Indonesian Journal on Health Science and Medicine

Vol. 3 No. 1 (2026): July
DOI: 10.21070/ijhsm.v3i1.434

ISSN 3063-8186 (online), https://ijhsm.umsida.ac.id, published by Universitas Muhammadiyah Sidoarjo

Indonesian Journal on Health Science and Medicine

Vol. 3 No. 1 (2026): July
DOI: 10.21070/ijhsm.v3i1.434

Table Of Contents

Indonesian Journal on Health Science and Medicine
Vol. 3 No. 1 (2026): July
DOI: 10.21070/ijhsm.v3i1.434

Originality Statement

The author[s] declare that this article is their own work and to the best of their knowledge it contains no materials previously published or written by another person, or substantial proportions of material which have been accepted for the published of any other published materials, except where due acknowledgement is made in the article. Any contribution made to the research by others, with whom author[s] have work, is explicitly acknowledged in the article.

Conflict of Interest Statement

The author[s] declare that this article was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Copyright Statement

Indonesian Journal on Health Science and Medicine
Vol. 3 No. 1 (2026): July
DOI: 10.21070/ijhsm.v3i1.434

EDITORIAL TEAM

Editor in Chief

Section Editor

Complete list of editorial team (link)

Complete list of indexing services for this journal (link)

How to submit to this journal (link)

ISSN 3063-8186 (online), https://ijhsm.umsida.ac.id, published by Universitas Muhammadiyah Sidoarjo

Indonesian Journal on Health Science and Medicine

Vol. 3 No. 1 (2026): July
DOI: 10.21070/ijhsm.v3i1.434

Article information

Check this article update (crossmark)

Check this article impact (*)

Save this article to Mendeley

(*) Time for indexing process is various, depends on indexing database platform

Indonesian Journal on Health Science and Medicine
Vol. 3 No. 1 (2026): July
DOI: 10.21070/ijhsm.v3i1.434

Determining the Levels of Zinc, Iron, Vitamin D, Renin Hormone, and Cystatin in Patients With Kidney Failure

Abdalrahim H. Eefan, arhim640@gmail.com (*)
Directorate of Education Nineveh, Iraq

(*) Corresponding author

Abstract

General Background: Kidney failure is characterized by impaired filtration function requiring dialysis and associated with metabolic and biochemical disturbances. **Specific Background:** This study evaluated zinc, iron, vitamin D, renin hormone, and cystatin C levels among 100 kidney failure patients treated at a dialysis center in Mosul between March and May 2025. **Knowledge Gap:** Conventional indicators of renal dysfunction lack sufficient sensitivity, necessitating integrated biochemical profiling to better characterize disease status. **Aims:** To determine variations in selected trace elements, hormones, and proteins and their association with demographic and clinical factors in kidney failure patients. **Results:** The findings revealed decreased zinc, iron, vitamin D, and renin levels alongside elevated cystatin C concentrations, particularly in the 50–60 age group. Iron deficiency was linked to dialysis-related blood loss, while zinc deficiency was associated with malnutrition or independent occurrence. Vitamin D deficiency was associated with fluid imbalance and renal dysfunction, though not directly linked to renin deficiency. Higher disease prevalence was observed among smokers, rural residents, individuals with low education levels, and those consuming unsafe water sources. **Novelty:** The study integrates multiple biochemical markers with demographic variables, highlighting cystatin C as a sensitive indicator of glomerular insufficiency compared with traditional measures. **Implications:** These results support routine monitoring of trace elements, vitamin D, renin activity, and cystatin C to improve early detection and guide clinical and public health strategies in kidney failure management.

