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RESEARCH ARTICLE

Iron and Zinc Status of Children with Short Stature from Egyptian Rural Areas

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Abstract

Background and Aims: Short stature is a common problem in children globally, especially in developing countries. Micronutrient deficiencies are prevalent in developing country. Our aim was to study iron and zinc status in Egyptian children with short stature from rural areas (Eastern province) in age group 8-12 years.
Methods: This study was conducted on 80 children who divided into 2 groups: group (1): 40 children with normal length for age as controls. Group (2): 40 children with short stature. All children included submitted to clinical assessment and laboratory tests including CBC, serum iron, TIBC, serum ferritin and zinc levels. Familial and Endocrinological causes of short stature and chronic diseases were excluded, **Results:** There was significant decrease in height (cm), weight(kg), BMI(%), hemoglobin (g/dl), and serum iron(µg/dl) in group 2 (128.9 ± 6.98, 60.2 ± 8.11, 20.1 ± 1.36, 10.1± 1, 61.5± 3.65 compared to group 1 (136.8 ±7.65, 68.9 ±7.58, 22.65 ± 1.98,11.15 ± 0.98 , 66.8± 4.32 ($p<0.05$). Serum zinc levels (mg/dl) and serum ferritin (ng/ml) were significantly lower and TIBC (µg/dl) were significantly higher in group 2 (54.3 ± 5.65, 24.5 ± 2.36, 325.6± 109.58) in comparison with group 1 (70.6 ± 6.22, 32.5 ± 5.32, 198.6 ± 56.8) ($p<0.001$). Serum iron was positively correlated with serum zinc and negatively correlated with TIBC ($p<0.001$). While, there was no significant correlation between serum zinc, iron levels, TIBC and serum ferritin with height, weight and BMI ($p>0.05$).
Conclusion: Serum iron and zinc are significantly decreased in children with short stature

INTRODUCTION

Short stature is a common problem in children globally, especially in developing countries (Lam et al., 2002). The past few years have seen several substantial advances in our understanding of the importance of micronutrients in child health nutrition. Although, historically child nutrition in developing countries has focused on protein and energy sufficiency, more recent efforts have been made to evaluate and eliminate micronutrient deficiencies (Oken and Duggan, 2002).

Micronutrient deficiencies are prevalent in early life, particularly in developing country and during infancy and toddler hood, when there is rapid growth and a concomitant high nutritional demand. Other vulnerable periods are adolescence and pregnancy. Among Micronutrients, iron is the most common nutritional deficiency in the world and is the major cause of anemia (UNICEF, 1999).

Another micronutrient of concern is zinc. Despite one of the main constraints to determining the prevalence of zinc deficiency accurately being the lack of reliable markers, evidence from supplementation studies and community-based investigations suggests that zinc deficiency can be as common as iron deficiency (Castillo-Duran et al., 1994).

Along with established risk factors such as frequent infection and poor weaning foods, there is strong evidence that several micronutrients (primarily zinc, iron, and vitamin A) play important roles in linear growth, and that deficiencies in these key nutrients may result in stunting. Zinc directly influences the growth hormone and insulin-like growth factor-I systems, affects bone metabolism and it is involved in DNA synthesis (Rivera el al., 1998).

Deficiencies of iron and zinc often coexist and cause growth faltering and delayed development and increased morbidity due to infectious disease (Bhutta et al., 1999). Combined supplementation with both iron and zinc in vulnerable populations may therefore be a logical preventive strategy when iron and zinc are low in complementary foods or when iron and zinc have low bioavailability (Sandström, 2001).

Zinc supplementation significantly improved growth (weigh-for-age Z score (WAZ) and knee-heel length), and iron supplementation significantly improved knee-heel length and psychomotor development compared with placebo (Perrone et al., 1999).

A number of supplementation trials have been carried out in children to assess the effect of zinc on physical growth. A meta-analysis of 33 randomized intervention trials showed that zinc supplementation produced highly significant positive response in weight gain as well as linear growth (Brown et al, 2002).

Our aim was to study iron and zinc status in Egyptian children with short stature in rural areas as (Eastern province) in age group 8-12 years.

Materials and methods:

This is a case control study was conducted on 80 children, their age ranged from 8-12 years. They collected from one of Egyptian rural areas Eastern province. Exclusion criteria included Familial and Endocrinological causes of short stature, chronic infections and psychological deprivation.

