ROUND TABLE

TRACE ELEMENT INTAKES, STATUS AND DEFICIENCY IN THE ELDERLY: BENEFITS OF SUPPLEMENTATION

CHROMIUM AND AGEING

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Since 1950 the proportion of persons in the world older than 60 years has been rising from 8% in 1950 to 11% in 2007, and is expected to reach 22% in 2050. In a study involving over 40,000 people, chromium concentrations of the hair, sweat and urine declined with age. Aging is associated with increased blood glucose, insulin, blood lipids and fat mass, and decreased lean body mass and cognition leading to increased incidences of diabetes, cardiovascular diseases and decreased mental function. Improved chromium nutrition is associated with improvements in all of these variables. In people with type 2 diabetes, there is a dose response to the improvements in glucose, hemoglobin A1c, cholesterol, insulin and insulin sensitivity with larger effects when consuming 1000 µg per day of chromium as chromium picolinate compared with 200 µg. Animal studies also document improved cognition with supplemental chromium. Supplemental chromium has been associated with decreased depression that often increases with age. Food patterns common in aging including increased consumption of high sugar foods leads to higher chromium losses and decreased chromium status. Stresses associated with aging including physical trauma and glucocorticoid treatment also increase chromium losses. Supplemental chromium leads to a reversal of glucocorticoid-induced diabetes often associated with treatments for arthritis, allergies and related diseases. The addition of chromium to the diet of rats led to an increase in lifespan by 33% and improved body composition, blood glucose and insulin sensitivity. The increases in obesity and chronic diseases such as type 2 diabetes, cardiovascular diseases and decreased mental function may not be normal consequences of aging but rather suboptimal dietary patterns that are manifest with age. Improved chromium nutrition is one of the factors that leads to reversal of suboptimal health that manifests with age.

SELENIUM IN THE ELDERLY

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Selenium is an essential trace element for human health and deficiencies could be predictive of an «accelerated ageing». Lower selenium intake or status have been associated with an increased risk of cancer and cardiovascular diseases, an increased incidence of inflammatory diseases and severity of infection. We reported recently a linked between selenium status decline and high risk of cognitive decline, and mortality. Furthermore selenium deficiency has been linked to altered thyroid metabolism since selenocystein is part of 5'desiodase type I and more recently with the development of type 2 diabetes. During aging the deficit becomes age-related. The deficit becomes more important especially in institutionalized subjects, in long stay hospitalized elderly, we measured selenium intakes as low as 23 µg/d. 71% of the women exhibited Se plasma concentrations below the cut-off of 0.76 µmol/l. In contrary in centenarian people the prevalence is low (3%), suggesting that selenium could be a factor of longevity. It is therefore important especially with age to have an adequate dietary intake of selenium. In Europe selenium intake are lower than in North America, and status are too low to reach the range for an optimal activity for protective antioxidant glutathione peroxidises (GPx) activity and concentration of others important such as selenoprotein P, that transports selenium to organs that need it. Less is know to selenium need for an optimal methionine sulphoxide reductase (MsrB1) and thioredoxine reductase, two important selenoprotein enzymes for repair oxidative damage, which could be important to prevent oxidative diseases associated with ageing. Several interventional trials using nutritional doses of Se reported a protective effect in decreasing oxidative stress, restoring the immune function, and in decreasing the incidence of cancers. Considering the key role of selenium for a successful aging and the poor Se nutriture in elderly people, older individuals should be encouraged to consume foods or supplements that increase selenium intake and status.

ZINC SUPPLEMENTATION IN ELDERLY PEOPLE: BENEFITS AND LIMITS

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Given the key role of zinc in many physiological functions, optimal zinc status could be a predictive parameter of successful ageing. During ageing, the intakes of zinc decrease due to inadequate diet and/or intestinal malabsorption, contributing to frailty, general disability and increased incidence of age-related degenerative diseases. Zinc deficiency is common in the elderly, especially those aged over 75, leading to chronic inflammation and oxidative stress, altered immune function and stress response. Dysfunctions of zinc homeostasis, affecting the intracellular zinc availability in brain,could also participate in impaired cognitive functions. The benefit of Zn supplementation for aged subjects is still a matter of debate. Recently, two European studies in free-living healthy elderly, the ZENITH study and the ZINCAGE study, aimed at formulating a rationale for an appropriate nutritional Zn supplementation. Long term supplementation with moderate doses of zinc is an efficient way to increase zinc status and exchangeable zinc pool masses. Several studies reported that, after zinc supplementation, the incidence of infections was significantly lower in relation with lower generation of tumor necrosis factor alpha and oxidative stress markers. Zinc supplementation appears to improve cognitive performances and stress response, but, at the same time, there is considerable evidence that amyloid-beta deposition in Alzheimer's disease is induced by zinc, and the pathological significance of this accumulation is still an open question. At high levels, zinc supplementation has also been reported to be associated with the alteration of Cu status and lipid metabolism, and, could have a deleterious impact on immunity. In conclusion, mildly zinc-deficient healthy elderly subjects and older and/or institutionalized zinc-deficient patients might benefit from moderate zinc supplementation due mainly to a more balanced immune response. High doses of zinc should be avoided.

