

## SYNERGISM OR COMPETITION BETWEEN ZINC AND CHROMIUM DIETARY LEVELS ON INSULIN ACTION MECHANISM. A METHOD TO INVESTIGATE

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### ABSTRACT

**Introduction:** The action of zinc and chromium on the metabolism of carbohydrates and, consequently, on lipids and protein metabolism improves, on the one hand, the receptor membrane efficiency and, on the other hand, plays an important role in the regulation of secretion and insulin activity. Aim of the study is to gather preliminary data on the efficacy of treatment with zinc or chromium on impairment glucose tolerance.

**Materials and methods:** Subjects: All patients from a dietician examination had levels of blood sugar limits (35 men and 58 women; age 39-61 years). Diet food: intake of all nutrients was measured in weekly diary. The supplementation of chromium or zinc has been carried out - in a random way.

**Statistical analysis:** Data are expressed as mean  $\pm$  SD or percentage changes from baseline.

**Results:** Blood glucose trigger levels of our patients (especially the elderly) was closely linked to the intake of chromium with diet rather than to zinc intake. The effect of dietary supplementation of chromium based on the contribution of some foods has a beneficial effect on the glucose tolerance test (0.5 g glucose / kg body weight) (Fig. 1-A) and on the basal blood glucose levels (Fig. 1-B). In particular, the basal level of glucose in the serum decreases after 1 month of treatment, and this is still true after 6 months.

**Discussion:** The effect of dietary chromium supplementation has a beneficial effect on the glucose tolerance test and fasting plasma glucose. The presence of zinc was less than chromium, but competes with the same chromium to the glucose tolerance test. The baseline serum glucose level decreases although it is still less than the amount detected in subjects treated with chromium.

We can speculate that zinc and chromium may present a competitive effect on the absorption of insulin secretion and insulin receptor.

**Keywords:** zinc, chromium, dietary supplementation, glucose.

DOI: 10.19193/0393-6384\_2017\_4\_085

Received November 30, 2016; Accepted March 20, 2017

### Introduction

Both zinc and chromium work are co-factors in regulating insulin action and their nutritional intake seem to be essential for carbohydrate, lipid and protein metabolism.

An important question is if these trace elements work in a synergism or compete with each others.

The biological importance of zinc has been described in numerous recent reviews as an essential component of several metalloenzymes, and as

vital to the biochemical process of cell growth and division. Zinc works to maintain membrane integrity and when deficient works through the receptor constellation and modifies hormone-receptor interaction<sup>(1-3)</sup>. Zinc deficiency causes impaired glucose tolerance probably depending on receptor uptake capacity.

Chromium works as a co-factor for insulin and is required for glucose homeostasis and lipid metabolism. Chromium works by increasing insulin efficiency<sup>(4,5)</sup>. Aging is associated with elevated blood glucose and insulin, decreased insulin efficiency, elevated cholesterol and triglycerides, decreased HDL-cholesterol and decreased lean body mass<sup>(6-32)</sup>.

The action of zinc and chromium on carbohydrate metabolism and, consequently, on lipids and protein metabolism improves, on one hand, membrane-receptors efficiency and, on the other hand, plays an important role in regulating insulin secretion and activity<sup>(6-32)</sup>.

This study collects preliminary data on the effectiveness of one or the other trace element on the glucose tolerance impairment.

## Materials and methods

### Subjects

All patients that from a dietological examination had a borderline blood glucose level, were enrolled in the study (35 men and 58 women; 39 - 61 age range).

Participants were provided with both written and oral information regarding the study protocol and were ensured that they were free to withdraw from the study at any time. All subjects gave their written informed consent before participation. All procedures conformed to the directives of the Declaration of Helsinki. This study has been approved by the Azienda Universitaria Policlinico (AUP) at the Università della Campania "Luigi Vanvitelli".

### Dietary intake

The intake of all nutrients was measured from a week nutritional recall card using the WinFood 3.0. The intake levels during the study periods were calculated using the same method applied to either the dietary scheme or to a week nutritional recall card randomly filled by the subjects.

Chromium or zinc supplementation - Randomly the subjects enrolled in the study were

treated with chromium or zinc supplementation during the same dietological therapy.

Chemical clinical analysis - Before and during the dietological therapy a chemical-clinical check up was performed by the same laboratory or preferably by a laboratory at our University.

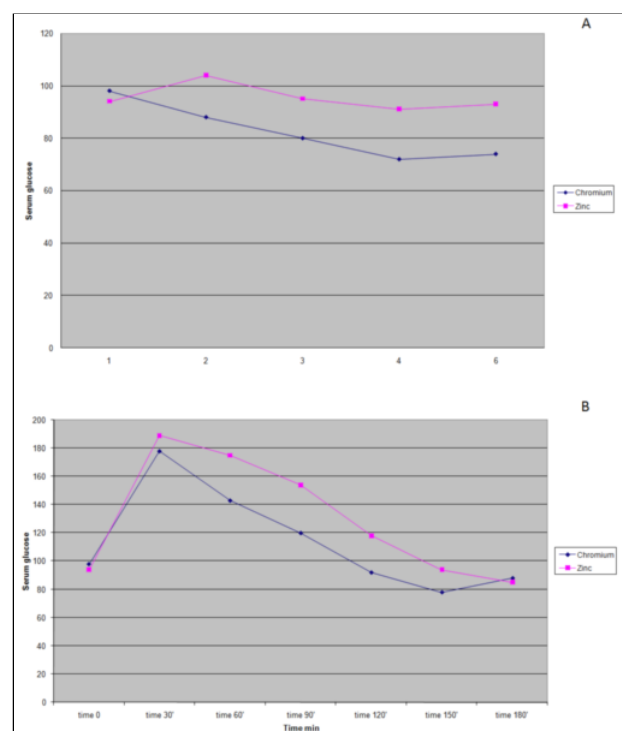
Loading glucose tolerance test - A loading glucose tolerance test was carried out on all our subjects enrolled in the study (0.5 g of glucose/Kg body weight).

### Statistical analysis

Data are expressed as mean  $\pm$  SD or percentage changes from baseline.

## Results

The borderline glucose level of our patients (especially the elderly) was strictly related to the chromium dietary intake rather than to the zinc intake. The effect of chromium dietary supplementation based on the contribution of certain aliments has a beneficial effect on glucose tolerance test (0.5 g of glucose/kg of body weight) (fig. 1-A) and on the basal blood glucose level (fig. 1-B). Particularly, the basal level of serum glucose decreases after 1 month of treatment, and this is still true after 6 months.



**Figure 1-A.** Effect of dietary supplementation of chromium or zinc in subject with border line serum glucose at same diet. **1-B.** Glucose loading test in border line subjects with dietary supplementation of chromium or zinc.

## Discussion

Generally, the subclinical micronutrient deficiencies have been gradually becoming more important as a public health problem and drawing attention of the health authorities in all ages of life. This deficiency is not only relevant in glucose metabolism, but also for regulation of complex cortical functions as sleep and involved in many different diseases<sup>(33-50)</sup>.

Zinc presence was lower than chromium and in some cases it competes with chromium on the glucose tolerance test. Our findings show that the basal level of serum glucose increases after 2 months of treatment and then decreases even though it's still less than the amount of subjects treated with chromium. The present data may be considered preliminary, although we can speculate that zinc and chromium could present a competitive effect on insulin secretion and on receptor-insulin uptake, even if further specific research are needed. In this light, specific zinc and chromium dietary supplementation and/or via nutraceutical administration may represent an interesting new topic research in the management of metabolic diseases in all ages of life.

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