

# Alterations in serum levels of minerals and trace elements in helminth infected and non-infected school children in Gondar, Ethiopia



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## Abstract

**Background:** Trace elements are essential micronutrients with regulatory, immunologic, and antioxidant functions resulting from their action as essential components or cofactors of enzymes throughout metabolism. Alteration of serum trace elements concentration is commonly found in children suffering from gastrointestinal parasites and it has been reported in developing countries of South-east Asia, Latin America and some African countries. In Ethiopia, information on the levels of many trace elements in human biological tissues is scarce.

**Objective:** The study was aimed to assess the serum levels of Mg, Ca, Fe, Cu, Se and Mo in children with and without helminth infection in North-west Ethiopia.

**Method:** One hundred school children were used in this study. Serum level of Mg, Ca, Fe, Cu, Se, and Mo were determined using an inductively coupled plasma mass spectrometer from all subjects. Parasite infection was detected using formalin-ether sedimentation concentration method.

**Results:** The mean concentration of Ca (mg/dl), Cu, and Mo (µg/dl) (Mean ± Sd, 16.393 ± 2.046, 214.739 ± 56.576, and 0.308 ± 0.159) in helminth infected was significantly (P<0.05) higher than the non-helminth infected children (Mean ± Sd, 15.072 ± 2.098, 186.155 ± 47.491, and 0.212 ± 0.139) controlling other confounding factors (age, sex and body mass index). However, there was no significant variation in the serum level of Mg, Fe, Zn, and Se in the two groups.

**Conclusion:** The result indicates that there is alteration in serum trace elements. The higher mean serum trace elements (Ca, Cu, and Mo) in helminth infected children than the non-helminth infected implicate altered element metabolism due to the pathophysiological changes of helminth infection. A large scale detailed biochemical and clinical studies are needed to put forward a relationship between serum trace elements level and helminth infection.

## Methods

**Study area:** Meseret Elementary School in Gondar town, Ethiopia

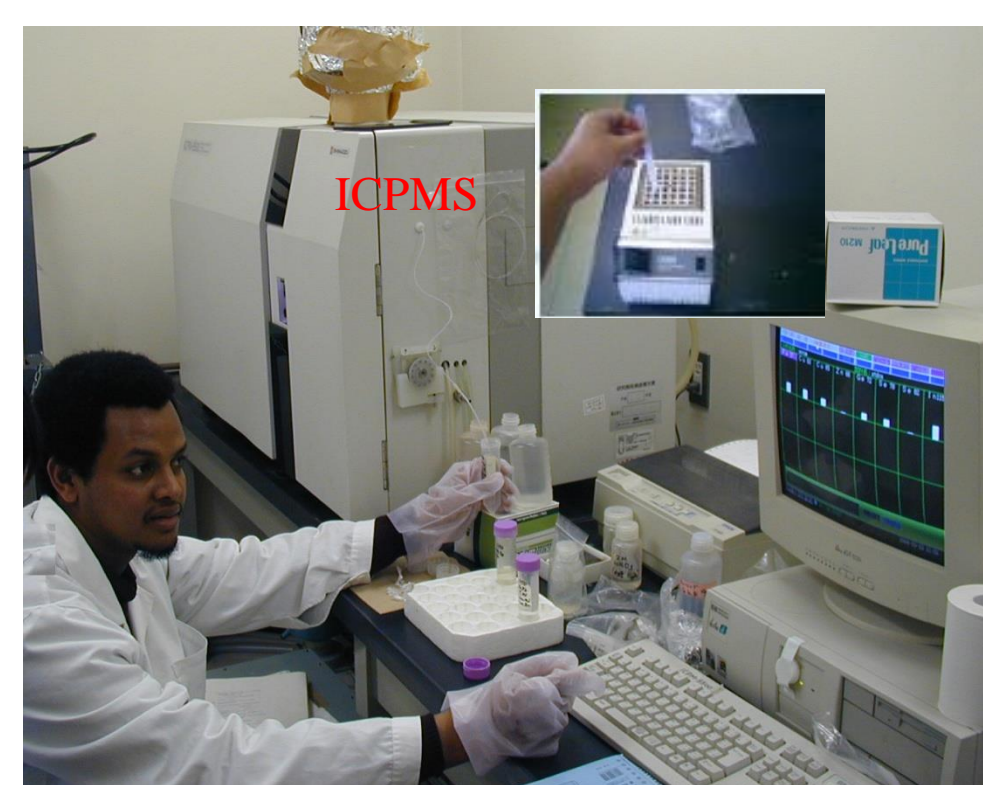
**Subjects:** School children

**Design:** Cross-sectional

**Nutritional assessment:** Body Mass Index (BMI) as recommended by WHO.

**Diagnosis of intestinal parasites:** Direct and concentrated stool microscopy

**Determination of trace elements in serum:** using an Inductively Coupled Plasma Mass Spectrometer



High sensitivity: ppt detection level  
Multi-elemental coverage: almost all elements  
Fast analysis time: few minutes/sample  
Wide analytical detection range: up to 9 orders

