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Zinc supplementation may recover taste for salt meals

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Abstract

Objective: To evaluate the effect of zinc on the appetite for salt foods in children aged 8 months to 5 years.

Method: Double-blind, placebo-controlled study. Two groups of 20 children refusing to eat salt foods were followed during six months. The children in the first group received zinc chelate 1 mg/kg daily for three months. The second group received a placebo solution. The two groups were similar in terms of age, sex, weight, duration of breastfeeding, age at weaning, biochemical and hematological data. The response of children to treatment was informed by their mothers.

Results: 17/20 (85%) of the children receiving zinc chelate and 10/20 (50%) of the children receiving placebo improved their appetite for salt foods. The difference was statistically significant ($p < 0.05$, chi-square test).

Conclusion : Zinc supplementation may improve the acceptance of salt foods by children.

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Introduction

Lack of appetite is one of the most frequent reasons for consultation with a clinical pediatrician. Although epidemiological studies on lack of appetite are few, it may account for 11% to 15% of all consultations between the ages of six months and four years in a pediatric outpatient clinic.[1]

Lack of appetite usually appears after weaning, when salt-containing foods are introduced to the diet. Sometimes it affects older children after convalescence from different infectious diseases.

In most of these cases, lack of appetite is not accompanied by any other symptoms and is specific to certain types of food, especially those with a salty flavor, receiving the name of "false anorexia".[2] Its cause has been attributed almost always to behavioral changes and inappropriate eating habits.

The diagnosis of false anorexia rules out the so-called "true anorexia" whose genesis includes subclinical infections,[3] parasitic infestations[4] and nutrient deficiencies, such as iron deficiency.[5]

Although overlooked by pediatricians, it is an important manifestation, causing stress and anxiety to the mother/child relationship. The information provided by the mothers about their children's lack of appetite, often regarded as false anorexia, should be valued, since a close relationship between mothers' complaint and their children's food intake has already been shown, as confirmed by an objective method that evaluates food intake.[6]

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Some previous studies[7] suggest zinc deficiency as being one of the causes of childhood anorexia. As a matter of fact, zinc deficiency is characterized by hypogeusia and hyposmia,[8] as classically described.[9] The effects of zinc on the taste sensation of adults are widely known.[10] However, the issue is still controversial when it involves children. Zinc supplementation in children living in rural Guatemala, for instance, improved their diet, but changes in taste sensation were not analyzed.[11]

The present study examines the hypothesis that children with zinc deficiency may lose their capacity to distinguish the taste and smell of some foods, becoming indifferent to foods that contain such taste and smell, although they have a normal appetite for other foods. This hypothesis may explain the refusal of many children with false anorexia to eat salt-containing foods.

Therefore, appetite improvement as a result of zinc supplementation allows speculating about the possible causal relationship between a suspected zinc deficiency and a seemingly simple complaint that has challenged pediatric practice.

Patients and methods

The study was carried out at the pediatric outpatient clinic of Hospital Universitário de Brasília between May 1999 and April 2001. The study protocol was previously approved by the Research and Ethics Committee of Universidade de Brasília.

Sampling

A total of 40 children, both male and female, aged between eight months and five years participated in the study. All of them were selected among the children treated at the pediatric outpatient clinic who complained of lack of appetite for salt-containing foods for at least one month. Only children with a normal clinical examination and anthropometric parameters above the 10th weight and height percentiles were included in the study. Those children who did not show up more than twice for the follow-up examination or those who did not comply with the treatment were excluded.

Methods

A double-blind study design was used. Patients were split into two groups of 20 according to the medication received (zinc chelate or placebo). Patients were alternately placed in the groups.

Each of the patients was supposed to fill out a form with the following information: age, gender, birthweight, height at birth, length of exclusive breastfeeding, total length of breastfeeding, age at the introduction of complementary foods, length of lack of appetite, family member who prepares the child's food, family member who gives the child the food, mother's job outside the home, composition of current meals, favorite and rejected foods, force-feeding practices used, medications used for lack of appetite.

