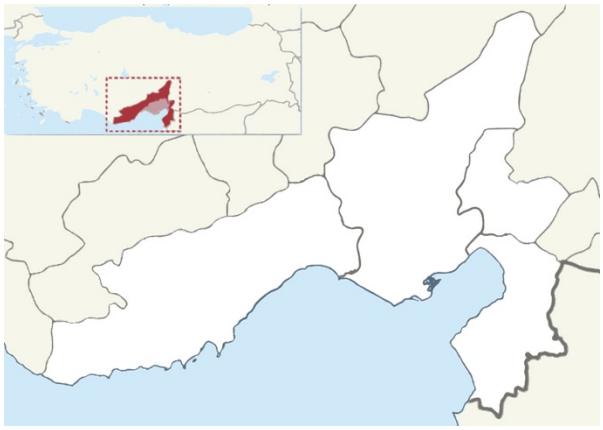

Figure 1. The map of the southern part of Turkey.

Table I shows the results of the trace elements analyzed in the normal population (n:2067) and thalassemia (n:229) carriers.

According to these values, it was shown that in HbS carriers Zn_e and Mg_e showed a significant decrease as compared to the normal values[8]. On the other hand a significant decrease in plasma Zn and Mg and a significant decrease in Zn_e and Mg_e ($p<0.05$) was observed in thalassemia carriers in comparison to the normal values.

Table I: The statistical values of plasma Cu, Zn, Mg and erythrocyte Zn and Mg in the Healthy (MCV>79, Hb Electrophoresis AA,), in the Hemoglobin S carrier and the Thalassemic gene carrier population.

	Healthy population $\bar{X}$ ±SD (Min-Max)	Hemoglobin S carriers $\bar{X}$ ±SD (Min-Max)	Thalassemic gene carriers $\bar{X}$ ±SD (Min-Max)
Cu (mg/L)	1.01±0.14 (0.60-1.60) n:2067	1.00±0.14 0.60-1.40 n:431	1.03±0.16 0.70-1.40 n:229
Zn (mg/L)	0.91±0.17 (0.45-1.70) n:2067	0.92±0.17 (0.50-1.45) n:431	0.97±0.16** (0.50-1.30) n:229
Mg (mg/L)	20.90±2.50 (14.00-30.00) n:2067	20.90±2.30 15.00-28.00 n:431	21.50±2.46** 0.50-1.30 n:229
Zn_e (mg/gHb)	0.030±0.015 (0.010-0.098) n:1861	0.029±0.010* (0.008-0.077) n:342	0.029±0.012* (0.010-0.099) n:189
Mg_e (mg/gHb)	0.179±0.065 (0.070-0.800) n:1861	0.170±0.045 (0.100-0.360) n:342	0.170±0.054* (0.110-0.680) n:189

DISCUSSION

In the present study blood samples from 431 HbS carriers and 229 thalassemia carriers were studied for plasma Cu, Zn, and Mg and also for erythrocyte Mg and Zn levels. All the results were compared with the values obtained from healthy persons (n:2067) of the same population (Table I). The results in plasma obtained from the healthy population were found to agree with the levels given in the literature[9]. However, the results for the mean for erythrocyte Zn and Mg differed. This may depend on environmental and nutritional conditions in the southern part of Turkey.

Up to this time, most studies were published for the trace elements in HbS and thalassemia cases but comprehensive work in the levels of trace elements in HbS and thalassemia trait was not carried out in such a big population.

Zinc deficiency was also reported in other related hemoglobin disorders such as β thalassemia[10]. While most studies documented zinc deficiency with hemoglobinopathies, other investigators have found normal zinc levels. This variation in zinc levels has been explained by geographic loci, diet, and/or socioeconomic differences, which might modulate disease severity and impact nutritional status.

In our studies, we found erythrocyte zinc level significantly lower than normal cases while no difference was found for plasma Zn levels. This result is completely in agreement with the other studies. As is well known, Zn depletion correlates with sickle cell crises, and the decrease of Zn_e is well documented. However, a decrease of Zn_e might indicate inadequate erythropoiesis in sickle cell trait patients.

Increased serum Cu concentration has been reported in various hematological disorders such as thalassemia and sickle cell anemia[7]. The importance of the increased Cu concentration in sickle erythrocyte is unknown. On the other hand, Cu and Zn compete with each other for similar binding sites on proteins and in zinc-deficient tissues, an increase in copper has been observed. Thus it is likely that the increased plasma Cu observed was secondary to zinc deficiency.

For magnesium, some researchers demonstrated a significant negative correlation between erythrocyte Mg and plasma Mg in sickle cell anemia[11]. However contradictory results have been reported for Mg both for plasma and erythrocyte.

In thalassemia, erythrocyte cation permeability is increased, but the increment in ATPase-dependent cation pumps maintains a normal concentration of Ca^{++}, Na^{+}, and K^{+}. The results suggest that the increment in ATPase-dependent cation pumps is not sufficient to maintain normal Mg_e in the thalassemia trait. Our results also showed a decrease in Mg_e in thalassemia and sickle cell trait.

As has been documented by several authors, our large survey is in agreement with the decrease in Zn_e and Mg_e and increased plasma Zn and Mg levels in sickle cell and thalassemia trait.

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