Hasegawa et al. Anal. Sci. 2001; 17:i979-i982

Significant difference in mean concentration of some trace elements was observed In Relation To Children's Nutritional Status

Micronutrients	Nutritional status			
	Severe malnutrition N(37)	Moderate malnutrition N(16)	Mild malnutrition N(18)	Normal N(29)
Magnesium (mg/dl)	2.56±0.34*	2.35±0.34	2.31±0.19	2.36±0.30
Calcium (mg/dl)	15.97±2.09	14.85±2.57	15.01±1.89	14.90±1.99
Iron (µg/dl)	361.88±170.22	311.68±167.59	299.11±132.51	312.36±113.95
Copper (µg/dl)	203.66±51.36	197.67±54.46	179.27±43.58	179.48±47.98
Zinc (µg/dl)	76.81±46.01	82.76±34.39	101.67±39.12	91.18±42.05
Cu/Zn ratio	3.36±1.67 <sup>†,‡</sup>	2.79±1.23	2.01±0.87	2.25±0.84
Selenium (µg/dl)	5.69±2.33	5.50±2.34	7.058±2.69	7.12±2.75
Molybdenum (µg/L)	0.29±0.15 <sup>**</sup>	0.19±0.14	0.21±0.13	0.18±0.13

\*P<0.05 versus mild nutrition  
\*\*P<0.05 versus normal  
† P<0.05 versus moderate malnutrition  
‡ P<0.05 versus normal

## Results

Malnutrition and helminth infection was observed in (71%) and (18%) of school children, respectively

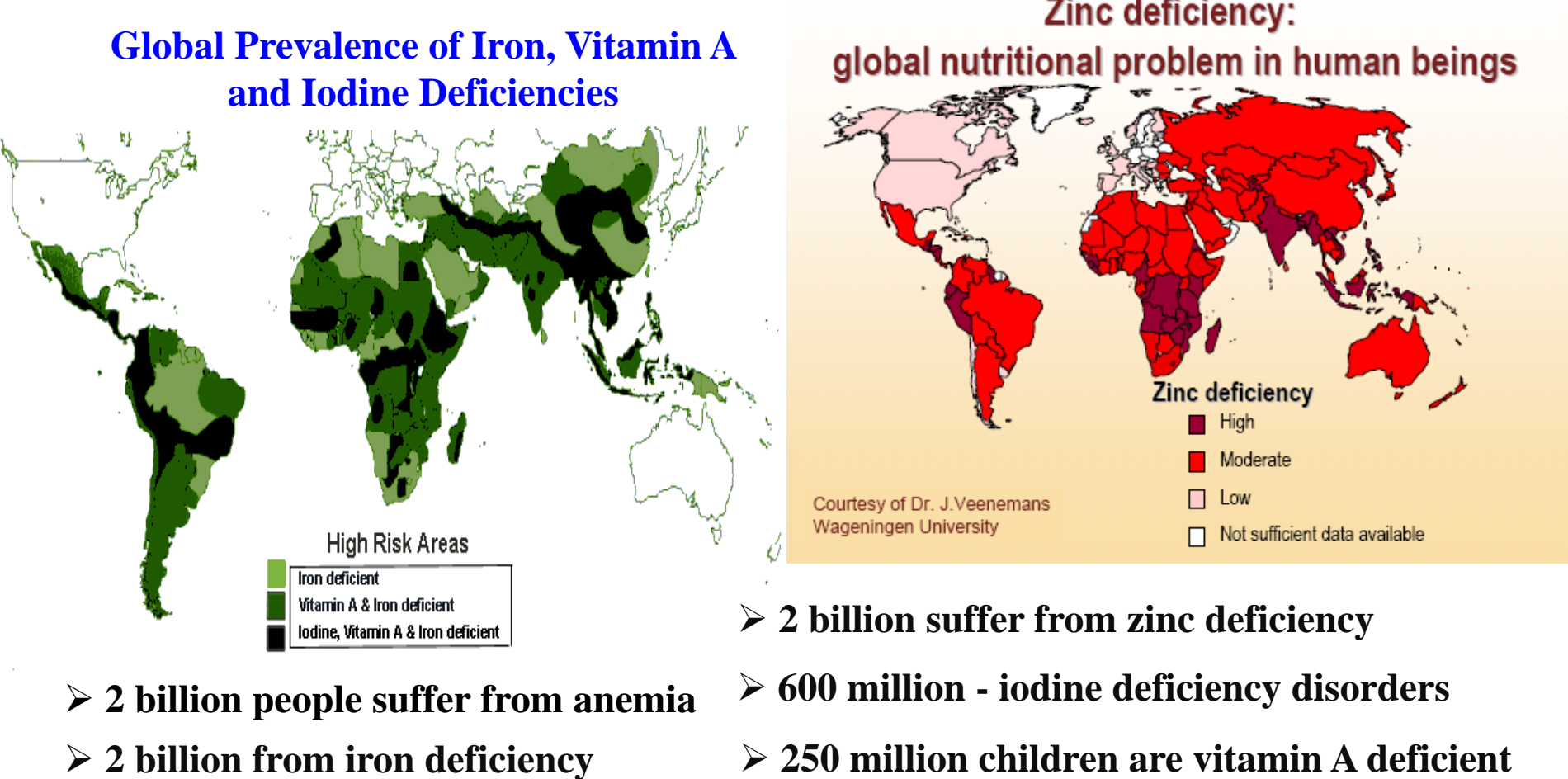
Features	Number (%)	
Age	5-9	11 (11)
	10-14	79 (79)
	15-19	7 (7)
	20-24	3 (3)
Gender	Male	52 (52)
	Female	48 (48)
Body mass index (BMI)	Severe malnutrition (<15.9kg/m <sup>2</sup> )	37 (37)
	Moderate malnutrition (16-16.9kg/m <sup>2</sup> )	16 (16)
	Mild malnutrition (17-18.4 kg/m <sup>2</sup> )	18 (18)
	Normal (>18.5-25kg/m <sup>2</sup> )	29 (29)
Helminths infection	Yes	18 (18)
	No	82 (82)
Mother education	Yes	47 (47)
	No	53 (53)

