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Efficacy of Zinc Supplementation on Improvement of Weight and Height Growth of Healthy 9-18 Year Children

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Abstract: The purpose of this study was to evaluate the effect of zinc supplementation on weight and height growth of non-zinc-deficient healthy children. A parallel single-blinded randomized clinical trial was conducted on 9-18 year old healthy referred children to Pediatric Clinic of Shahid Sadoughi Hospital, Yazd, Iran from April to October 2011.Children were randomly assigned into two groups to receive daily supplementation of single dose of 5 mg zinc sulfate supplementation for 4 months or placebo. The primary variables were weight gain velocity, height gain velocity and serum zinc level that were evaluated before and four months after intervention. Secondary variable was clinical side effects. Results revealed that 48 girls and 47 boys with mean age of 12.2 ± 2.39 years were evaluated. Weight gain velocity (0.52 ±0.41 kg/month vs. 0.27 ±0.11 kg/month, p= 0.01) and height gain velocity (0.89±0.23 centimeter/month vs. 0.40 ±0.28 centimeter/month, p= 0.001) were higher in zinc group. Serum zinc level was not significantly different in both groups. Transient mild gastrointestinal side effects were seen in four children (8.3%) in zinc group. In conclusions, Zinc supplementation can improve weight and height gain velocity of healthy adolescents.

Key words: Children · Height · Supplement · Weight · Zinc

INTRODUCTION

Zinc is an essential micronutrient and plays critical role in cell division, protein synthesis, wound healing and immune function. Clinical manifestations of zinc deficiency include growth retardation, weight loss, acne, predisposal to infections and poor immune system, delay of wound healing, hypogonadism in males, lack of sexual development in females, rough skin, poor appetite, diarrhea, pneumonia and taste abnormalities [1].

It is estimated that 25% o f the world population is at risk of zinc deficiency [2] and prevalence of zinc deficiency in Iran varies from 7.9% [3] to 85.5% [4].

Zinc deficiency decreases insulin-like growth factor(IGF) -I secretion, cellular responsiveness to IGF and affects responsiveness of GH deficient children to hormone therapy. Zinc-containing nucleoproteins that are involved in gene expression of multiple proteins many of which are important for growth and suboptimal intake of zinc can also cause growth retardation [5].

A study in Turkey showed higher variation percentile of serum IGF-I level in prepubertal children compared to pubertal children [6].

Efficacy of zinc supplementation on improvement of growth of infants and prepubertal children has been evaluated in several studies in Iran and other countries [7-12].

Little is known, however, about efficacy of zinc on post-pubertal growth of children. The purpose of this study was to evaluate the effect of zinc supplementation on weight and height growth of non - zinc deficient healthy 9-18 year old children in Yazd, central city of I.R. Iran.

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MATERIALS AND METHODS

A randomized single – blind clinical, open-label, parallel group study was conducted on healthy 9-18 year old referred children to Pediatric Clinic of Shahid Sadoughi Hospital, Yazd, Iran from April to October 2011.

Simple randomisation was done by a computer generated random numbers list which was prepared by an investigator with no clinical involvement in the trial.

Eligible participants included 9-18 year old healthy children with normal serum zinc level (plasma level of 70-158 µg /dL) [3].

Exclusion criteria consisted of receiving a zinc combination within the past three months, presence of any chronic systemic diseases(endocrine,cardiac, renal, metabolic, malignancy, rheumatologic, etc), acrodermatitis enteropathica, neurodevelopmental delay, underweight (weight below the third percentile on a standard growth curve) and short stature (height of less than two standard deviation from height) based on NHANES III (National Health and Nutrition Examination Survey III) curves [13] and severe malnutrition.

The children were randomly assigned to two groups to receive daily supplementation of single dose of 5 mg zinc sulfate for four consecutive months or placebo as control group. Appearance and taste of zinc and placebo tablets were identical.

Zinc level of venous blood sample of all children was measured at first and at the end of four months with atomic absorption spectrometry.

Weight and height of all children were measured at baseline, two and four months after starting of the intervention. All children were weighted by a children digital weighing scale with a sensitivity of 100 grams without shoes, in little or no outer clothing. The scale was calibrated at regular intervals.

The standing crown- heel height was measured by wall-mounted stadiometer to the nearest millimeter.

The weighing scale and stadiometer were made by Seca (Germany).

To minimize errors due to interobsever variability, all measurement were made in the Shahid Sadoughi Hospital and by one researcher.

The primary measures were weight and height gain velocity and serum zinc level before and four months after starting of the intervention. Secondary measures were clinical side effects.

The intervention was delivered by mothers and the primary and secondary outcomes were assessed by a researcher who was not informed of the intervention group assignment. Investigators, the staff and participants were all masked to outcome measurements and trial results.

Sample size was based on Z formula and a confidence interval of 95% with 80% power, type one error of 5% to detect any significant difference between the two groups with a level of 0.05, was assessed in 50 children per group.

The data were analyzed using Statistical Package for the Social Sciences version 17 (SPSS, Chicago, IL, USA) statistical software.

Chi-square test was used for data analysis of qualitative variables and mean values were compared using independent T-test. Differences were considered significant at P values of less than 0.05.

Permission for children participation in the research, history taking and physical examination performance was asked from their parents and the study has been approved by the Ethic Committee of Shahid Sadoughi University of Medical Sciences, Yazd, Iran.

This study is registered in Iranian clinical trials with registration number:

IRCT201305302639N13. Meanwhile, the researchers got no support from the drug company.

