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Trace Elements in Elderly Individuals and Their Clinical Significance in General Practice

YAŞLILARDA ESER ELEMENTLER VE AİLE HEKİMLİĞİ AÇISINDAN KLİNİK ÖNEMİ

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Summary

Objective: To estimate whether aging interferes or not with the mineral and micronutrient status of Mg, Zn and Cu in plasma and erythrocytes of healthy elderly individuals.

Method: Fifty two old subjects over 80 years were examined. The data were compared to a control group of 63 healthy persons <65 years. Mg, Zn and Cu were measured in both plasma and RBC with atomic absorption spectrophotometer AAS - 3030 B Perkin Elmer.

Results: Plasma and erythrocyte concentrations of Mg in healthy elderly were normal. While plasma Cu showed tendency to increase, intraerythrocytic (RBC) Cu was significantly decreased in the 80-89 years of age group in comparison to controls, respectively (11.53 ± 5,63 µmol/l vs 16.67 ± 5.86 µmol/l). Plasma Zn was in normal range, but showed tendency to decrease, while RBC Zn was significantly lower in both elderly groups in comparison to controls, respectively 80 - 89 years (158.44 ± 43.57 µmol/l) and 90 - 102 years (150.04 ± 23.68 µmol/l) vs (230.75 ± 51.36 µmol/l).

Conclusion: Study of RBC Cu, Zn and Mg instead of plasma gives more precise information for their actual status and reveals a deficiency of Cu and Zn in healthy individuals over 80 years. This gives us a basis to recommend food enrichment with Zn even in healthy elderly individuals without clinical symptoms.

Key words: Copper, elderly, erythrocytes (RBC), plasma, magnesium, zinc

Abbreviations: Copper (Cu), erythrocytes (RBC), magnesium (Mg), zinc (Zn)

Özet

Amaç: Sağlıklı yaşlılarda, yaşlanmanın plazma ve eritrositlerdeki Mg, Zn ve Cu'ın mineral ve mikro-besin elementi niteliğini etkileyip etkilemediğini saptamak.

Yöntem: Yaşı 80'in üzerindeki 52 birey incelendi. Veriler <65 yaşındaki 63 sağlıklı bireyin sonuçlarıyla karşılaştırıldı. Plazma ve eritrositlerdeki Mg, Zn and Cu AAS - 3030 B Perkin Elmer atomik absorbsiyon spektrofotometresiyle ölçüldü.

Bulgular: Sağlıklı yaşlılardaki Mg'un plazma ve eritrosit yoğunlukları normaldi. Buna karşılık 80-89 yaş grubunda plazma Cu'ı artma eğilimi gösterirken, eritrosit içi Cu kontrol grubuna göre anlamlı derecede azalmıştı, sırasıyla (11.53 ± 5.63 µmol/l vs 16.67 ± 5.86 µmol/l). Plazma Zn düzeyi normal değer aralığında olmakla birlikte azalma eğilimi gösteriyordu. Eritrosit Zn'su ise her iki yaşlı grupta kontrol grubuna kıyasla anlamlı derecede azalmıştı; sırasıyla 80 - 89 yaş (158.44 ± 43.57 ± mol/l) ve 90 - 102 yaş (150.04 ± 23.68 µmol/l) vs (230.75 ± 51.36 µmol/l).

Sonuç: Cu, Zn ve Mg'un plazma yerine eritrositlerdeki yoğunluklarının incelenmesi bu maddelerin halihazırdaki durumları hakkında daha kesin bilgi vermekte ve 80 yaşını aşkın sağlıklı bireylerde Cu ve Zn eksikliği geliştiğini ortaya koymaktadır. Bu bulgular, klinik belirti vermeyen, sağlıklı yaşlılarda besinlerin Zn ile zenginleştirilmesinin yararlı olacağını düşündürmektedir.

