

THE EVALUATION OF SERUM ELECTROLYTES CALCIUM, IONIC CALCIUM, MAGNESIUM AND HEMOGLOBIN IN SULINA'S PATIENTS, DANUBE DELTA, ROMANIA

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Abstract

According to literature data, the normal values of biochemical parameters in blood vary by sex, age, geographical region and type of diet. The aim of this study was to analyze the benefits of a fish-based diet among the population of Sulina Town, in the Danube Delta. The batch of patients underwent a set of biochemical tests in the RoutineMed Laboratory of Sulina. The novelty of the research is represented by the geographic area covered, as the Danube Delta had no medical analysis laboratory until 2010, when RoutineMed Laboratory was opened in Sulina. Blood samples were collected from 260 patients (of 3663 residents) for the evaluation of the serum electrolytes: total calcium, ionic calcium, magnesium and hemoglobin. Both women and men were involved in the research and patients were grouped into age ranges: 20-40 years, 40-60 years, > 60 years. The study included 260 patients, of which 90 men (34.6%) and 170 women (65.4%), who declared they eat fish or fish-based products at least once a week. The values obtained were statistically analyzed using the SPSS v. 20 software and then compared to the ranges considered normal for these parameters. The results obtained showed that patients with a fish-based diet seem to be healthier than those with a diet in which fish meat is scarce, as their blood biochemical parameters values are closer to normal, which leads to the conclusion that including fish and fish products in people's regular diet is beneficial.

Keywords: calcium, ionic calcium, magnesium, hemoglobin, Sulina

Introduction

The aim of this study was to analyse the benefits of fish diet in the Danube Delta, Sulina's population. Based on literature data, normal values of biochemical parameters vary by gender, age, diet and geographical region (Wallach, 2001).

Calcium is the major mineral component of bone. Calcium ions play an important role in transmitting nerve impulses, muscle contraction, heart function and coagulation processes (Fischbach, 2009). Hormonal regulation of calcium metabolism as the phosphorus is complex (Rosoiu, 2005). Interrelation between the small intestine, skeleton, kidney and the endocrine system, particularly parathyroid, maintain homeostasis of calcium and phosphorus. Also, calcitonin, vitamin D, estrogen, androgens are factors that influence calcium levels (Thomas, 1998). 55% of plasma calcium is in the ionic form or free fraction and physiologically active processes regulating hemostasis and neuromuscular excitability and its concentration in plasma is directly regulated by PTH and 1,25 (OH) 2D3 (Brudasca, Cucuiaru, 2003).

Magnesium is an element which, although is found in small proportion in the body (0.05% of total body weight), shows great importance of structurally and functionally (Rosoiu, 2008). Actions of calcium and magnesium are closely linked. The one deficit of these elements significantly affect the metabolism of other (magnesium is required for both intestinal absorption and metabolism of calcium) (Fischbach, 2009). Magnesium ions with Na^+ , K^+ and Ca^{2+} regulates neuromuscular excitability and coagulation mechanism (Rosoiu, 2010).

Most of the iron in the body is found in compounds heme, special in hemoglobin and myoglobin. Most of the non-hemic iron is stored as ferritin or hemosiderin in macrophages and hepatocytes. Only a very small fraction (~ 0.1%) circulates in plasma in the form of Fe^{3+} linked to a carrier protein - transferrin. Hemoglobin is the main component of red blood cell (95% of erythrocyte cytoplasmic proteins) and serves as a vehicle for the transport of O_2 and CO_2 . Iron excretion occurs by cell loss in the gastrointestinal, skin, urinary and menstrual losses in women. Most of the functional iron in the body comes from reusing existing iron derived from senescent red blood cells destroyed in the reticuloendothelial system, mainly the spleen (Andrews, 2004).

Material and Methods

For serum biochemistry were used following measuring instruments: automatic biochemistry unit SAPPHIRE 350, centrifuges Rotofix 32 A and reagents Audit Diagnostics (Procedura specifică –determinări de biochimie, 2013). Blood samples were collected from 260 patients (of 3663 residents) for the evaluation of the serum electrolytes: total calcium, ionic calcium, magnesium and hemoglobin. Both women and men were involved in the research and patients were grouped into age ranges: 20-40 years, 40-60 years, > 60 years. The experimental data were processed using IBM SPSS Statistics 20. The procedures used were: Descriptive statistics (characterization variables discrete and continuous defined in the database), Graphs, Statistical tests parametric (t-test to compare the average of two independent samples, t-test to compare the average of a sample value specified test One-Way ANOVA), correlation analysis.