Highlights:
- Reduced Trace Elements and Hormone Levels Accompanied by Elevated Cystatin Protein
- Higher Disease Occurrence Linked to Age Group 50–60 and Lifestyle Factors
- Cystatin Biomarker Identifies Glomerular Dysfunction More Sensitively Than Conventional Measures

Keywords: Kidney Failure, Zinc, Iron, Vitamin D, Cystatin C

Published date: 2026-04-05

Vol. 3 No. 1 (2026): July
DOI: 10.21070/ijhsm.v3i1.434

Introduction

Kidney failure occurs when your kidneys have stopped working to the extent that you need special blood-cleaning (dialysis) treatments. In this state, the kidneys have lost all capability of functioning and typically resulted from CKD (chronic kidney disease) that has been afflicting them for an extended period of time. Dialysis must be done; it's a method of cleansing the blood by passing it through a membrane very thin as to remove unwanted substances like toxins, salts and urea treated on one side with a plasma-like solution. This is the membrane that lets some things through and traps other things as well -these are the ones the kidney cannot get rid of content [1]. Medical conditions related to the kidneys result in a variety of complications from toxins that remain in the blood because one's body is not able to clean them out via its kidneys, and having problems maintaining one's water and electrolyte balance. Kidney failure is GFR <(15 ml/min) per (1.73 m^2). Morbidity and mortality rates are unacceptably high, especially among the developing world, largely owing to lack of access to renal replacement therapy (RRT). In addition to a number of socio-economic factors, comorbidity and the type of RRT as well as kidney failure per se affect mortality in patients receiving RRT. The characterization of the principal pathophysiological determinants of increased mortality and renal risk classification systems is needed for an evidence-based decision process to take place in clinical trials that aim to reduce mortality. Policy interventions to enhance access to renal replacement therapy must be matched with research on low cost RRT as well as optimal clinical care [2].

Consistence

Patients with chronic renal illness, especially those with uremia and nephrotic syndrome, have a well-documented disruption in zinc metabolism. Uncertainty surrounds the causes of zinc deficiency in renal disease. Impaired zinc metabolism may be caused by decreased dietary zinc intake and intestinal absorption, increased endogenous excretion, and increased urine excretion (as shown in kidney transplant recipients and nephrotic syndrome). Poor taste, sexual dysfunction, gonadal problems, high blood prolactin levels, glucose intolerance, hyperlipidemia, childhood growth retardation, neuropathy, anemia, neutropenia, lymphocytic malfunction, and delayed wound healing can all be explained by a zinc deficiency. To determine whether zinc supplementation is effective in addressing these symptoms, more controlled research is required. Patients with uremia shouldn't be treated with zinc on a regular basis [3].

Blood pressure regulation and many other physiological processes depend on the hormone renin. Even though renin was first identified over a century ago, our knowledge of the genesis of renin-producing cells and the processes underlying its synthesis and secretion has only recently improved [4].

The essential enzyme in the renin-angiotensin-aldosterone chain reaction, renin protease plays a crucial role in both healthy and diseased states. Renin that is enzymatically active can only be released by the kidney. The number and location of renin-producing cells in the kidney can vary, although the most well-known site of renin generation is the prime area next to the glomeruli. CREB is the most researched and well-characterized of the transcription factors that regulate the pro-renin gene's transcription in these cells. Vesicles hold prorenin, which is converted to renin and then released when required. The cAMP (stimulatory) and Ca2+ (inhibitory) signaling pathways control the release of renin. In addition, numerous systemic or intrarenal stimuli have been shown to directly control renin secretion at the level of renin-producing cells by triggering any of the aforementioned signaling pathways. Prorenin receptors, angiotensin II, and angiotensin V mediate the wide range of physiologic effects of prorenin [5].

Patients with chronic renal disease frequently have vitamin D deficiency, and there seems to be a relationship between serum vitamin D levels and kidney function. There is mounting evidence that vitamin D insufficiency may be a factor in the decline of kidney function and the higher rates of morbidity and death among individuals with chronic renal disease.[6]. In animal models, treatment with active vitamin D or its analogs has been demonstrated to alleviate kidney injury by lowering inflammation, fibrosis, and apoptosis; in patients with chronic kidney disease, this treatment also lowers proteinuria and mortality. Beyond the traditional effects on bone and mineral metabolism, vitamin D treatment has nephroprotective qualities. The pathophysiology of secondary hyperparathyroidism in CKD is centered on disruption of vitamin D metabolism. A number of mechanisms combined to prevent kidney damage from maintaining normal vitamin D levels even in the face of a prevalent elevation in parathyroid hormone, which is why 1,25-dihydroxyvitamin D gradually declines with chronic kidney disease (CKD). According to recent data, a significant prevalence of dietary vitamin D deficiency, as indicated by low levels of the 25-hydroxyvitamin (calcidiol or circulating), may even be a hallmark of chronic kidney disease (CKD). The body is unable to produce enough 1,25-dihydroxyvitamin D as a result. Therefore, current clinical guidelines suggest natural vitamin D supplementation as a preventative approach for the treatment of abnormalities in bone and mineral metabolism in individuals with chronic kidney disease. Treatment response varies greatly, and active vitamin D steroids are also used [7].

