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Original Article

Serum Zinc and Immunoglobulin G Levels in Lower and Upper / Upper Middle Socioeconomic Groups

Uzair Mumtaz, Hamid Javaid Qureshi and Muhammad Usman Bashir

Objective: To assess the serum zinc and serum immunoglobulin G levels in different socioeconomic groups.

Methods: Hundred subjects in total were investigated. Out of these, 50 (25 males and 25 females) belonged to the lower socioeconomic (LSEC) group and 50 (25 males and 25 females) belonged to the upper / upper middle socioeconomic (USEC) group. Estimation of serum zinc was made by colorimetric method whereas serum immunoglobulin G (IgG) was determined by the immunoturbidimetric assay. A comparison of both parameters was made between the two socioeconomic (SEC) groups.

Results: Results revealed significantly low serum zinc in the LSEC group as compared to the USEC group. Similarly serum IgG levels were also significantly low in the LSEC group. Serum IgG levels did not show significant gender difference in the LSEC group however it was significantly higher in females than in males in the USEC. Generally a significantly positive correlation was found between serum zinc and serum IgG levels.

Conclusion: The LSEC class has low serum zinc levels and low serum IgG levels and hence is at greater risk of developing infections.

Keywords: Zinc, immunoglobulin G, socioeconomic status.

Introduction

Trace elements or trace minerals are proven to be essential for optimal growth and development of human body.[1] Zinc is an essential trace element for all forms of life and is necessary for optimal growth and development of human body.[2] It exists in nearly every cell of the body.[3,4] It is the second most abundant metal in organisms (second only to iron). Human body contains about 2-3 g of zinc. Of this, 60% is present in skeletal muscle and 30% in bone. Remaining is present in body fluids.[5,6]

Zinc plays a significant role to provide immunity to the body. It is crucial not only for the normal development and functions of cells mediating non specific immunity but also for the development of acquired immunity, like the immunoglobulin production.[7] Fortes et al (1998) reported that zinc supplementation improves cell mediated immune response in older population.[8] Zinc supplementation potentiates the effects of antiseptic agents.[9] Zinc is an excellent antioxidant. It gets rid of free radicals that cause damage to cells in the body by bonding with them and neutralizing them.[10] Neutrophil chemotaxis is impaired in zinc deficiency.[11] Compared with residents who had low zinc levels, people with normal levels had fewer cases of pneumonia, required fewer antibiotic prescriptions for it, and when they did get pneumonia, they had it for fewer days. Zinc supplementation also resulted in stronger humoral responses against antigenic challenges particularly in raising immunoglobulin G and immunoglobulin M levels in sheep.[12] In zinc deficiency, not only is the total amount of antibodies diminished; even the repertoire of antigens recognized by these antibodies is depressed. Interestingly this effect is even seen in mild or transient zinc deficiency during pregnancy.[7] Certain developmental steps responsible for B-cell receptor repertoire maturation thus seem to be dependent on zinc.[13]

The richest sources of zinc are meat, milk products, shell fish (oyster) and poultry while fruits and vegetables are poor sources.[14,15] Oyster contains the largest content of zinc which is 188.5 341 mg / kg. Human breast milk has higher concentration of zinc.[16] When given orally, zinc is absorbed from the small intestine.[17] Zinc is excreted through feces, urine and sweat.[18] A number of factors affect the absorption of zinc.[2] It is widely accepted that of the numerous dietary factors known or suspected to affect zinc absorption, zinc and phytate content have the greatest effect.[19] Phytates which are present in foods like cereals, corn, rice and vegetables have a strong negative effect on zinc absorption from composite meals. Inositol hexaphosphates and pentaphosphates are the phytate forms that exert

these negative effects on zinc absorption.[20] Zinc deficiency is associated with diets based on plant foods which are rich in zinc absorption inhibitors. Such diets are habitually consumed in rural areas and in economically poor areas of the cities.[21]
The above facts reveal that Zinc deficiency may occur in those individuals who do not take animal foods. Majority of poor people in Pakistan do not afford animal foods due to their high prices and hence consume foods of vegetable origin. Food of vegetable origin contains phytates which are zinc absorption inhibitors. Hence the poor population of Pakistan is likely to be suffering from zinc deficiency and immunodeficiency. The present study was planned to assess zinc levels and serum IgG levels in LSEC and USEC groups.