Results and Discussion

The study included 260 patients, 90 were males (34.62%) and 160 were females (65.38%) (Figure 1). The distribution by age groups on male was: 25 were in the age range (20-40) years, 38 were in the age range (40-60) years and 27 were in the age range (60 -...) years. The distribution by age groups on female was: 46 were in the age range (20-40) years, 74 were in the age range (40-60) years and 50 were in the age range (60 -...) years (Figure 2).

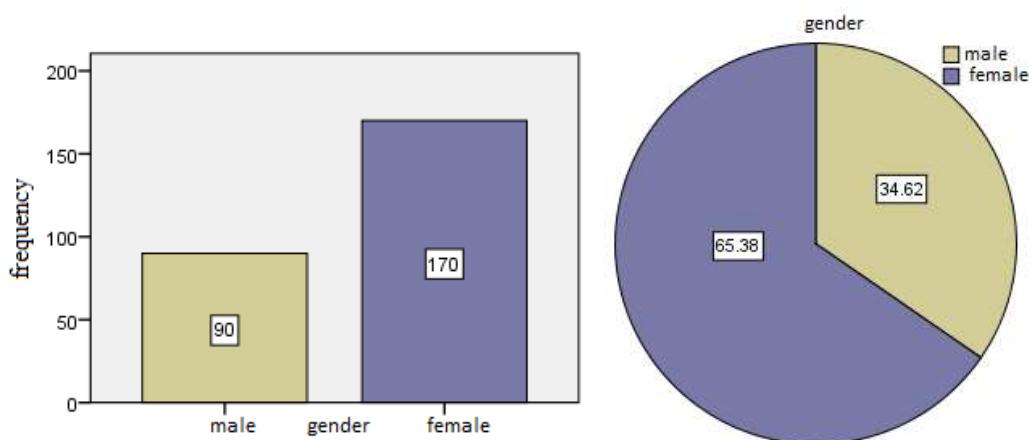


Fig. 1: The distribution by gender and percent

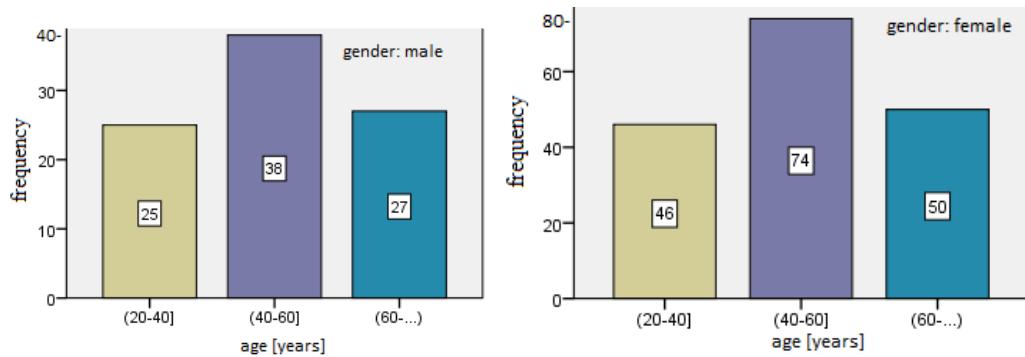


Fig. 2: The distribution by age groups on male and female

The average value of total calcium : For male patients ($N = 90$) the mean of total calcium is $M_M = 9.104 \text{ mg / dL}$ For female patients ($N = 170$) the mean of total calcium is $M_F = 9.179 \text{ mg / dL}$.

When the mean of total calcium are compared in the two groups of patients with a reference value $L_{\text{sup}} = 10.2 \text{ mg / dL}$: for the group of male patients average amount of total calcium - $M_M = 9.104 \text{ mg / dL}$ and for the group of female patients average amount of total calcium - $M_F = 9.179 \text{ mg / dL}$ indicate that both women and men results are within normal limits (Figure 3). The amount of protein in the blood affects the level of calcium, since 45% of the calcium in serum is protein-bound (Fischbach, 2004). Hypercalcemia and hypokalemia often accompanies it always leads to dehydration because excess calcium cause nephrogenic diabetes insipidus (Laboratory Corporation of America, 2015). Women have a diurnal variation ionic calcium and intact PTH hormone higher than men.