Besides classic symptomatologic analysis, on initial physical examination the children were weighed unclothed on an electronic Filizola scales, their height was measured with an anthropometer and their arm circumference was measured with a tape measure. The following lab exams were performed on each patient at the time of their inclusion in the study: complete blood cell count (using a cell counter), total protein, serum protein electrophoresis, serum alkaline phosphatase, urinalysis, and stool test for parasites. Serum zinc levels were not determined.

Children were given a solution containing either placebo or zinc chelate and were followed every month during six months. Neither the attending physicians nor the mothers knew about the composition of the solution used. One milligram of zinc/kg/day was prescribed, divided into two equivalent doses, given 30 minutes before the two major meals. In addition to giving the medication supplied by the laboratory every month, the mothers have received the same instructions since the first consultation. They were told to offer the meals at the regular time, not to force-feed, not to make any negative comments if the child refuses to eat, not to offer another food to compensate for the refused one, not to start an argument, not to make threats or reward the child in order for him/her to accept the refused foods, and to give little importance to the child's refusal to eat.

Eating history was assessed in every appointment, when the information about the child's appetite was obtained from the mother, especially about salt-containing foods that used to be rejected before the introduction of medication. This information was recorded on the follow-up form. Appetite improvement was considered as appetite for salt-containing foods that used to be rejected, recorded in at least two appointments.

Placebo and zinc chelate were given in identical flasks, had the same color, taste and smell, and were labeled as solutions "a" and "b", supposedly containing 10 mg of zinc per ml. The solutions were prepared and supplied by a pharmaceutical laboratory in the city of Brasília.

The completed forms were tabulated for the calculation of the means of numerical variables and of the percentage of categorical variables for both groups. The homogeneity of groups was tested using Student's t test for independent samples and Fisher's exact test for comparing proportions. A p value < 0.05 was established.

The statistical analyses were made using SPSS, version 8, and Epi-Info version 6.

Results

Twenty children received zinc chelate, and another 20 received placebo. Even though patients were

alternately included, the means and proportions of the analyzed variables did not show any significant differences, except for birthweight and height, which were lower in the placebo group. Thus, two virtually homogeneous groups were randomly formed (Table 1).

Table 1 - Comparison between the groups that received zinc chelate and placebo

	Zinc	Placebo	p
Sex			
Male (%)	50.0	38.9	0.15
Female (%)	50.0	61.1	
Feeding			
Mother (%)	61.1	87.5	0.07
Others (%)	38.1	12.5	
Maternal working			
Working mother (%)	11.8	6.3	0.21
Non-working mother (%)	88.2	93.8	
Forcing children to eat			
Yes (%)	88.2	80.0	0.17
No (%)	11.8	20.0	
Previous treatment			
Yes (%)	77.8	75.0	0.73
No (%)	22.2	25.0	
Age (months)	32.2	28.0	0.14
Weight (kg)	12.4	10.6	0.50
Height (cm)	90.9	85.8	0.004
Birthweight (g)	3,031	2,664	0.042
Arm circumference (cm)	15.0	14.4	0.09
Exclusive breastfeeding (months)	4.4	4.7	0.65
Breastfeeding (months)	12.1	15.3	0.33
Weaning (months)	4.7	5.4	0.15
Hemoglobin (g/dl)	12.4	12.0	0.32
Hematocrit (%)	37.2	36.7	0.63
Proteins (g/dl)	7.0	6.9	0.63
Albumin (g/dl)	4.2	4.4	0.49
Alkaline phosphatase (U/l)	240.8	230.6	0.85

Significance level: $p < 0.05$.

The response to zinc chelate and placebo are shown in Table 2, where we note a preponderance of favorable responses in the children who received zinc chelate, comparatively to those who received placebo ($p < 0.05$).

Table 2 - Response to zinc chelate and placebo

	Increase appetite	Unaltered appetite	Total
Chelate	17	3	20
Placebo	10	10	20
Total	27	13	40

$\chi^2 = 5.58$ $p = 0.018$ Significance level: $p < 0.05$.