Early detection of renal insufficiency and timely treatment are vital to survival. Nevertheless, the conventional parameters of kidney function are not sensitive and specific enough. Mean recent data say that cystatin C (cysC) could be of interest as markers of GFR. Cystatin C is a cysteine protease inhibitor protein, which mainly produced by nucleated cells [8]. The ultrafiltration of polylysine is easy because it has low molecular weight and positive neutral point. And its serum level is not influenced by sex, age, or muscle mass – factors that commonly confound measurement of GFR. The chapter is focused on the structure and biological action of cystatin C, including its application as a GFR marker and methods commonly used for its measurement.

The kidneys eliminate unwanted metabolic waste products that are toxic, and regulate the volume and composition of body fluids; maintain water, electrolyte, and acid-base balance; facilitate normal blood pressure [9]. Therefore, kidney function is essential for maintaining the body's internal balance due to its unique ability to shape and maintain the biochemical

ISSN 3063-8186 (online), https://ijhsm.umsida.ac.id, published by Universitas Muhammadiyah Sidoarjo

Vol. 3 No. 1 (2026): July
DOI: 10.21070/ijhsm.v3i1.434

environment within organs. Disorders of glomerular filtration negatively impact the body as a whole. Thus, any pathological abnormality in the urinary system should not be underestimated [10]. Early detection and treatment of the pathological component or process are crucial for survival. Once identified, immediate action is necessary to prevent irreversible changes and extend the time before renal replacement therapy becomes required. The hallmark diagnostic feature of kidney failure is the glomerular filtration rate (GFR), which is the amount of plasma filtered by the glomeruli per unit time [11][12][13][14][15].

Materials and Methods

Laboratory Diagnostic Methods Blood

Samples

7ml of venous blood was collected from patients visiting the outpatient clinic/dialysis unit. The collected blood samples were transferred to two sets of tubes as follows:

1- 3ml was placed in isolated tubes for testing renin hormone and vitamin D.

2- 4ml was placed in anticoagulant tubes (serum tubes) to separate the serum and use it to measure the concentration of zinc and iron in the serum, as well as the concentration of cystatin C protein.

3- The serum was stored under freezing at -20°C until use.

Measurement of zinc and iron concentrations in blood serum:

A SHIMADZU A.A 6200 atomic absorption/flame emission spectrophotometer with an air-acetylene flame was used to measure zinc and iron concentrations. A cathode lamp was used for zinc and another for iron.

Procedure:

1. Thaw the frozen serum at room temperature.

2. Dilute 100 microliters of serum in 900 microliters of distilled water to make a total volume of 1 cm^3 per sample.

3. Measure zinc and iron levels in the serum of all patients and control groups using an atomic absorption/flame emission spectrophotometer.

4. The results, obtained in parts per million (ppm), were converted to micromoles per liter (µmol/L) by dividing the results by the molecular weight of zinc and iron separately (setting the instrument to the wavelength for zinc at 213.9 nm and the wavelength for iron at (248.3) nm .

Measurement of renin, vitamin D, and cysteine hormone and protein concentrations in blood serum:

These were analyzed using ELISA, which is used to detect all the samples included in the study (renin, vitamin D, and cysteine).

Renin analysis procedure:

1-Antibodies against renin are fixed to the surface of the ELISA plate.

2-A blood sample (plasma) from the patient is added, and the antibodies bind to the renin present in the sample.