## Concentration of elements in human body and human serum

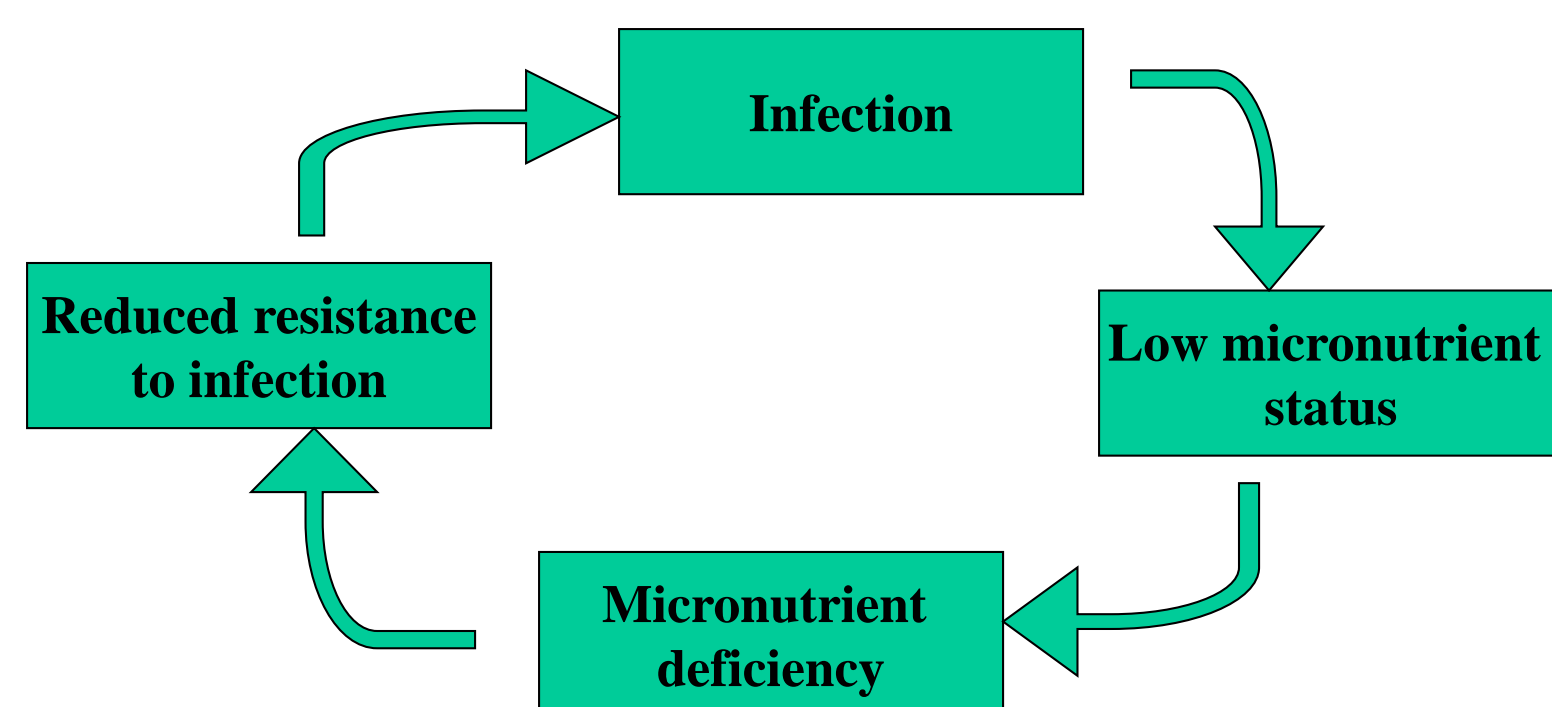
Element	Concentration in human body (ppm)	Concentration in human serum (ppm)
Na	10000	1000
Ca	10000	1000
P	10000	1000
K	10000	1000
Mg	10000	1000
Fe	10000	1000
Zn	10000	1000
Cu	10000	1000
Mn	10000	1000
Co	10000	1000
Ni	10000	1000
Mo	10000	1000
Se	10000	1000
Cr	10000	1000
V	10000	1000
As	10000	1000
Sb	10000	1000
Bi	10000	1000
W	10000	1000
Re	10000	1000
Os	10000	1000
Ir	10000	1000
Pt	10000	1000
Au	10000	1000
Hg	10000	1000
Tl	10000	1000
Pb	10000	1000
Bi	10000	1000
Po	10000	1000
At	10000	1000
Rn	10000	1000
Fr	10000	1000
Ra	10000	1000
Ac-Lr	10000	1000