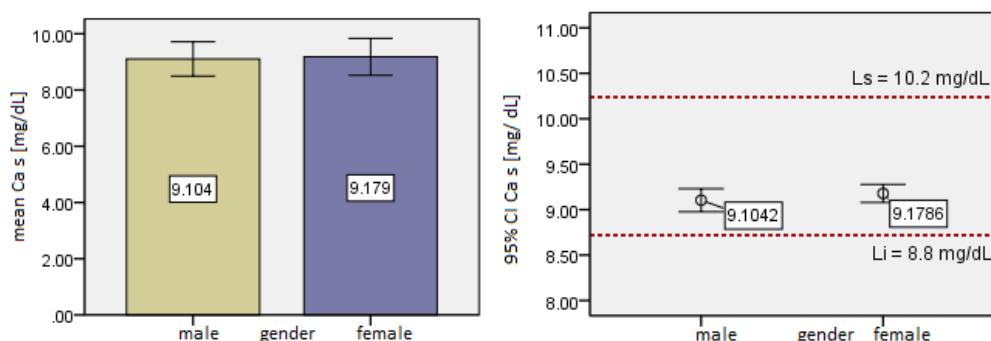


Fig. 3: Mean total calcium on male and female

The average value of ionic calcium : For male patients ($N = 90$) the mean of ionic calcium is $M_M = 4.1197 \text{ mg / dL}$. For female patients ($N = 170$) the mean of ionic calcium is $M_F = 4.125 \text{ mg / dL}$.

When the mean of ionic calcium are compared in the two groups of patients with a reference value $L_{\text{sup}} = 5.2 \text{ mg / dL}$: for the group of male patients average amount of ionic calcium - $M_M = 4.11 \text{ mg / dL}$ and for the group of female patients average amount of ionic calcium - $M_F = 4.12 \text{ mg / dL}$ indicate that both women and men results are within normal limits (Figure 4). Ionized serum calcium fraction tends to decline in case alkalizing blood, they increase the ability of proteins to fix calcium (Brudasca, Cucuiaru, 2003). Circadian variations in ionic calcium shows significant increases after exercise and decreases postprandial.

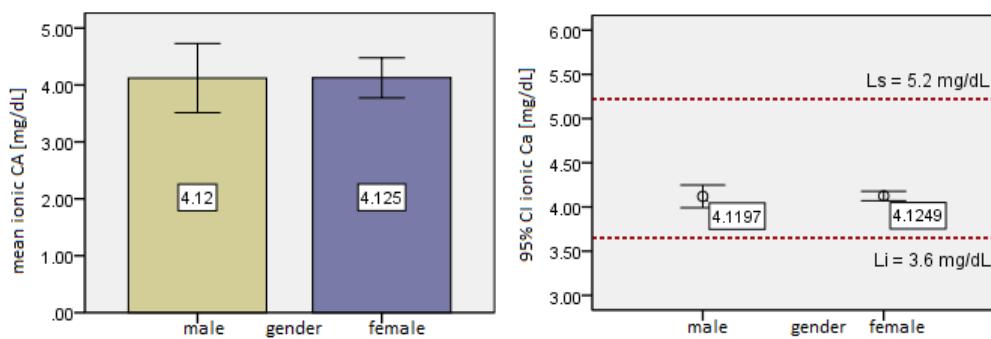


Fig. 4: Mean ionic calcium on male and female

The average value of magnesium : For male patients ($N = 90$) the mean of magnesium is $M_M = 2.457 \text{ mg / dL}$. For female patients ($N = 170$) the mean of magnesium is $M_F = 2.349 \text{ mg / dL}$.

When the mean of magnesium are compared in the two groups of patients with a reference value $L_{\text{sup}} = 2.6 \text{ mg / dL}$: for the group of male patients average amount of magnesium - $M_M = 2.457 \text{ mg / dL}$ and for the group of female patients average amount of magnesium - $M_F = 2.349 \text{ mg / dL}$ indicate that both women and men results are within normal limits (Figure 5).

Magnesium deficiency will generate bone calcium mobilization, the possible occurrence of abnormal calcification in the aorta and kidney. It is therefore important to consider both levels when evaluating calcium and magnesium. Also, hypokalemia and hypomagnesemia was associated with 60%

of cases. (Thomas, 1998). From clinical point of view, magnesium deficiency cause neuromuscular disorders (muscle weakness, tremor, tetany and convulsions) and on the heart may cause arrhythmias (Laboratory Corporation of America, 2010). Serum levels of magnesium may remain normal even in the presence of a depletion up to 20% of the total reserves of the body.