3- Other antibodies are added, bound to an enzyme (such as HRP) and/or an enzyme substrate, resulting in a color change proportional to the amount of renin. 4. The color change is read using a special device, and the renin concentration is calculated (usually using plasma renin activity,(PRA).

Vitamin D Analysis Method:

1-The ELISA plate is coated with an antibody designed to capture vitamin D.

2-A blood sample (plasma or serum) is added, and the vitamin D present in it binds to the antibody on the plate.

3-The plate is washed to remove any unbound particles.

4- Additional enzyme-bound antibodies, which also bind to vitamin D, are added.

5-A substrate (basic substance) is added, with which the enzyme reacts, producing a color signal proportional to the amount of vitamin D in the sample.

Vol. 3 No. 1 (2026): July
DOI: 10.21070/ijhsm.v3i1.434

6-The color intensity is measured using a special device to determine the vitamin concentration.

Cystanin Protein Analysis Method:

1- Cystanin-specific antibodies are fixed to the surface of the ELISA plate.

2- The patient's sample is added to the wells. If cystatin C is present in the sample, it binds to the fixed antibodies.

3-A second enzyme-bound antibody (such as HRP) that binds to cystatin is added. C, forming a complex.

4-A substrate is added that changes color upon reacting with the enzyme, resulting in a color change.

5- The color intensity is measured using a spectrophotometer, and the intensity is directly proportional to the amount of cystatin C in the original sample.

Results and Discussion

The study showed that the highest incidence was in the (50-60) age group, where zinc, iron, vitamin D, and renin levels were lower than in younger age groups, and cysteine protein levels were higher. The lowest incidence was in the (30-40) age group, where zinc, iron, vitamin D, and renin levels were higher than in older age groups, and cysteine protein levels were lower, as shown in (Table 1). The study also showed that the highest incidence was among smokers compared to non-smokers, as shown in (Figure 1). Furthermore, the study showed that the highest incidence was among uneducated individuals compared to educated individuals, with the lowest incidence among university graduates, as shown in (Figure 2). The study showed that the highest infection rate was among people who drank from rivers or wells compared to those who drank from distillers or bottled water, as illustrated in (Figure 3). The infection rate was also higher among rural residents compared to urban residents, as shown in (Figure 4).

Table (1): Distribution of Renin Hormone, Cystatin Protein, and Vitamin D by Age Groups

Vitamin D concentration ng/mL	Cystatin protein concentration mg/L	Renin hormone concentration ng/ml	
25.143 ±5.05	**0.9811±0.124**	**4.0 ± 1.2**	Control groups
9.154±5.13	**1. 979 ±0.335**	**6.4 ± 2.5**	Groups of infected age) 30-40(
7.122±5.22	**2. 425 ±0.671**	**8.1 ± 2.2**	Groups of infected age) 50-60(

ISSN 3063-8186 (online), https://ijhsm.umsida.ac.id, published by Universitas Muhammadiyah Sidoarjo

Indonesian Journal on Health Science and Medicine
Vol. 3 No. 1 (2026): July
DOI: 10.21070/ijhsm.v3i1.434