Selected subjects were divided into 2 groups: Group 1: 40 healthy children with normal height for age (according to growth charts) (Figure 1, 2) as a control group matched for age and sex Group 2**:** 40 children with short stature for age according to growth charts. All included children submitted to clinical assessment by history (dietary, developmental, family history and socioeconomic status), and complete examination (height, weight, body mass index (BMI), upper and lower body segments). The following laboratory tests were done to all children: complete blood picture(CBC), serum zinc by atomic absorption technique (normal values 60-120 µg /dl)(Vogel; 1961), serum iron by Colorimetry (normal values for children: 50-120 µg /dl) (Sandell, 1944), serum ferritin (normal values for children up to 15 years 7-140 ng/ml) (Ginder et al., 2011), total iron binding capacity (normal values 240-450(µg/dl) (Ginder et al., 2011) and stool analysis. Hormonal assay as thyroid profile, fasting growth hormone and after clonidine stimulation to exclude short stature due to hormonal deficiency

This study was approved by the internal review board of Ain Shams University. All subjects' family provided written informed consent before the study.

Results:

The studied groups were age and sex matched ($p > 0.05$). There was a statistically significant difference ($p < 0.05$) between both groups regarding anthropometric measurements (Table 1). There were 2 positive parasitic infections in group 1, and 3 positive parasitic infections in group 2 with no significant difference between both groups ($p > 0.05$). There was significant decrease in hemoglobin (g/dl), and serum iron (µg/dl) in group 2 (10.1± 1, 61.5± 3.65) compared to group 1 (11.15 ± 0.98, 66.8± 4.32 ($p<0.05$) (Figure 3). Serum zinc levels (mg/dl) and serum ferritin (ng/ml) (Figure 4) were significantly lower and TIBC (µg/dl) were significantly higher in group 2 (54.3 ± 5.65, 24.5 ± 2.36, 325.6± 109.58) in comparison with group 1 (70.6 ± 6.22, 32.5 ± 5.32, 198.6 ± 56.8) ($p<0.001$). Serum iron was positively correlated with serum zinc and negatively correlated with TIBC ($p<0.001$). While, there was no significant correlation between serum zinc, iron levels, TIBC and serum ferritin with height, weight and BMI ($p>0.05$) (Table 2).

Table (1): Comparison between the different studied groups as regard their anthropometric measurements by student t-test

	Control group "n=40"	Study group "n=40"	p
Height (cm)			
Range	125 – 152	122 – 142	
Mean	136.8	128.9	0.041*
S.D.	7.65	6.98	
Weight (kg)			
Range	55 – 80	52 – 75	
Mean	68.9	60.2	0.048*
S.D.	7.58	8.11	
BMI			
Range	18.85 – 26.2	17.2 – 25.1	
Mean	22.65	20.1	0.033*
S.D.	1.98	1.36	

Table (2): Correlation between different studied parameters by correlation Pearson test:

		Iron binding capacity	Serum zinc level	serum ferritin	serum iron level	WBCs
Serum zinc level	r	-.893**				
	p	.000				
serum ferritin	r	-.877**	.881**			
	p	.0001	.0001			
serum iron level	r	-.940**	.787**	.817**		
	p	.0001	.0001	.0001		
WBCs	r	-.919**	.763**	.701**	.955**	
	p	.0001	.0001	.0001	.0001	
Hb	r	-.947**	.902**	.964**	.910**	.833**
	p	.0001	.0001	.0001	.0001	.0001
Wt	r	0.132	0.204	0.115	0.365	0.125
	p	0.322	0.307	0.411	0.201	0.46
Ht	r	0.214	0.105	0.225	0.365	0.15
	p	0.325	0.426	0.421	0.145	0.365
BMI	r	0.116	0.21	0.25	0.165	0.465
	p	0.452	0.265	0.25	0.365	0.151