ZINC, COPPER AND ANTIOXIDANT ENZYME ACTIVITIES IN HEALTHY ELDERLY TUNISIAN SUBJECTS

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Trace elements like zinc and copper play an important role in maintaining metabolic homeostasis in elderly subjects and is therefore expected to have a crucial effect on antioxidant mechanism. The objective of the present study was to investigate age-related variations of zinc, copper and antioxidant enzyme activities (superoxide dismutase: SOD, glutathione peroxidise: GPx and catalase: CAT) taking into account gender differences in a Tunisian elderly population. A group of 100 healthy elderly subjects (55 to 85 years old) were then separated in three sub-groups according to age intervals. A control group of 100 adults aged between 30 and 45 years was considered. The obtained results confirmed the decrease of plasma zinc level with age increase in both men and women. Moreover, prevalence of zinc deficiency increased with age: normal zinc concentration was obtained in about 60% of adults and only in 35% of the elderly subjects over 75 years old. No significant variation was obtained for copper concentration. GPx and SOD activities were lower in aged subjects in comparison to adults. Zinc and antioxidant enzyme activities were found to be negatively correlated to age. However, an investigation on a large size sample with various health and well-controlled dietary statuses should be conducted for a better understanding of the zinc or copper metabolism and their effect on oxidant stress during aging.

THE MEMBRANE EFFECTS INDUCED BY Zn^{2+}-ACTION IN HUMAN ERYTHROCYTES

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Zn^{2+} occupies the second place after Fe^{3+} as to its maintenance and involvement into chemical, structural and regulatory processes in biological systems. Zn^{2+} is an important component of many intracellular enzymes responsible for RNA synthesis, proteolytic splitting, degradation etc. Zn^{2+} stabilizes the cellular membranes under physiological (< 30 μM) concentration. However, under high concentration this ion can act as a cell toxicant and lead to the changes in membrane properties. Up to now, the problem of influence of high concentrations of Zn^{2+} on erythrocyte remains to be open. In this study the effect of subhaemolytic (0.1—1 mM) concentration of zinc ions on human erythrocytes *in vitro* was investigated. The surface topography of erythrocyte membranes was studied by atomic force microscopy. The differences in fine structure of membranes were found. The profiles of the structure of erythrocyte membranes modified by zinc ions looked smoother as compared to unmodified control membranes. Using the fluorescent probes 1-(4-trimethylammoniumphenyl)-6-phenyl-1,3,5-hexatriene p-toluenesulfonate and 6-dodecanoyl-2-dimethylaminonaphthalene it was shown that influence of above (0.1—1 mM) concentrations of zinc ions caused the alteration of lipid microviscosity in the vicinity of polar heads of lipid molecules in outer lipid monolayer of erythrocyte membrane.Also it was also discovered a decrease in fluorescence intensity of polyene antibiotic filipin bound to cholesterol was detected if zinc ions was added to isolated erythrocyte membrane under the same concentrations. These data make possible to draw a conclusion that zinc ions under 0.1—1 mM concentrations interact with erythrocyte membrane and modify the state of both phospholipids and membrane that cause the changes in membrane fluidity and as the consequence a failure of cell functioning. The observed smoothing of irregularities on the surface of erythrocyte membranes treated with zinc ions can be due to clusterization of band 3 proteins and release of spectrin-free vesicles from membrane surface. The other findings are the redistribution of phosphatidylserine molecules from inner to outer monolayer of lipid bilayer of erythrocyte membrane and a correlation between the Zn-induced changes in surface topography of erythrocytes and that in parameters reflecting the structure-function characteristics of erythrocyte membranes. It is suggested that similar effects can occur under different pathological states related to imbalance of microelements in organism.