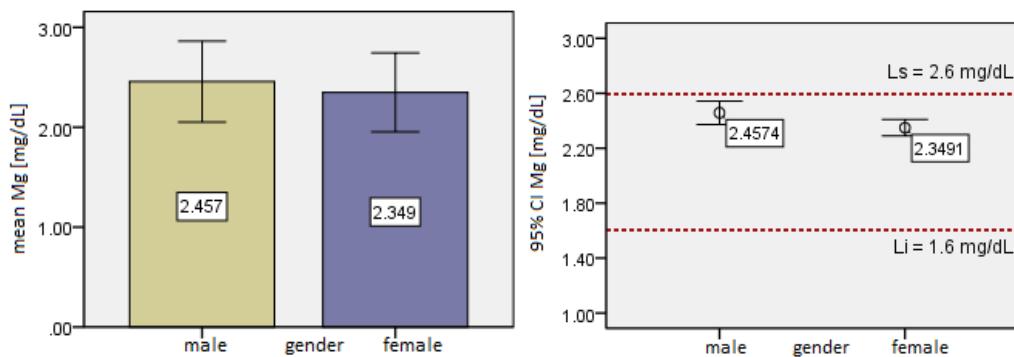


Fig. 5: Mean magnesium on male and female

The average value of hemoglobin : For male patients ($N = 90$) the mean of hemoglobin is $M_M = 15.04 \text{ mg / dL}$. For female patients ($N = 170$) the mean of hemoglobin is $M_F = 13.91 \text{ mg / dL}$.

When the mean of hemoglobin are compared in the two groups of patients with a reference value $L_{\text{sup}} = 18 \text{ mg / dL}$: for the group of male patients average amount of hemoglobin - $M_M = 15.04 \text{ mg / dL}$ and for the group of female patients average amount of hemoglobin - $M_F = 13.91 \text{ mg / dL}$ indicate that both women and men results are within normal limits (Figure 6).

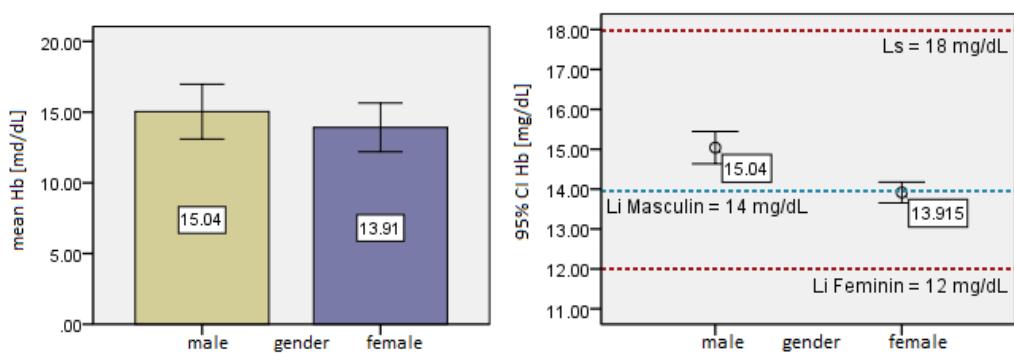


Fig. 6: Mean hemoglobin on male and female

Serum iron level without transferrin / ferritin and transferrin saturation has limited clinical value. Decreased hemoglobin below baseline levels cause anemia. Hemoglobin should be evaluated together with hematocrit, erythrocytes, erythrocyte indices and cell morphology on smear for classification of anemia. A normal value of the concentration of hemoglobin does not exclude the anemia due to acute hemorrhage.

The average value of total calcium by age groups – Male and Female: For the group (20-40] years ($N = 71$) the average of total calcium is $M_{(20-40]} = 9.11$ mg / dL; in group (40-60] years ($N = 112$) the average value of the total calcium is $M_{(40-60]} = 9.23$ mg / dL; in the group (60- ...) years ($N = 77$) the average value of the total calcium is $M_{(60-...]} = 9.07$ mg / dL (Figure 7a).