Anahtar sözcükler: Bakır, yaşlılar, eritrositler, plazma, magnezyum, çinko

Kısaltmalar: Bakır (Cu), eritrositler (RBC), magnezyum (Mg), çinko (Zn)

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The role of trace elements in the process of aging is not completely understood. One of the components of the antioxidant system includes zinc (Zn) and copper (Cu) as ingredients of the enzyme superoxide dismutase (SOD) and this proposes participation of these elements in aging. The action of some hormones and over 200 enzymes are Zn-dependent in the human's immune system. Cu insufficiency reflects mainly in the cell and causes predominantly hematological disturbances connected with the reduced activity of Cu-containing enzymes.[1,2]

Magnesium (Mg); is an important intracellular ion, which activates a large number of enzymes, acts in the regulation of energy metabolism and supports the K/Na dependent membrane gradient. The development and progression of atherosclerosis, hypertension, heart diseases, psychological disturbances and osteoporosis in Mg deficiency puts forward the question of its possible role in the aging process.[3]

More significant information can be obtained for the active status of these elements with the examination of their concentrations in red blood cell (RBC) rather than their levels in the plasma. This fact may reflect their roles in enzymatic processes on molecular and cellular level. As ignoring their important role and active intracellular status[4] one should have controversial conclusions with the sole examination of their plasma concentration. In metabolic diseases like DM, which are very frequent in elderly even without any alarming symptoms, conclusions drawn from trace element concentrations in blood cells usually offer more valuable clinical information about the metabolic state than the concentrations in plasma or whole blood, especially for Cu and Zn.[4]

Some authors consider that in elderly, it's important to detect trace elements deficiency at the earliest stage of the micronutrient disturbances when there were no clinical symptoms and only minimal metabolic changes were found. When the deficiency is noticed later, the basic homeostatic processes may have been involved and it may difficult to regulate them.[3,5]

Aim of the Study

The aim of the study is to assess whether aging interferes with the concentrations of Mg, Cu and Zn in the plasma and in the erythrocytes in healthy elderly individuals (over 80 years) in order to determine the adequate mineral supply if it's necessary.

Subjects and Methods

We examined the concentration of Mg, Cu and Zn in plasma and RBC in 52 elderly individuals (25 men and 27 women), aged 80 to 102 years (Table 1), and living in a nursing home without data for renal disease, hypertension, diabetes mellitus, hypercholesterolemia and iron-deficiency anaemia. They were selected from 425 elderly individuals (12.23%), living in 6 nursing homes in North-Eastern Bulgaria. They were subdivided into 2 age groups: B group (80-89 years), n=28 and C group (90-102 years), n=24. Results were compared with the control group A of 63 clinically healthy subjects, aged 40 to 65 years.[6]

Demographic data of our studied groups

	Age (years)		Number of patients	m: f
	Range	X ± SD		
Controls	40-65	54.3 ± 2.1	63	29/34
Group B	80-89	85.7 ± 2.4	28	13/15
Group C	90-102	92.0 ± 3.4	24	12/12

Mg, Cu and Zn in both, plasma and RBC were measured with atomic absorption spectrophotometer AAS - 3030 B Perkin Elmer.[7,8] Variation analysis (x ± SD) was applied for statistical data processing. The results were assessed with t-coefficient of Student - Fischer test.

Results

Magnesium

No statistically significant difference was found in plasma Mg, either between the two groups of elderly individuals: B group, n=28 (0,863 ± 0,287 mmol/l) and C group, n=24 (0,787 ± 0,159 mmol/l) nor in the control A group, n=63 (0,786 ± 0,387 mmol/l), p - NS (Figure 1).

RBC Mg didn't show significant changes with aging, respectively control group A: (1,587 ± 0,53 mmol/l); group B: (1,891 ± 0,236 mmol/l) and group C: (1,588 ± 0,242 mmol/l), p - NS (Figure 2).

Copper

Plasma Cu increased with the age. The change was significant for the age group > 90 years (group C) in comparison to controls <65 years (group A), resp. 19, 84 ± 3,43 µmol/l and 15,38 ± 3,71 µmol/l, p<0.01 (Figure 3).