Discussion

In the last 10 years, a wide series of studies have shown that zinc deficiency is a major public health problem in developing countries.[12] In these countries, the high content of dietary phytate is regarded as an important factor for the remarkable prevalence of zinc deficiency.[13] On the other hand, in these countries, infants have a low intake of zinc, especially during the weaning period, when the complementary diet does not meet zinc requirements.[14] Besides the classic skin disorder caused by zinc deficiency – periorificial dermatitis –, several other clinical disorders have been described, such as growth retardation, hypogonadism, diminished taste sensation (hypogeusia) and hyposmia, in addition to a higher prevalence of respiratory infections and diarrhea.[15] There also is increasing evidence that zinc deficiency may be closely related to anorexia in humans.[16]

Our hypothesis herein is that lack of appetite for salt-containing foods, often observed in children in the first four years of life, may result from zinc deficiency in many cases, which explains the loss of interest in a flavor/taste that is not perceived. This hypothesis is based on an experimental study that shows an increase in the taste threshold for saline solution in rats previously submitted to zinc deficiency.[17] A study conducted with five adults submitted to zinc-deficient diets showed that they had no perception of the salty taste of foods, but that they restored such perception when they received a diet with appropriate zinc content.[18]

The results of our study show that the proportion of children who received zinc supplementation and regained their appetite for salt-containing foods is higher than that of children treated with placebo ($p < 0.05$) (Table 2). Despite this difference, we should not forget that the assessment of the response was based only on the information provided by the mothers. The fact that the children's zinc levels were not measured restricts the possibility for safer conclusions about the possible causal relationship apparently demonstrated by the results. In addition, the difference observed between both groups does not have a strong statistical significance due to the small sample size used.

The findings of similar studies suggest a comparable conclusion, although the authors used the increase in average calorie intake and the weight gain of analyzed children as a parameter for assessing their response to zinc.[19,20] Quite recently, there have been objective signs that zinc supplementation has reduced anorexia among malnourished Ethiopian children.[21]

Here, we used zinc chelate, differently from most of other authors, whose experience is concerned with zinc

sulfate, acetate, carbonate or oxide.[22,23] The solubility of these zinc salts in aqueous solution is variable; zinc carbonate and oxide are basically insoluble, having a much lower absorption.[24] In the present study, we used zinc bis-histidinate chelate, which consists of zinc bound to two histidine molecules as chelate. This is one the most easily absorbed forms of zinc, with an absorption greater than 50%.[25]

The fact that serum zinc levels were not determined does not invalidate the obtained results, since this exam has a relative diagnostic value for zinc deficiency, and may show normal levels, by means of homeostatic mechanisms, even in situations of severe dietary deficiency[26]. Because the investigation of zinc metabolic balance is technically restricted, the effects of zinc deficiency on children can only be confirmed through a therapeutic evaluation, as the one performed in the present study. The possibility of zinc deficiency in the analyzed children is high as most of them are at risk for this deficiency, that is, they are in the process of growing and still have breastfeeding as their major food source after the sixth month of life.[27] In fact, human milk does not seem to provide enough zinc concentration to protect infants from zinc deficiency, as suggested by the increase in the rate of growth produced by zinc supplementation in healthy children on exclusive breastfeeding.[28] It is common knowledge that between the sixth and twenty-fourth months of life 84-89% of the daily zinc requirement is provided by complementary foods, which represents a daily consumption of 50-70 g of liver or red meat, or of 40 g of fish between the sixth and ninth months of life,[29] a requirement that exposes most infants to the risk of zinc deficiency, especially in economically underprivileged populations.

The possible interference of other variables in the observed results is basically ruled out, since the comparison of their means and proportions in both groups of children did not show statistically significant differences, except for current height and birthweight, whose means are lower in the placebo group (Table 1). However, this discrepancy does not seem to have influenced the results as no difference in children's nutritional status was observed. None of the children were malnourished.

The results of this study, based on the information provided by the mothers, suggest that supplementation with zinc chelate may be efficient in restoring the appetite for salt-containing foods in clinically healthy children aged between eight months and five years. The effect of zinc supplementation was 35% higher than that of placebo. Further studies should be conducted so as to determine the actual efficiency of this possible therapeutic action of zinc.

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