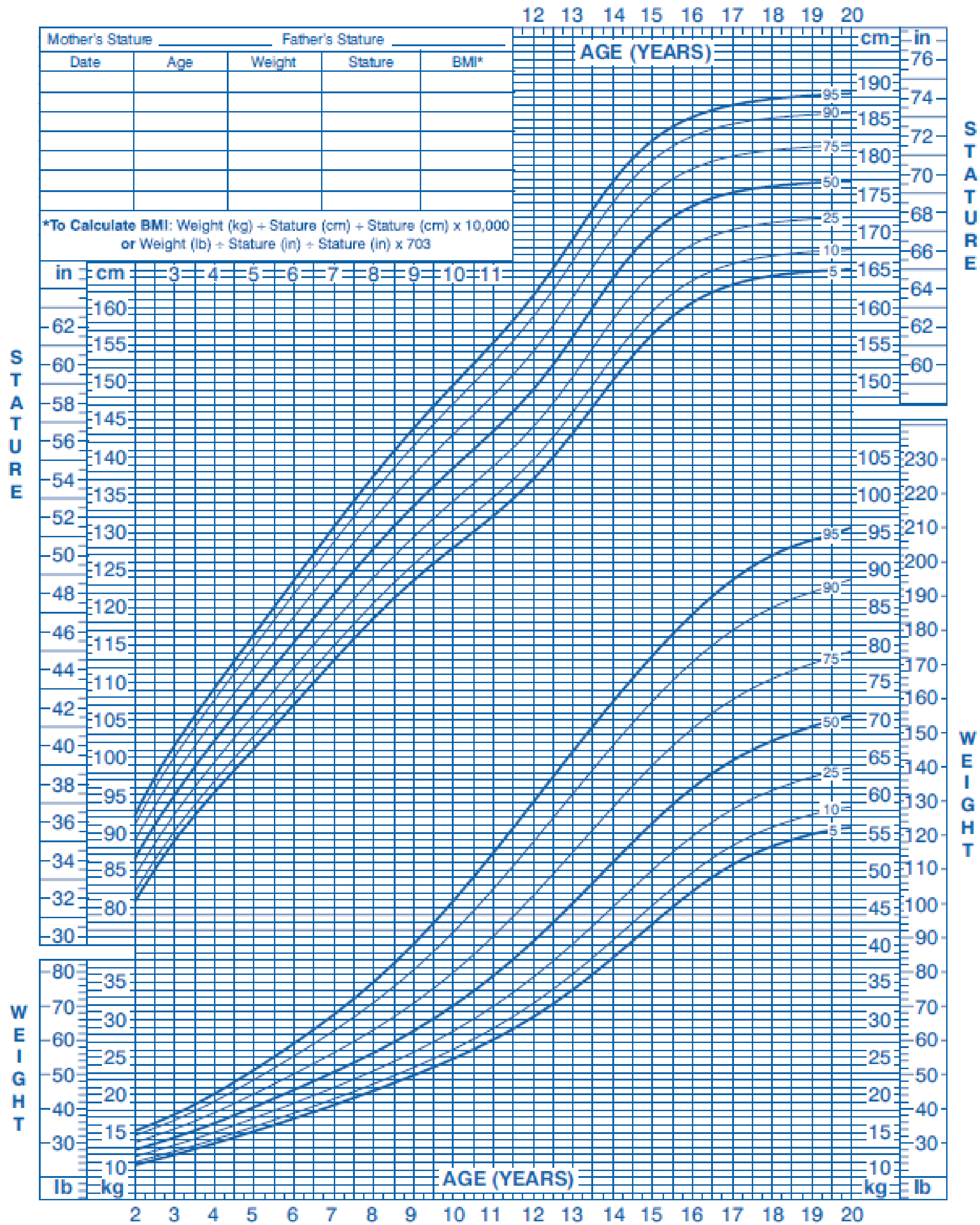

Figure 1: Stature-for-age and Weight-for-age percentiles for boys 2-20 years (The National Center for Health Statistics; 2000)