Figure (1): Shows the relationship between kidney failure and smoking

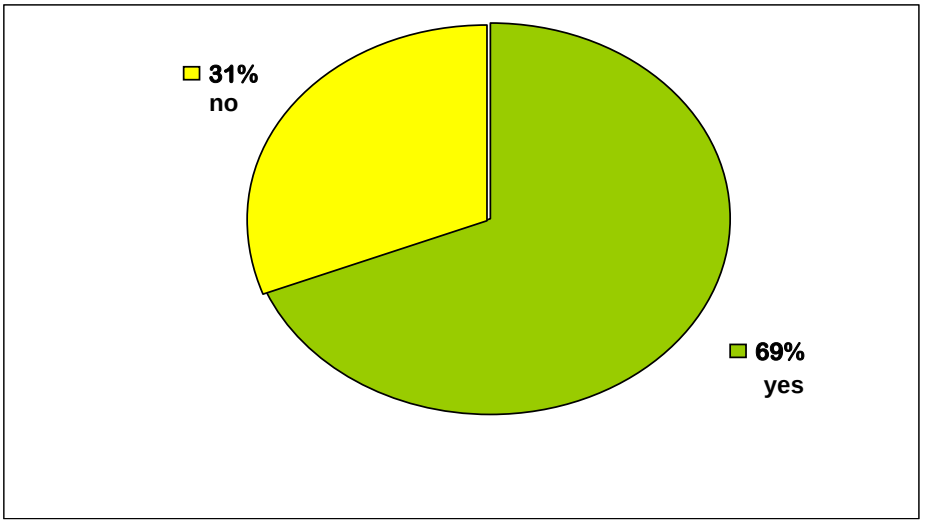
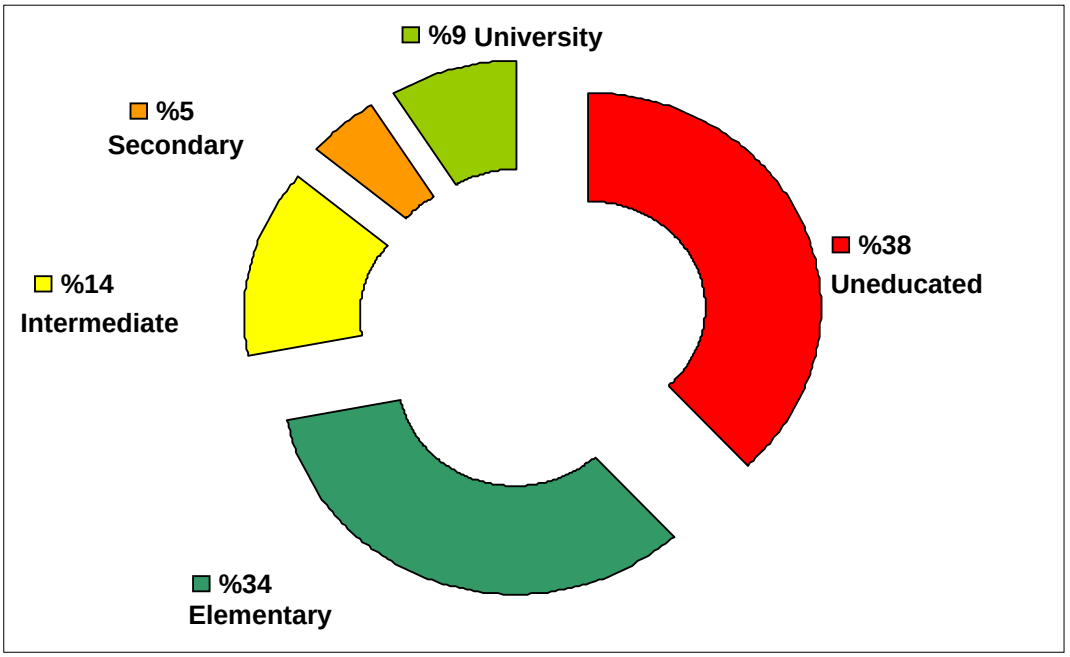


Figure (2): The relationship between education level and kidney disability incidence



ISSN 3063-8186 (online), https://ijhsm.umsida.ac.id, published by Universitas Muhammadiyah Sidoarjo

Indonesian Journal on Health Science and Medicine
Vol. 3 No. 1 (2026): July
DOI: 10.21070/ijhsm.v3i1.434

