

Estimation of Serum Levels of Iron and Zinc in Chronic Renal Failure Patients: An Institutional Based Study

Shakti Aggarwal

Associate Professor, Department of Biochemistry,
United Institute of Medical Sciences and Hospital, Prayagraj, Uttar Pradesh, India

ABSTRACT

Introduction: Chronic renal failure (CRF) is a syndrome that might occur in the pathway of various pathological processes that are followed by dysfunction and degradation of evacuative, regulative and metabolic activities of kidneys. Proper diet is an ideal component in the prevention of CRF. The diet should not only fulfil the needs of an organism with respect to basic nutritional ingredients (carbohydrates, proteins and fats), but it should also provide adequate amounts of vitamins and minerals. The reason for the lower level of microelements—particularly of zinc—was its inadequate intake in the diet and insufficient absorption from the gastrointestinal tract. Such diet should be energy- and proteins-rich, while poor in potassium, phosphorus and sodium.

Materials and Methods: The analysed group consisted of 50 people including 25 women and 25 men aged 25–85 years. The breadth of the age range is caused by the need to cover all the patient's undergoing haemodialysis who agreed to take part in the testing. The nutritional basis was assessed on the basis of a 24-h nutritional recall performed twice in both the groups. In the patient's group, the nutritional recall was performed on a dialysis day and a non-dialysis day. The U-Mann–Whitney test was used to compare the results data between the studied group of patients and controls.

Results: A significant difference in microelements intake was seen to be observed in the diets of patients and in the control group. Zinc and iron were all taken in by patients at a reduced levels than by controls. The intake differences of these

microelements were statistically significant. The reduced intake of all the analysed microelements, as compared to recommended values, is easily appreciated in the daily diet of both women and men with CRF. Most patients from the patients group showed significantly lower intake of zinc and iron in the diet, in relation to the safe level.

Conclusion: The diet of patients who are suffering from chronic renal failure was low in microelements such as zinc and iron. In comparison with the control group, the intake of all analysed microelements was appreciably lesser, in a statistically significant pattern.

Keywords: Chronic Renal Failure, Zinc, Iron, Anemia, Micronutrients.

*Correspondence to:

Dr. Shakti Aggarwal

Associate Professor, Department of Biochemistry,
United Institute of Medical Sciences and Hospital,
Prayagraj, Uttar Pradesh, India.

Article History:

Received: 18-10-2020, Revised: 03-11-2020, Accepted: 25-11-2020

Access this article online	
Website: www.ijmrp.com	Quick Response code 
DOI: 10.21276/ijmrp.2020.6.6.010	

INTRODUCTION

Chronic renal failure (CRF) is a syndrome that might occur in the pathway of various pathological processes that are followed by dysfunction and degradation of evacuative, regulative and metabolic activities of kidneys.¹ Proper diet is an ideal component in the prevention of CRF. If the proper diet introduced early, it might help in slowing down the progress of the disease i.e., CRF.²⁻⁴ The diet should not only fulfil the needs of an organism with respect to basic nutritional ingredients (carbohydrates, proteins and fats), but it should also provide adequate amounts of vitamins and minerals.

Oxidative stress may also play an important role leading to the progression of complications in CKD patients. Many trace elements are involved in the oxidant-antioxidant balance. As far as

the minerals are concerned, many studies reflect disparities in their blood concentration, mainly with lower levels of zinc, selenium and iron in the serum of CRF patients who were treated using haemodialysis.⁵⁻⁸ The reason for the lower level of microelements—particularly of zinc—was its inadequate intake in the diet and insufficient absorption from the gastrointestinal tract.⁹ Fewer studies are available which focus on a precise analysis of zinc supplementation and other microelements in the special diet related to chronic renal failure. Such diet should be energy- and proteins-rich, while poor in potassium, phosphorus and sodium.^{2,3} Various other minerals including zinc, copper and iron should be consumed at the level that are generally recommended by the dietitian.

This study was aimed to analyse the intake of certain selected microelements (zinc and iron) in the diet of dialyzed patients and to compare the results with the control group.