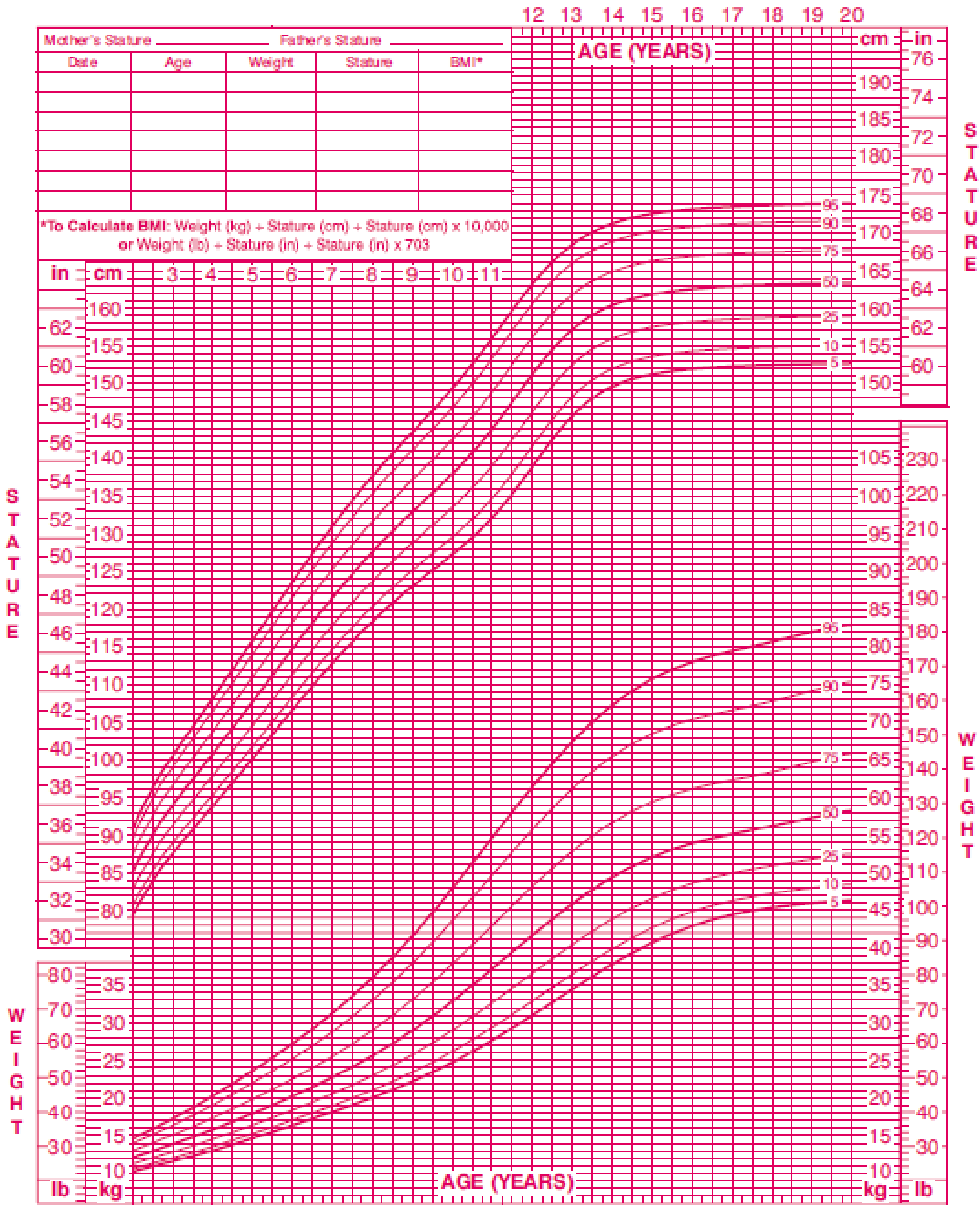

Figure 2: Stature-for-age and Weight-for-age percentiles for girls 2-20 years (The National Center for Health Statistics; 2000)