RBC Cu showed tendency to decrease with aging. The difference was significant for the age group 80-89

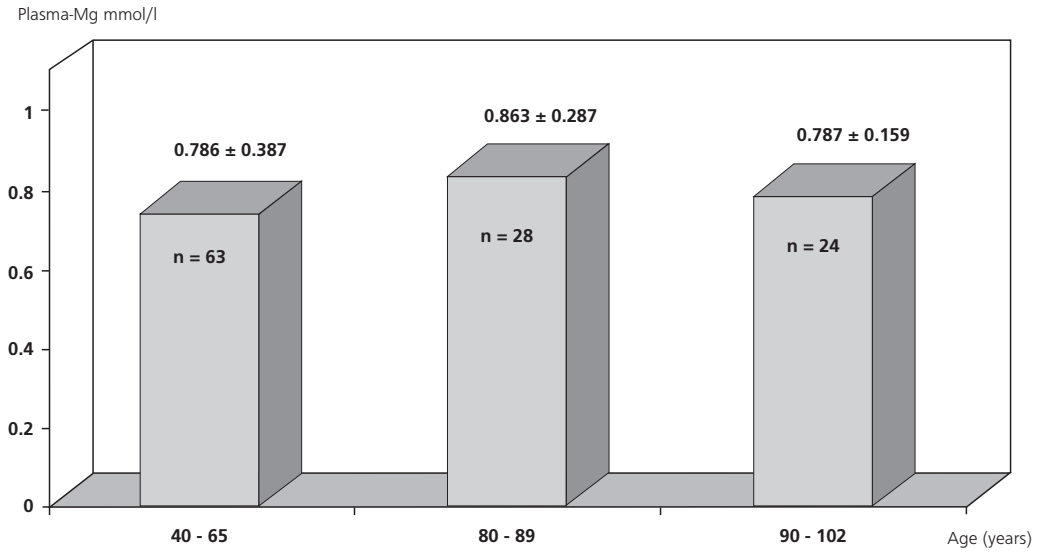

Figure 1

Plasma-Mg concentrations are compared between two groups of elderly patients (B and C) and control group young patients (A). Values are given as mean ± standard deviation. Significant differences were assumed if p<0.05.

years (group B) in comparison to controls (group A), resp.11,53 ± 5,63 µmol/l vs 16,67 ± 5,86 µmol/l, p<0.05 (Figure 4).

Zinc

Plasma Zn in both groups of elderly was decreased compared to the controls, but the difference was not statistically significant (Figure 5).

RBC Zn was significantly decreased in elderly individuals > 80 years: group B (80-89 years) - (158,44 ± 43,57 µmol/l) and group C (90-102 years) - (150,04 ± 23,68 µmol/l) in comparison to controls, group A (230,75 ± 51,36 µmol/l). There was not a significant difference in RBC between the two elderly groups, p>0.05 (Figure 6).

Discussion

The examination of the plasma concentrations of Cu, Zn and Mg in healthy elderly individuals gives us the opportunity to assess the possible influence of aging on the homeostasis of the electrolytes and trace elements.[9] The literature includes numerous studies basically on

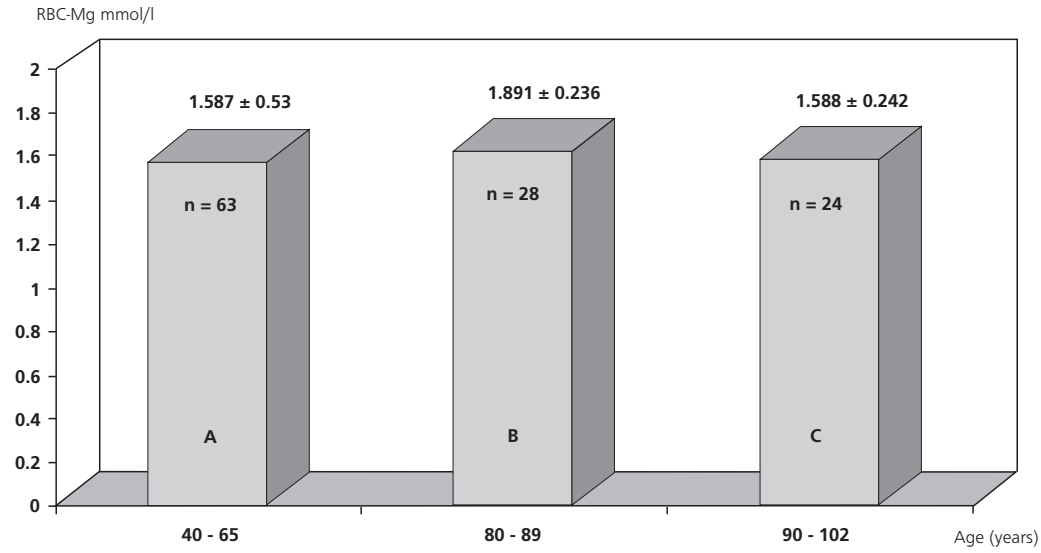

Figure 2

RBC-Mg concentrations are compared between two groups of elderly patients (B and C) and control group young patients (A). Values are given as mean ± standard deviation. Significant differences were assumed if p<0.05.