MATERIALS AND METHODS

The analysed group consisted of 50 people including 25 women and 25 men aged 25–85 years. The breadth of the age range is caused by the need to cover all the patient's undergoing haemodialysis who agreed to take part in the testing. The control group consisted of 30 healthy people, matching the group under analysis with respect to gender and age. A detailed history taking followed by the written consent had been obtained from the

patients who were all participating in this study. The nutritional basis was assessed on the basis of a 24-h nutritional recall performed twice in both the groups. In the patient's group, the nutritional recall was performed on a dialysis day and a non-dialysis day.

In the control group, the nutritional recall was performed on two non-consecutive days. The received quantitative nutritional analyses were then processed using specialised nutrition software that calculates nutritional values of daily diet for further comparison.

The U-Mann–Whitney test was used to compare the results data between the studied group of patients and controls.

Table 1: General characteristics of the diet of CRF patients, as compared to the control group.

	Mean		Standard Deviation		Minimum		Maximum	
	P	C	P	C	P	C	P	C
Energy {Kcal}	1423.3	1313.4	478.7	455.6	502.3	410.1	2665.2	2045
Protein (g)	49.5	56.7	18.7	19.6	9.8	13.3	102.3	88.4
Fat (g)	60.4	73.8	24.4	34.6	14.8	21.7	114.4	142.3
Carbohydrates (g)	181.6	256.7	66.8	132.2	71.6	40	346.4	457.2

p<0.05

Table 2: Comparison of Microelements Intake Between the Patients' Group (P) and the Control Group (C)

	Mean		Standard Deviation		Minimum		Maximum	
	P	C	P	C	P	C	P	C
Zinc	7.23	10.66	2.67	6.26	2.12	1.89	14.4	24.32
Iron	6.89	9.87	2.5	4.89	2.12	1.62	17.65	18.32

* p<0.005

Table 3: The Content and the Percentage of Norm Realization of Zinc, Copper and Iron in Daily Nutritional Rations of Patients (Women and Men) with Chronic Renal Failure

	Men			Women		
	Mean	Norm	% of norm realisation	Mean	Norm	% of norm realisation
Zinc (mg)	7	10	70	7.2	14	54.1
Iron (mg)	6.86	14	48.1	7.01	11	63.5

Table 4: The Content and the Percentage of Norm Realization of Zinc and Iron in Daily Nutritional Rations of Women and Men from the Control Group

	Men			Women		
	Mean	Norm	% of norm realisation	Mean	Norm	% of norm realisation
Zinc (mg)	10	10	101	13.3	14	97
Iron (mg)	9.4	14	68.2	11.2	11	103.6

RESULTS

Table – 1 shows general characteristics of the diet of CRF patients, as compared to the control group. Energy, protein and fat intake were on similar levels in both groups, while the carbohydrates intake was statistically lower in the patient's group when compared to the control group (p<0.05).

A significant difference in microelements intake was seen to be observed in the diets of patients and in the control group. Zinc and iron were all taken in by patients at a reduced levels than by controls. The intake differences of these microelements were statistically significant which was shown in Table 2.

Table 3 focuses on the comparison against recommended standards in India and on the intake of selected microelements in daily nutritional rations of women and men with chronic renal failure. Table 4 presents the same analysis for the women and men from the control group.

The reduced intake of all the analysed microelements, as compared to recommended values, is easily appreciated in the daily diet of both women and men with CRF.

Most patients from the patients group showed significantly lower intake of zinc and iron in the diet, in relation to the safe level.

DISCUSSION

The reduced levels of zinc in the blood serum of patients suffering from renal failure is a well-established phenomenon. The major clinical symptoms of the zinc shortage include taste depreciation, hair loss, sexual impotence and delayed curing of injuries. Metabolism of proteins, carbohydrates and lipids, as well as on energetic processes will also greatly impeded by the shortage of zinc.⁹ It is responsible for the synthesis of nucleic acids, protein absorption, bone metabolism and oxygen transport throughout the body.¹⁰ Eventually, zinc is an important factor for the functioning of our immune system. The products particularly rich in zinc include bread, cereals, leguminous plant seeds and mushrooms.¹¹ The last two group of foods—due to their high phosphorus content—should not be consumed by patients with chronic renal failure condition. Among animal products, one rich source of zinc is red meat, but it should not be consumed regularly in this specific patient group, due to their high content of saturated fatty acids and homocysteine. Average absorption of zinc from daily diet is calculated to be around 20–40% but may also be increased in cases of shortage of this microelement in the organism. Though the deleterious effects of the decreased level of zinc is well documented in many studies, the microelement is often supplemented to patients with CK.⁹ Intravenous zinc supplementation may cause an increased reaction of acute phase proteins with patients in severe clinical condition; therefore, it is used only very rarely. On the other hand, oral supplementation of big doses of zinc decreases copper and iron absorption, thus reducing their blood concentration.⁹