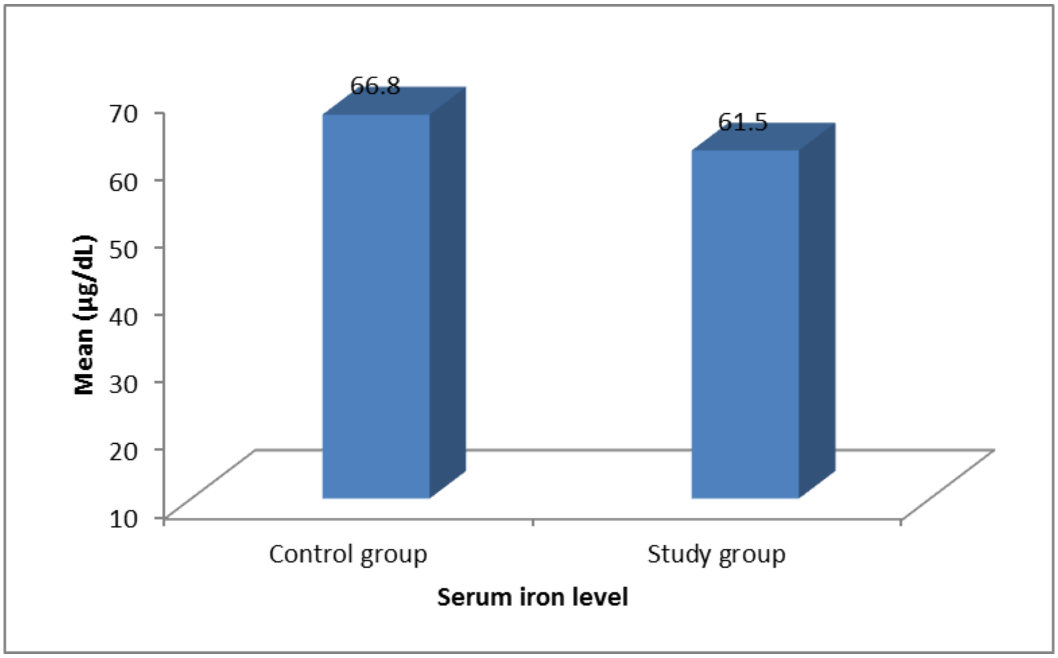

Figure 3: Comparison between the two studied groups regarding serum iron level (µg/dL). (P=0.042)

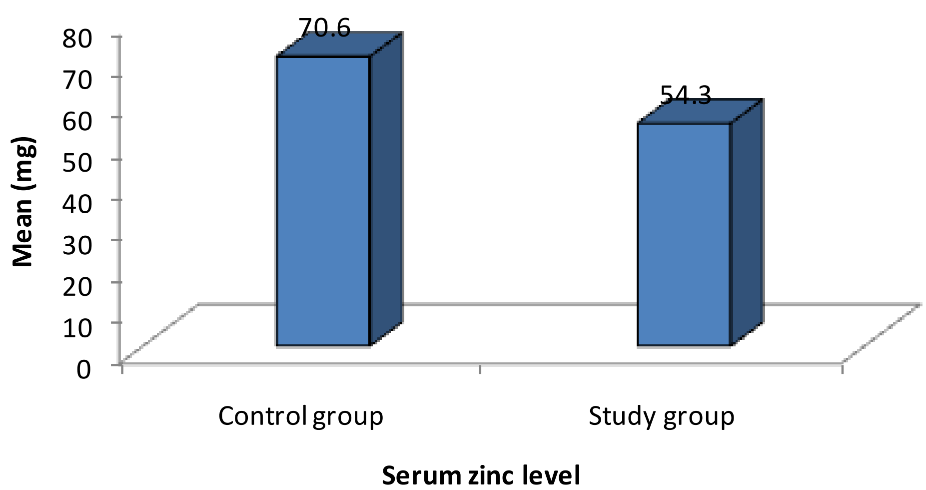

Figure 4: Comparison between the two studied groups regarding serum zinc level. (P<0.001)

Discussion:

Micronutrient deficiencies are common consequences of the plant-based diet in children from developing countries which may affect their linear and ponderal growth (chiplonkar et al, 2013). In developing countries, zinc deficiency is still present and is usually associated with iron deficiency (Hettiarachchi et al., 2006). Zn deficiency was first documented in Egyptian subjects with growth retardation (Prasad et al., 1963). Further studies showed that the growth rate was higher in subjects who received supplemental Zn than in those who received iron instead or an adequate animal-protein diet (Karaca et al., 2007). In the present study we found that serum iron and zinc were significantly decreased in children with short stature in Egyptian rural area (Eastern province) in comparison to control children with normal height for age ($p<0.05$). Clinical iron deficiency anemia is one of the features of the Zn deficiency syndrome (Prasad, 2001). Therefore, it was not surprising to detect iron deficiency besides Zn deficiency in our patients .Chiplonkar and Colleagues found that Micronutrient sufficiency is of paramount importance for adequate growth in Indian girls (chiplonkar et al, 2013). Girls with short stature (HAZ <-2) had significantly lower intakes of calcium, zinc, iron, β-carotene, riboflavin, niacin, folate and ascorbic acid ($p<0.05$). Higher levels of serum zinc and hemoglobin were observed in girls with HAZ >-1 than in short girls even after adjusting for socioeconomic status (SES). The mean serum zinc level of thin girls (BMIZ <-2) was significantly lower than those of both normal and overweight girls after adjusting for SES (chiplonkar et al, 2013). More studies are needed to understand the effect of Zn and iron state and its supplementation on the growth process.

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