Methods

It was a cross sectional analytical study. It was conducted in the Department of Physiology, Services Institute of Medical Sciences, Lahore on a total of 100 healthy subjects. Their ages were between 10 to 30 years. Fifty subjects (25 males and 25 females) belonged to the LSEC group and 50 (25 males and 25 females) belonged to the USEC group. The subjects having average monthly income of less than 3200 rupees per capita per month (US$ 0-1.25 per capita per day) were included in the LSEC group. The subjects having a family income of more than 4000 rupees per capita per month and living in their own house were included in the USEC group.[22] Informed consent of the subjects was obtained. History taking and general physical examination of the subjects were carried out. Individuals who were diabetic, hypertensive, smokers and those taking any medication or drugs especially steroids, vitamin supplementation or minerals were excluded on history. Five milliliters (ml) of blood was drawn aseptically from each subject. The blood was centrifuged at 2500 rpm for 10 minutes at room temperature. Serum was separated and stored at 4°C. Serum zinc was determined by colorimetric method using the kit manufactured by Spectum.[23] Serum IgG was estimated by immunoturbidimetric assay[24] using Roche kit. Roche IgG assay is based on the principle of immunological agglutination. Data analysis was carried out with the SPSS version 19 (SPSS, Inc, Chicago, IL, USA). Arithmetic mean and standard deviation (SD) of each parameter were determined. The significance of differences among the groups was analyzed by student's t-test. Pearson's correlation was used to determine correlation between serum zinc and neutrophil percentage phagocytosis. A p-value < 0.05 was considered statistically significant.

Results

(Table-1) shows a comparison of serum zinc and Serum lgG between the two socioeconomic groups. Serum zinc was significantly higher (p=0.000) in the USEC group as compared to the LSEC group. Similarly, the serum lgG was significantly higher (p=0.000) in the USEC group as compared to the LSEC group. **(table-2)** depicts that serum zinc was significantly higher in the male subjects (p=0.000) in the USEC group as compared to males in the LSEC group. Similarly, in the female subjects, serum zinc was significantly higher (p = 0.000) in the USEC group as compared to the LSEC group. Same is the case with the serum lgG, which was significantly higher in USEC group as compared to LSEC group in both males (p=0.004) and females (p=0.000). Gender difference of parameters within USEC group as shown in **(table-3)** reveals that serum zinc difference was not significant (p=0.089). Serum lgG in males was significantly less (p=0.000) than in females. Both serum zinc and serum lgG did not show any significant gender difference in the LSEC group **(table-4)**. There was a significant positive correlation of serum lgG with serum zinc in total subjects of USEC group (r=0.323, p= .022) and the male subjects of LSEC group (r=0.469, p=0.018) but no significant correlation was found in total subjects of LSEC group and in male subjects of USEC group **(table-5, fig-1, 2)**.

Table-1: Comparison of serum zinc and Serum lgG in total subjects in the two socioeconomic groups.

Parameter	USEC Group (n=50)	LSEC Group (n=50)	P-value
Serum Zinc (ug/dl)	111.05±13.66	77.28±14.90	0.000*
Serum 1gG(mg/dl)	1430.82±276.26	1065.44±328.93	0.000*

Table-2: Comparison of serum zinc and Serum lgG in male and female subjects in the two socioeconomic groups.

Paramters	Males		P-value	Females		P-value
	USEC group (n=25)	LSEC group (n=25)		USEC group (n=25.)	LSEC group (n=25)	
Serum zinc (ug/dl)	107.76±14.29	76.72±8.56	0.000*	114.33±12.42	77.83±19.48	10.000*
Serum1gG (ud/dl)	1288.16±268.33	1044.48±307.19	0.004*	1573.48±203.53	1086.40±354.42	0.000*

Table-3: Gender difference of parameters within upper/ upper middle socioeconomic group.

Parameter	Males (n=50)	Females (n=50)	P-value
Serum Zinc (ug/dl)	107.76±14.29	114.33±12.42	0.0089
Serum 1gG(mg/dl)	1288.16±268.33	1573.48±203.53	0.000*

Table-4: Gender difference of parameters within Lower socioeconomic group.

Parameter	Males (n=50)	Females (n=50)	P-value
Serum Zinc (ug/dl)	76.72±8.56	77.83±19.48	0.796
Serum 1gG(mg/dl)	1044.48±307.19	1086.40±354.42	0.657

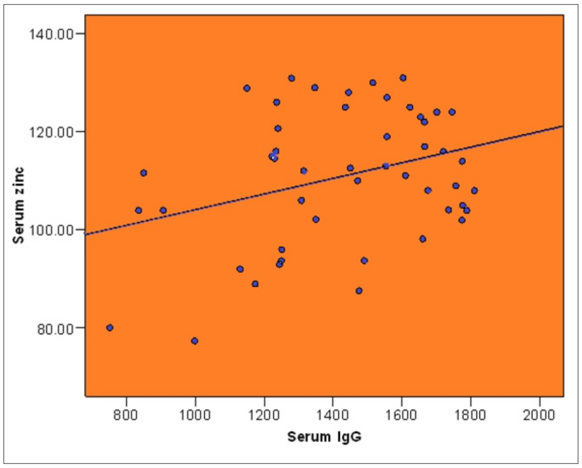

Fig-1: Scatter diagram showing positive significant correlation (n=50, r=0.323, p=0.022) between serum zinc and serum IgG in total subjects of USEC group.