The low levels of copper and iron may cause anaemia, as erythropoiesis requires not only iron, but also copper demand.^{9, 10} Both these microelements are necessary in the process of haematopoiesis in the bone marrow, whereas iron is incorporated into the heme particle. The shortage of copper may be a reason behind the decreased ferritin level in serum and eventually resulting in sideroblastic anaemia.^{9, 12} Addedly, copper takes part in collagen and elastin synthesis, activating lysin oxidase. There are many copper-dependent enzymes like supraoxidase dismutase, tyrosinase, cytochromic oxidase, lysin and ascorbate oxidase.

A growing phenomenon is the iron depletion in the blood serum among the CRF patients. That is related with the increased demand in the course of the erythropoietic process. The repeated loss of even the scarce amounts of blood that takes place in the course of haemodialysis is also a reason of iron shortages. As shown in the study, supplementation of iron in the diet is not sufficient to cover the need for this microelement.⁹ Also, oral supplementation of iron is largely inefficient in case of the parallel administration of drugs binding phosphorus salts in the gastrointestinal tract. Bioavailability is estimated at no more than 10–20% in such cases.⁹

CONCLUSIONS

The diet of patients who are suffering from chronic renal failure was low in microelements such as zinc and iron. In comparison with the control group, the intake of all analysed microelements was appreciably lesser, in a statistically significant pattern.

REFERENCES

- Luciak M (2004) Chronic renal failure. In: Januszewicz W, Kokot F (eds) Internal Medicine. Polish Medical, Warsaw, Poland, 679–690.
- Bujacz M. Dietetic procedure in chronic renal failure. Q B Pol Diet Soc 1999; 15:30–6.
- Cebulski W, Pertkiewicz M. Principles in nutrition of patients with renal failure. Q B Pol Diet Soc 1997; 8:41–5.
- Łysiak-Szydłowska W. Nutritional standards in chronic renal diseases. Pract Pediatr 2000; 8:241–8.
- Prehn B. The trace elements zinc and copper in chronic renal failure. J Urol Nephrol 1988; 81:35–42.
- Kamińska-Galwa B, Grzeszczak W, Jedryczko A et al. Influence of long-term hemodialysis on serum trace elements concentration in patients with chronic renal failure. Med Rev 1994; 51:9–14.
- Navarro Alarcon M, Reyes Perez A, Lopez-Garcia H et al. Longitudinal study of serum zinc and copper levels in hemodialysis patients and their relation to biochemical markers. Biol Trace Elem Res 2006; 113:209–22.
- Esfahani ST, Hamidian MR, Madani A et al. Serum zinc and copper levels in children with chronic renal failure. Pediatr Nephrol 2007; 22:618–9.
- Wilcox CS, Tisher CC (2006) Handbook of nephrology and hypertension. Czelej Sp. z o.o, Lublin.
- Ziemiański S (2001) Norms in human nutrition, physiological basis. Polish Medical, Warsaw.
- Garrow JS, James WPT (1998) Human nutrition and dietetics. Churchill Livingstone, London.
- Kamińska-Galwa B, Grzeszczak W, Jedryczko A et al. Level of zinc, copper, selenium and nickel in serum of patients treated for chronic renal failure with hemodialysis influence of erythropoietin therapy. Ann Clin Biochem 2005; 42:364–75.

Source of Support: Nil.

Conflict of Interest: None Declared.

Copyright: © the author(s) and publisher. IJMRP is an official publication of Ibn Sina Academy of Medieval Medicine & Sciences, registered in 2001 under Indian Trusts Act, 1882. This is an open access article distributed under the terms of the Creative Commons Attribution Non-commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

Cite this article as: Shakti Aggarwal. Estimation of Serum Levels of Iron and Zinc in Chronic Renal Failure Patients: An Institutional Based Study. Int J Med Res Prof. 2020 Nov; 6(6): 36-38.
DOI:10.21276/ijmrp.2020.6.6.010