## Background

Micro nutrient deficiency is a major public health problem worldwide, with greater magnitude in areas where TB and HIV are rampant



- Deficiency of micronutrients compromise immune function and contribute to increased susceptibility to infections.
- The infections reciprocally contribute to deficiencies of important micronutrients due to reduction in dietary intake, decreased intestinal absorption, increased loss, etc.
- A vicious cycle of infection and micronutrient deficiency



## Picture in Ethiopia

- High prevalence of intestinal parasitoses
- Scarcity of information on:
- ✓ prevalence of multiple micronutrient deficiency,
- ✓ impact of intestinal helminthes on micronutrient deficiency

## Objectives:

The study was aimed to assess the level of Mg, Ca, Fe, Cu, Se and Mo in children with and without helminth infection in North-west Ethiopia.

## Significant difference in levels of Ca, Cu, and Mo in school children by status of helminth infection

Trace elements	Helminth infected (Mean ± Sd)	Non-helminth infected (Mean ± Sd)	P-value
Mg	2.492 ± 0.332	2.407 ± 0.320	0.31
Ca	16.393 ± 2.046	15.072 ± 2.098	0.01*
Fe	371.145 ± 151.316	318.758 ± 147.635	0.17
Cu	214.739 ± 56.575	186.155 ± 47.490	0.02*
Zn	100.980 ± 53.662	83.205 ± 39.181	0.11
Se	5.683 ± 2.615	6.461 ± 2.585	0.25
Mo	0.308 ± 0.158	0.212 ± 0.138	0.01*

## Important features of Fe, Zn, Cu & Se

Function	Iron ( <sup>56</sup> Fe <sub>55.847</sub> )	Zinc ( <sup>65</sup> Zn <sub>65.38</sub> )	Copper ( <sup>63</sup> Cu <sub>63.546</sub> )	Selenium ( <sup>78</sup> Se <sub>78.96</sub> )
RDA	Men: 10 mg/day Women: 15 mg/day	11 mg/day 8 mg/day	0.9 mg/day	55 ug/day
Absorption	5-10%	10-35%	55-75%	75-90%
Dietary source	Meat, baked food, soy, legumes, nuts	Lean meat, liver, sea food, beans, nuts	Sea food, liver, meat	Breads, grains, sea food, egg, meat
Amount in 70kg body weight	6 g	2 g	80 mg	12 mg
Reference range	60-200ug/dl	70-160ug/dl	70-160ug/dl	7-13ug/dl
Deficiency symptoms	Anemia, pale skin, fatigue & weakness, reduced work performance, loss of appetite.	Growth retardation, reduced immunity, loss of appetite, skin rash, failure in wound healing. Acrodermatitis enteropathica (genetic)	Anemia, neutropenia, poor growth, impaired immunity, abnormal bone growth, Menkes disease (genetic)	Cardiomyopathy (Keshan disease), muscle pain, and weakness
Toxicity	>45 mg/day Hereditary hemochromatosis	>40 mg/day	>10,000ug/day Wilson disease	>400 ug/day Selenosis

## Conclusion

- Presence of intestinal parasites was associated with altered trace element level.
- High prevalence of selenium and zinc deficiency among the school children regardless of intestinal helminth infection and nutritional status.

## Implication

- Further large scale detailed biochemical and clinical studies are needed to put forward a relationship between serum trace elements level and helminth infection.

## Acknowledgements

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