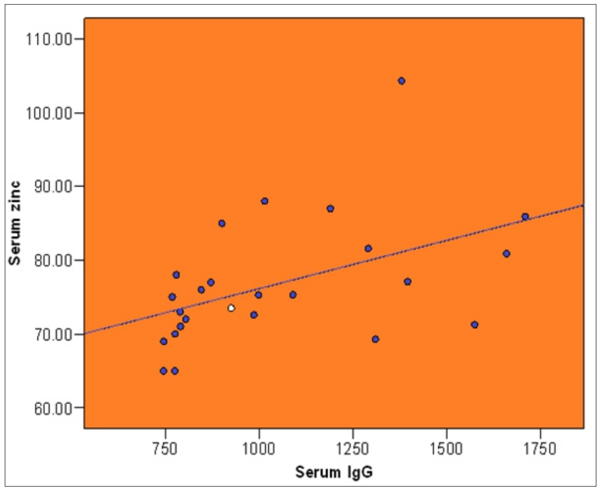

Fig-2: Scatter diagram showing positive significant correlation (n=25, r=0.469, p=0.018) between serum zinc and serum IgG in males of LSEC group

Table-5: Correlation of serum zinc with Serum lgG in the two socio economic groups. Correlation coefficient (r) and p.value are given.

Correlation of serum Zinc with	USEC (n=50)		LSEC (n=50)	
	r Value	p value	r value	p-value
Serum1gG (ud/dl)	0.323	0.022*	-0.099	0.493

** p <0.05 — Significant*

Table-6: Correlation of serum zinc with serum lgG in male and female subjects in the two socioeconomic groups. Correlation coefficient (r) and p.value are given.

Correlation of serum zinc with	USEC Group				LSEC Group			
	Male (n=25)		Female (n=25)		Male (n=25.)		Female (n=25)	
	r value	p value	r value	p value	r value	p value	r value	p value
Serum1gG (ud/dl)	0.212	0.309	0.277	0.181	0.469	0.018*	-0.326	0.112

** p <0.05 — Significant*

Discussion

The present study was conducted on 100 healthy subjects of LSEC class and USEC class. Serum zinc levels were found to be significantly low in the LSEC as compared to the USEC group in the total number of subjects as well as in the male and female subgroups. The deficiency of zinc is associated with diets based on plant origin, which are rich in zinc absorption inhibitors like phytates. All cereals and vegetables contain phytates which can bind zinc and reduce its biological availability.[19] Phytates are co-precipitated with zinc and absorption of zinc is decreased.[25] The LSEC class of our country being unable to consume animal diet due to its high price and mostly take vegetable diet, so is at the risk of low serum zinc levels.

Zinc is necessary for the normal function of the immune system. Even mild zinc deficiency, which is widely spread in contrast to severe zinc deficiency, depresses immunity of humans. B cells represent the main cells of humoral immunity. After stimulation, B cells differentiate to antibody producing plasma cells. B lymphocytes and their precursors (especially pre-B and immature B cells) are reduced in absolute number during zinc deficiency, Thus, there are fewer naive B cells during zinc deficiency that can react on neoantigens. Taking into account that the number of T cells is also reduced during zinc deficiency and that the most antigens are T-cell dependent, it is probable that with zinc deficiency, the body is unable to respond with antibody production in response to neoantigens. This assumption is consistent with findings that show that B-lymphocyte antibody production is disturbed during zinc depletion.[26] In the current study it was found that serum IgG was significantly higher ($p < 0.01$) in the USEC group as compared to the LSEC group. It was significantly low in the male LSEC ($p < 0.01$) group as well as in the female LSEC group ($p < 0.01$). There was a significant positive correlation between serum zinc and serum IgG levels in the present study. Also in this study it was found that serum IgG was significantly more in females as compared to males in the USEC group but no such finding was observed in the LSEC group

Conclusion

Serum zinc level is significantly low in the lower socioeconomic class. A significant positive correlation is found between serum zinc and serum IgG levels.

Department of Physiology
SIMS/Services Hospital Lahore
www.esculapio.pk

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