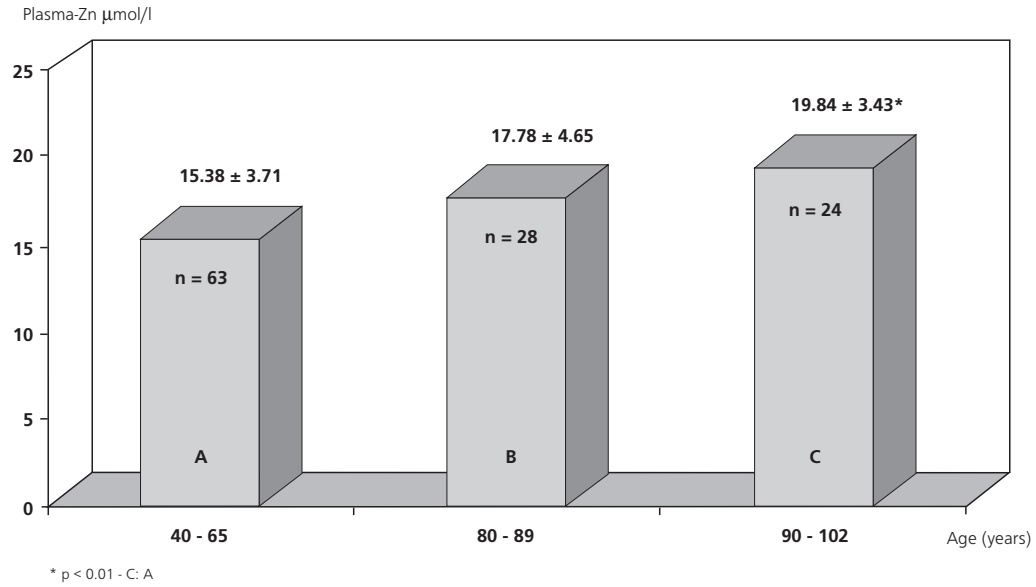

Figure 3

Plasma-Cu concentrations are compared between two groups of elderly patients (B and C) and control group young patients (A). Values are given as mean ± standard deviation. Significant differences were assumed if p<0.05.

establishing the plasma levels of trace elements. Many authors have shown that there is a difference between the plasma and the intracellular concentrations of trace elements and this difference becomes greater with aging. There are few reports on the intracellular and especially intraerythrocytic concentrations of trace elements and Mg.[4,9,10] It's supposed that the needs of protective agents (vitamines, minerals) against the degenerative processes in elderly are higher.

Del Corso et al[9] determined blood and erythrocyte concentrations of Cu, Zn and Mg. Their results showed higher plasma levels of Cu and Mg in the elderly group, but low RBC concentrations. The data of the study showed that the levels of Zn and RBC Mg did not differ between the two groups. No correlation was found between the age and single elements. The authors suggested that healthy free-living elderly had an adequate mineral intake and didn't need nutrient supplements.

