

Zinc in Adult Human Serum in Spain

B. Gil-Extremera*, A. Maldonado, M. Ruiz-Martínez and M. A. Rubio

Departamento de Medicina
Hospital Universitario de Granada
18012 Granada (Spain)

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B. GIL-EXTREMERA, A. MALDONADO, M. RUIZ-MARTÍNEZ and M.A. RUBIO.
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Zinc levels in serum taken from 1,166 healthy, adult volunteers, from 16 to 70-year-olds living in 10 different districts of the Province of Granada (Spain), have been measured by atomic absorption spectrophotometry. The zinc levels ranged from 80 µg to 130 µg/100 ml. There were no significant differences with regard to age. The overall results showed higher zinc levels for males than for females but this did not appear when the values for each individual district were analysed separately.

Key words: Zinc, Blood, Healthy adults

Zinc is an essential trace element in the human organism, forming as it does part of numerous metalloenzymes (10, 20), participating in the synthesis of nucleic acids (3, 8) and proteins (6), and exercising a stabilizing role on cell membranes (2). Foods and diets high in protein are also high in zinc, whereas foods high in carbohydrates are much lower in it. The major dietary sources of zinc are food of animal origin such as meat, fish, shellfish, poultry, eggs, and dairy products (16). Zinc deficiencies have been described in association with various clinical states, such as enteropathic acrodermatitis (1, 15), in patients with cirrhosis of the liver (5, 9, 21), chronic renal insufficiency (19) and diabetes mellitus (11). Since the chemical environment, food and drinking water

vary with geographic location, it is of interest to study the possible effect of such variations on the concentrations of trace element (Zn) in human tissues and body fluids. Blood serum is often considered a convenient sample material for such studies as it can be obtained quite easily by routine procedures from large groups of people.

The aim of this study, the first of its kind in Spain, has been to measure the levels of zinc in the serum of healthy adults living in different districts of the Province of Granada and also to discover whether there are any variations due to age or sex.

Materials and Methods

The collection of blood samples was carried out in collaboration with the local blood-donor unit («Centro Regional de

* To whom all correspondence should be addressed

Donantes de Sangre de Granada»). Samples were taken from 1,166 healthy volunteers (555 males and 611 females), living in 10 different districts of the Province of Granada and ranging in age from 16 to 70. The protocol had the prior approval by the Committee for Research and Clinical Trials (Hospital Universitario de Granada).

The selection of volunteers. — The volunteers were selected according to the following criteria: They were suffering from no chronic illness, had had no acute infection during the three weeks previous to the tests, and were not regular takers of alcohol or any other drugs. Their haematological parameters (blood cells, haemoglobin and haematocrit) were all normal. The results were negative for hepatitis B, syphilis and AIDS.

The collection of blood samples. — The samples were taken with the volunteer in a state of fast, with disposable plastic syringes and left to coagulate for 30 min at room temperature in plastic tubes. They were then centrifuged for 5 min at 3,000 rpm and the serum was drawn off with disposable, plastic, mechanical pipettes and stored in tubes of a similar nature.

Analytical procedure. — Each blood sample (0.5 ml) was diluted with 2 ml of deionized water using a mechanical agitator. The zinc levels were then measured with an atomic absorption spectrophotometer (Perkin-Elmer, USA, model 560) under the following conditions: slit, 0.7; wavelength, 213.9; oxidising flame, oxy-acetylene. Blood samples with any signs of haemolysis whatsoever were rejected.

Statistical method. — All the data are expressed as a mean value \pm its standard deviation (SD). Student's *t* test and a variance analysis have been used to compare the mean values according to residential district, age and sex.

Results

The zinc levels in the population group studied ranged from 80 μg to 130 μg /100 ml. The mean zinc levels in serum are shown in table I, where statistically significant differences exist between some of the districts. As far as sex is concerned, males, in general, have a significantly higher zinc content than females, although no such difference appears at the individual regional level (table II), nor was it found in relation to age.

Table I. Mean zinc levels ($\mu\text{g}/100\text{ ml}$, means \pm S. D.) in serum according to district.

District	N	Zinc
GRANADA	250	113 \pm 21
HUESCAR	250	112 \pm 22
BAZA	129	98 \pm 21
MOTRIL	113	111 \pm 24
IZNALLOZ	104	102 \pm 16
GUADIX	99	101 \pm 17
SANTAFE	83	88 \pm 17
ORGIVA	57	107 \pm 29
ALBUÑOL	41	104 \pm 10
LOJA	40	117 \pm 13

$p < 0.001$.

Table II. Mean zinc levels ($\mu\text{g}/100\text{ ml}$) in serum according to sex.