RESULTS

Parents of five children(three children in placebo and two children in zinc group) did not return for the follow up and therefore their children were excluded from the study.

Finally, 95 children including 48 girls and 47 boys with mean age of 12.2 ± 2.39 years were compared in two groups (zinc and placebo).

The baseline characteristics of the children are shown in Table 1 which indicates that no statistically significant differences were noted between the two groups for gender, sexual maturity rating and before intervention of mean of age, weight, height and zinc level.

Table 2 shows mean of weight and height of children two months after the intervention. No statistically significant differences were noted between the two groups for these variables.

Mean of weight, height, weight gain velocity, height gain velocity and serum zinc level of children in four months after the intervention is presented in Table. 3 which indicates that no statistically significant differences were noted between the two groups for mean of weight, height and zinc level but weight and height gain velocity were higher in zinc group.

Table 1: Baseline characteristics of children in both groups

Data		Group: Zinc	Group: Placebo	P. value
Gender	Girl	23	25	0.47
	Boy	25	22	
Sexual maturity rating	1	8	7	0.45
	2	12	10	
	3	12	9	
	4	11	13	
	5	5	8	
Age in years (mean ±SD)		11.93 ±2.3	12.41±2.35	0.15
Zinc level at the start of the study in µg/dL (mean ±SD)		71.8±15.8	76.5±15.1	0.14
Weight at the start of the study in kilograms(mean ± SD)		49.8 ±13.5	54.4±12.8	0.11
Height at the start of the study in centimeters(mean ±SD)		144.8±12.4	148.5±14.2	0.18

Table 2: Mean of weight and height of children in two months after the intervention

Data	Group: Zinc	Group: Placebo	P.value
Weight in kilograms (mean ±SD)	50.76±13.18	55.02±12.18	0.11
Height in centimeters (mean ±SD)	146.45±12.66	149.24±14.31	0.32

Table 3: Mean weight, height, weight and height velocity and serum zinc level of children in four months after the intervention

Data	Group: Zinc	Group: Placebo	P. value
Weight in kilograms (mean ±SD)	51.86±12.43	55.54± 12.48	0.15
Height in centimeters (mean ±SD)	148.41±12.59	150.09±14.34	0.54
Weight velocity in kilogram per month(mean ±SD)	0.52 ±0.41	0.27 ±0.11	0.01
Height velocity in centimeter per month(mean ±SD)	0.89±0.23	0.40 ±0.28	0.001
Serum zinc level in µg/dL (mean ±SD)	77.55±16.04	76.72±14.86	0.79

Transient mild gastrointestinal side effects were seen in four children (8.3%) in zinc group which disappeared in 1-2 weeks and treatment stopped in none of the children who suffered from them.

DISCUSSION

Assessment of prevalence and severity of zinc deficiency in different countries is important to evaluate the need for right targeting of programs for zinc intervention and their effectiveness assessment to improve the health and well-being of risky populations [14].

Because of insufficient food habits and poor plant-based diets bioavailability of zinc, adolescents in developing countries may be at high risk of zinc deficiency [15].

In present study, efficacy of 5 mg of zinc supplementation for four months on weight and height gain velocity of non- zinc deficient healthy 9-18 year old children was evaluated and results showed that weight and height gain velocity were higher in zinc group.

In meta-analyses of 43 randomized controlled trials of Ramakrishnan et al. zinc interventions in children under the age of five, had a small positive effect on changes in weight for-height z scores but had no significant effect on height or weight gain [16].

In meta-analyses of Brown et al. preventive zinc supplementation in infants, preschoolers and older prepubertal children, significantly improved linear growth and weight gain velocity and increased mean of serum zinc level [17].

In another meta-analyses of Brown *et al.* [18]zinc supplementation increased significantly weight, height and serum zinc level of prepubertal children but had no significant effect on weight-for-height indexes.

In Kawade study in India, supplementation of zinc-rich recipes in 10-16 year girls improved plasma zinc level [15].

In a study in Khorramabad, Iran, 20 mg of zinc supplementation for four months in 11 year old children increased serum zinc level and children who were zinc deficient at the start of the study had a significantly greater increase in serum zinc than non-zinc deficient children [19].

Results of evaluation of 12 studies by Ruz in Chile showed that zinc supplementation in infants and children increased weight gain velocity in two studies and improved height in one study and it concluded that zinc supplement to healthy non-zinc-deficient, non-stunted children did not induce growth effects [20].

In a randomized, double-blind, placebo-controlled efficacy trial study in Burkina Faso, Africa, height, weight, z scores for height-for-age, weight-for-age and weight-for-height were not significantly different in 6-31 month old children who received 12.5 mg daily zinc sulphate supplementation for 6 days a week for 6 months. But, serum zinc level significantly increased in zinc group [21].

Possible explanations for these discrepancies are differences in: dose, duration of zinc therapy , geographic area, sample size, markers and definitions for zinc deficiency.

It should be mentioned that growth is a dynamic and complex process in which the role and interact of many nutritional and non-nutritional factors are important, but the extent and consequences of such roles and interactions are not still clearly discovered [19].

It seems necessary to conduct further researches with a larger sample size, longer follow- up duration, in equal sexual maturity rating indexes, in same gender and with different dosage of zinc to evaluate the effect of zinc supplementation on growth process of post puberty children.

In conclusion, based on results of present study , weight and height gain velocity were higher in zinc group. Zinc supplementation may be effective in improvement of physical growth velocity of healthy non- zinc deficient children in different stages of puberty. Further studies in different countries and in same stages of puberty are highly recommended to clarify the definite efficacy of this micronutrient supplementation.

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