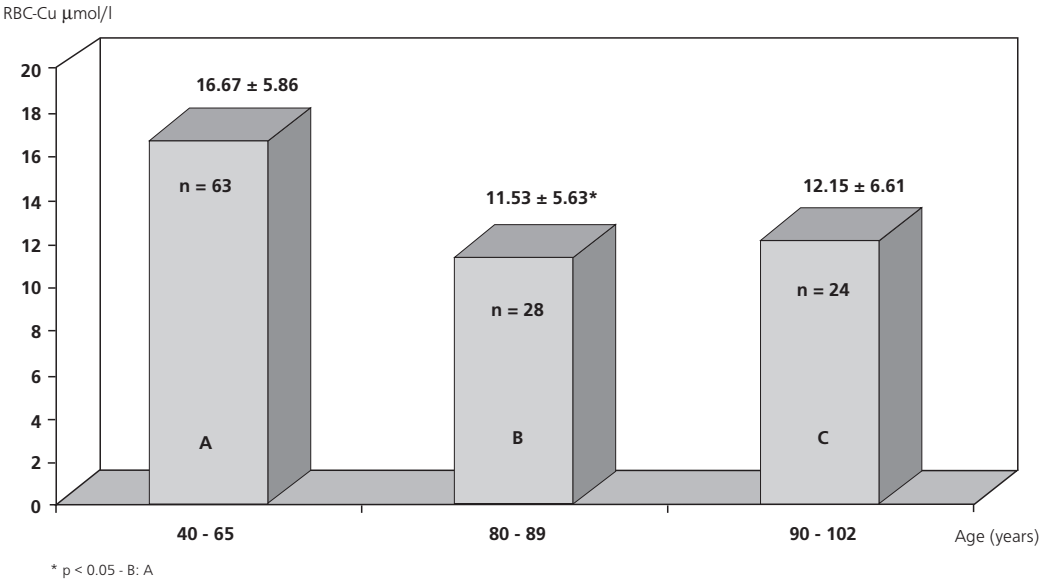

Figure 4

RBC-Cu concentrations are compared between two groups of elderly patients (B and C) and control group young patients (A). Values are given as mean ± standard deviation. Significant differences were assumed if p<0.05.

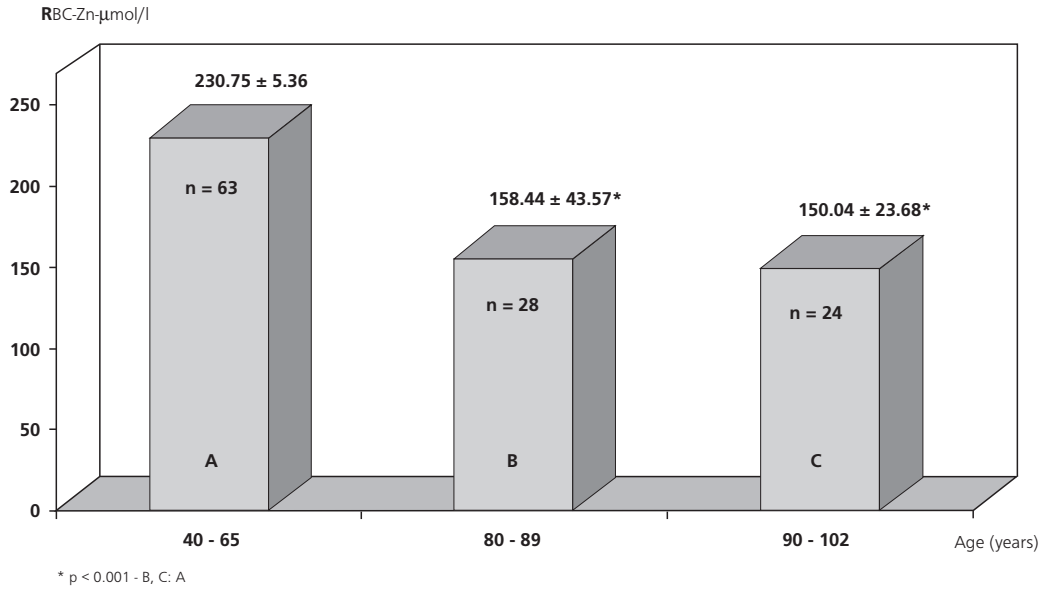

Figure 5

RBC-Zn concentrations are compared between two groups of elderly patients (B and C) and control group young patients (A). Values are given as mean ± standard deviation. Significant differences were assumed if p<0.05.

They concluded that the study of trace elements may be useful in the elderly patients with chronic diseases, comorbidities, and polypharmacy to prevent further age related dysfunctions.

Wakamoto et al.[11] found higher serum concentrations of trace elements in ≥ 85 years, especially of phosphorus and Zn.

In our study, healthy elderly subjects over 80 years had normal plasma and RBC Mg, i.e. they did not have Mg-deficiency. They hadn't taken medicines that cause hypo or hypomagnesaemia and had no data for Mg resorption disturbances and probably these two reasons explain our results.