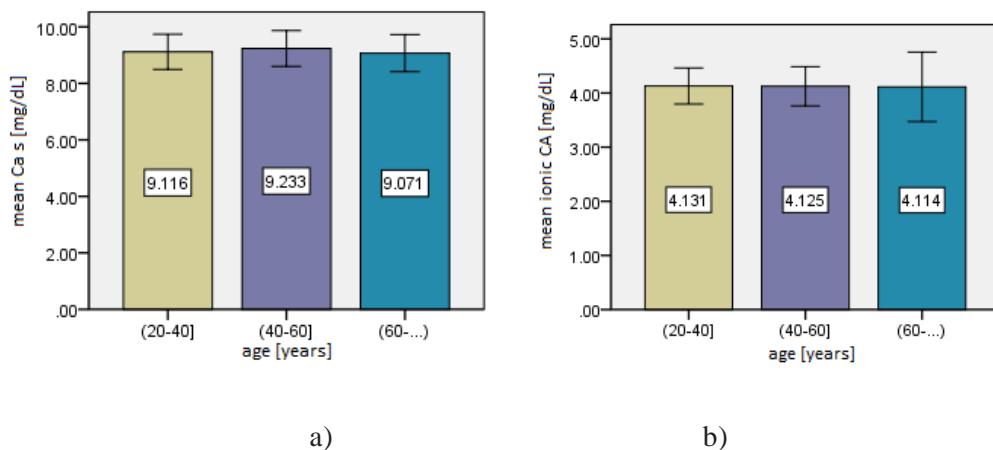


Fig. 7a (left) Mean total calcium on male and female by age groups
Fig. 7b (right) Mean ionic calcium on male and female by age groups

The average value of ionic calcium by age group – Male and Female: For the group (20-40] years ($N = 71$) the average of ionic calcium is $M_{(20-40]} = 4.13$ mg / dL; in group (40-60] years ($N = 112$) the average value of the ionic calcium is $M_{(40-60]} = 4.12$ mg / dL; in the group (60- ...) years ($N = 77$) the average value of the ionic calcium is $M_{(60-...]} = 4.11$ mg / dL (Figure 7b).

The average value of magnesium by age groups – Male and Female: For the group (20-40] years ($N = 71$) the average of magnesium is $M_{(20-40]} = 2.46$ mg / dL; in group (40-60] years ($N = 112$) the average value of the

magnesium is $M_{(40-60]} = 2.34 \text{ mg / dL}$; in the group (60- ...) years ($N = 77$) the average value of the magnesium is $M_{(60-...)} = 2.37 \text{ mg / dL}$ (Figure 8a).

The average value of hemoglobin by age groups – Male and Female: For the group (20-40] years ($N = 71$) the average of hemoglobin is $M_{(20-40]} = 14.25 \text{ mg / dL}$; in group (40-60] years ($N = 112$) the average value of the hemoglobin is $M_{(40-60]} = 14.37 \text{ mg / dL}$; in the group (60- ...) years ($N = 77$) the average value of the hemoglobin is $M_{(60-...)} = 14.25 \text{ mg / dL}$ (Figure 8b).

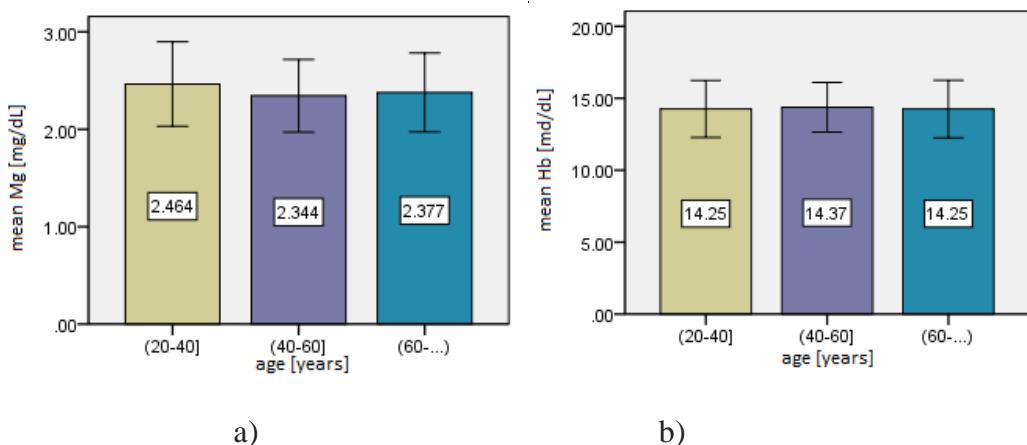


Fig. 8a(left) Mean magnesium on male and female by age groups
Fig. 8b(right) Mean hemoglobin on male and female by age groups

Conclusions

The values obtained were statistically analyzed using the SPSS v. 20 software and then compared to the ranges considered normal for these parameters. The results obtained showed that patients with a fish-based diet seem to be healthier than those with a diet in which fish meat is scarce, as their blood biochemical parameters values are closer to normal, which leads to the conclusion that including fish and fish products in people's regular diet is beneficial.

Including fish and fish products in people's regular diet is beneficial in preventing and screening osteoporosis in patients over 50 years, evaluation of

biologically active fraction of calcium in pregnant women, detection of certain metabolic disorders of kidneys and hemoglobin is useful for detection and monitoring of anemia and polycythemia

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