Sex	N	Zinc
M	555	109 \pm 21
F	611	105 \pm 22

$p < 0.005$.

Discussion

The mean global values for blood zinc content are similar to those found by other authors in various healthy populations (4, 7, 12-14). The levels are significantly different between some districts in the same province. HELGELAND *et al.* (13) also

discovered significant discrepancies in different districts in Norway, the lowest values occurring in coastal areas. They put this fact down to a greater consumption of fish by coastal dwellers, which is poor in zinc compared to meat, but this hypothesis cannot be extrapolated to our results as the inhabitants of the coastal districts have equal or even higher zinc levels than those inland.

With regard to sex, the results to be found in the literature are inconclusive; some authors speak of similar levels in both males and females (4, 7, 12, 17, 18, 22) while others report higher levels in males (13, 14). Our results show no significant differences between the sexes at a district level, but when the global results are analysed a higher value for males is evident. This fact may well be attributable to the relative quantities of the district and the global samples.

Resumen

Se determina el nivel de cinc sérico, por espectrofotometría de absorción atómica, en 1166 individuos adultos sanos, de 16 a 70 años, de diez regiones diferentes de la provincia de Granada (España). Los niveles de cinc oscilan entre 80 y 130 µg/100 ml. Existen diferencias entre los individuos de distintas regiones, pero no en relación con la edad. En el estudio global, los varones presentan valores más altos que las mujeres, no dándose, sin embargo, cuando se consideran cada una de las regiones por separado.

Palabras clave: Cinc, Sangre, Adultos sanos.

References

1. Brenton, D. P., Jackson, M. J. and Young, A.: *Lancet*, ii, 500-502. 1981.
2. Chvapil, M.: *Med. Clin. North. Am.*, 60, 799-812, 1976.
3. Cooper, H. K.: *Toxicology*, 34, 261-270, 1985.
4. Davies, I. J. T., Musa, M. and Dormandy, T. L.: *Clin. Pathol.*, 21, 359-365, 1968.
5. Díez-Ruiz, A., Gil-Extremuera, B., Gutiérrez-Gea, F. and Muñoz-Ruiz, C.: *Gastroenterol. Clin. Biol.*, 12, 584, 1988.
6. Dura-Trave, T., Puig-Abuli, M. and Villa-Elizaga, I.: *Acta Pediatr. Esp.*, 41, 18-22, 1983.
7. Foote, J. W. and Delves, H. T.: *J. Clin Pathol.*, 37, 1050-1054, 1984.
8. Fujioka, M. and Lieberman, L.: *J. Biol. Chem.*, 239, 1164-1167, 1964.
9. Gil-Extremuera, B., Maldonado, A., Díez-Ruiz, A., Mederer, S. and Ruiz-Martínez, M.: *Gastroenterol. Clin. Biol.*, 13, 1989 (in Press).
10. Gordon, E. F., Gordon, R. C. and Passal, D. B.: *J. Pediatr.*, 99, 341-349, 1981.
11. Hagglof, B., Hallmans, G., Holmgren, C., Ludvigsson, J. and Falkmer, S.: *Acta Endocrinol.*, 102, 88-95, 1983.
12. Halstes, J. A., Smith, J. C. Jr.: *Lancet*, i, 322-324, 1970.
13. Helgeland, K., Haider, T., Jonsen, J.: *Scand. J. Clin. Lab. Invest.*, 42, 35-39, 1982.
14. Kiilerich, S., Christensen, M. S., Naestoft, J. and Christiansen, C.: *Clin. Chim. Acta*, 105, 231-239, 1980.
15. Moynahan, E. J.: *Lancet*, ii, 399-400, 1974.
16. Murphy, E. W., Willis, B. W. and Watt, B. K.: *J. Am. Diet. Assoc.*, 66, 345-355, 1975.
17. Navarro, F., Mellado, J. M., Pérez-Cano, R., Cruz-Fernández, J. M. and Garrido, M.: *Rev. Clin. Esp.*, 158, 49-52, 1980.
18. Reusch, C. S. and Bunch, L. D.: *JAMA*, 210, 2285, 1969.
19. Río-Vázquez, A. del: *Rev. Iberam. Invest. Clin.*, 1, 3-10, 1982.
20. Riordan, J. F.: *Med. Clin. North. Am.*, 60, 661-674, 1976.
21. Solís-Herruzo, J. A., Castellano-Tortajada, G., Morillas-Sáinz, J. D. et al.: *Gastroenterol. Hepatol.*, 7, 353-361, 1984.
22. Vallee, B. L., Wacker, W. E. C., Bartholomay, A. F. and Hoch, F. L.: *An. Int. Med.*, 50, 1077-1091, 1959.