The elderly are a risk group for Zn deficiency. The zinc deficiency risk increases with aging. According to Savarino[12], Zn plays an important role in maintaining the metabolic homeostasis in elderly people and zinc concentrations, as indices of the micronutrient status in

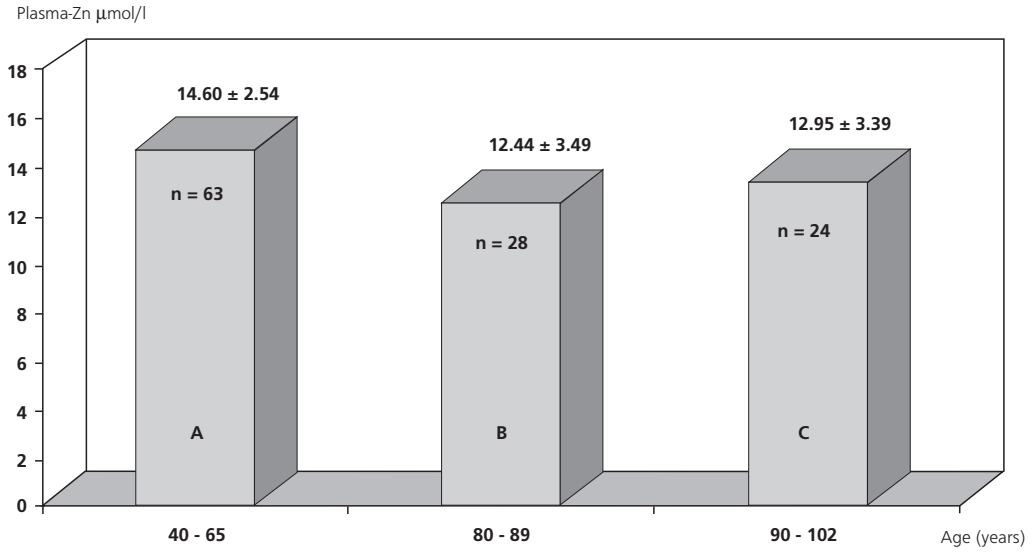

Figure 6

Plasma-ZN concentrations are compared between two groups of elderly patients (B and C) and control group young patients (A). Values are given as mean ± standard deviation. Significant differences were assumed if p<0.05.

healthy subjects over 80 years could represent a model for studying the physiology of successful aging. Savarino proposed that prospective follow-up of Zn as an index to monitoring micronutrient deficiencies that could represent an early sign of a health disturbance.[12] Prasad et al[1] established a low intake of Zn with food in elderly. In our study group plasma Zn is in normal range but tends to decrease, while RBC Zn level in elderly is lower than the control group and possibly points out the proper active status of this trace element.

Opposite to Zn, in elderly over 75 years plasma Cu increases and correlates with the age.[2] In case of insufficient nutrition, plasma Cu decreases clearly.[13] In our healthy elderly, the tendency of RBC Cu to increase with aging is underlined. On the other hand, the study of RBC Cu demonstrates the opposite trend - decreasing with age.

Conclusions:

In conclusion, the study of plasma Cu, Zn and Mg in healthy elderly gives the possibility of the assessment of the interference between aging and mineral, micronutrient status. Our results show an influence of aging on electrolytes' and trace elements' homeostasis. Their disturbances in the organism can't be disguised early by their minimal concentration in the plasma. If we remember their intensive action in cellular processes, the examination of their RBC level allows a correct clinical evaluation of their metabolic status.

In the study group of healthy elderly over 80 years we established normal plasma and RBC Mg. Plasma concentration of Zn was in the normal range but tended to decrease with age. In elderly over 80 years, RBC Zn was significantly decreased in comparison to the control group and Zn-deficiency was determined in these subjects. Plasma Cu increased with aging (significantly over 90 years), while RBC Cu showed a tendency to decrease (significantly at the age 80-89 years).

Elderly individuals of our study were clinically healthy subjects. They had no data for disease or medication, which would have provoked the deficiency. It's possible that the established results are due to aging itself or to unbalanced feeding. For this reason, we accept that even in healthy elderly over 80 years it's necessary to enrich the food with Zn.

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