Figure (3): Relationship between drinking water and kidney failure incidence

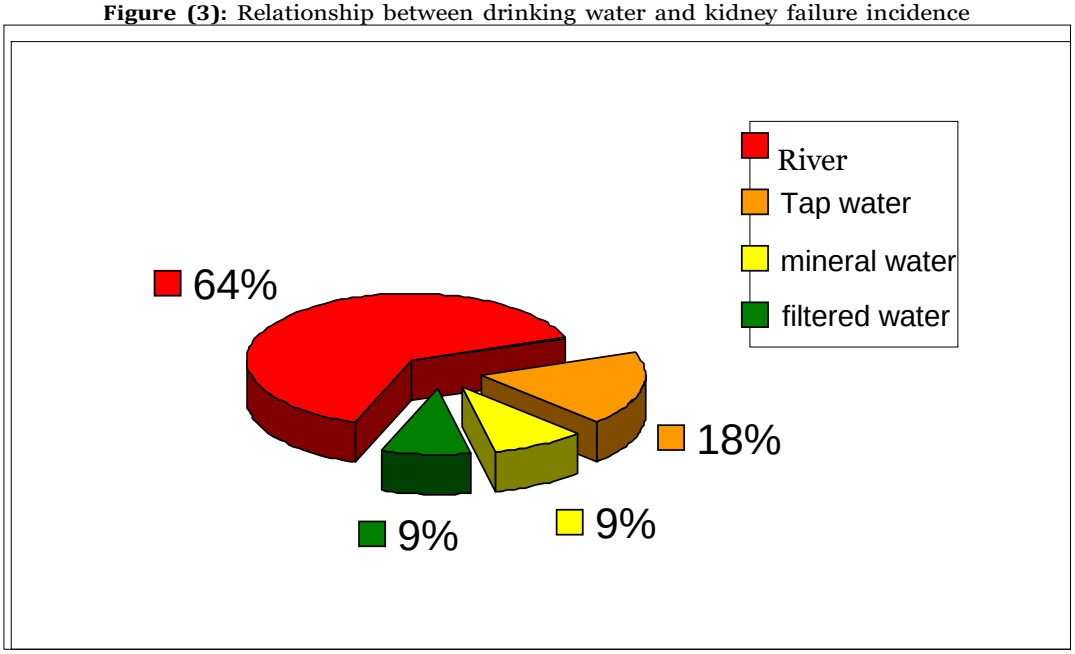
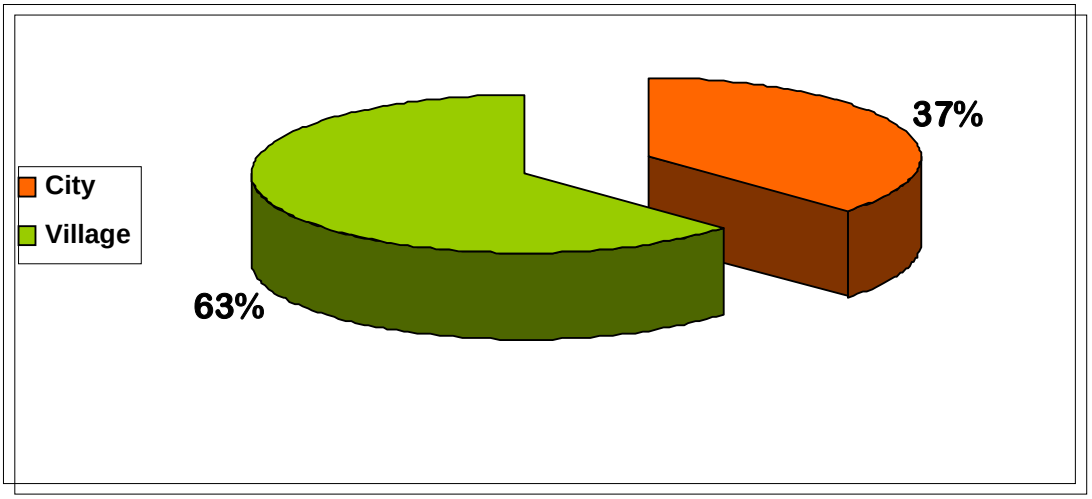


Figure (4): Relationship between place of residence and kidney failure incidence



Serum Zinc and Iron Levels in Patients with Renal Failure

Serum zinc levels in patients with renal failure were determined using atomic mass spectrometry. The concentration of zinc and iron in the serum of patients was compared to the control group. It was found that the mean concentration of zinc and iron in the serum of patients decreased significantly ($p \leq 0.05$). The mean zinc concentration in the patient group was(4.651 ± 1.241) µmol/L, while it was(15.312 ± 5.353) µmol/L in the control group. Statistical analysis showed significant differences between the two groups (Figure 5).

Indonesian Journal on Health Science and Medicine
Vol. 3 No. 1 (2026): July
DOI: 10.21070/ijhsm.v3i1.434

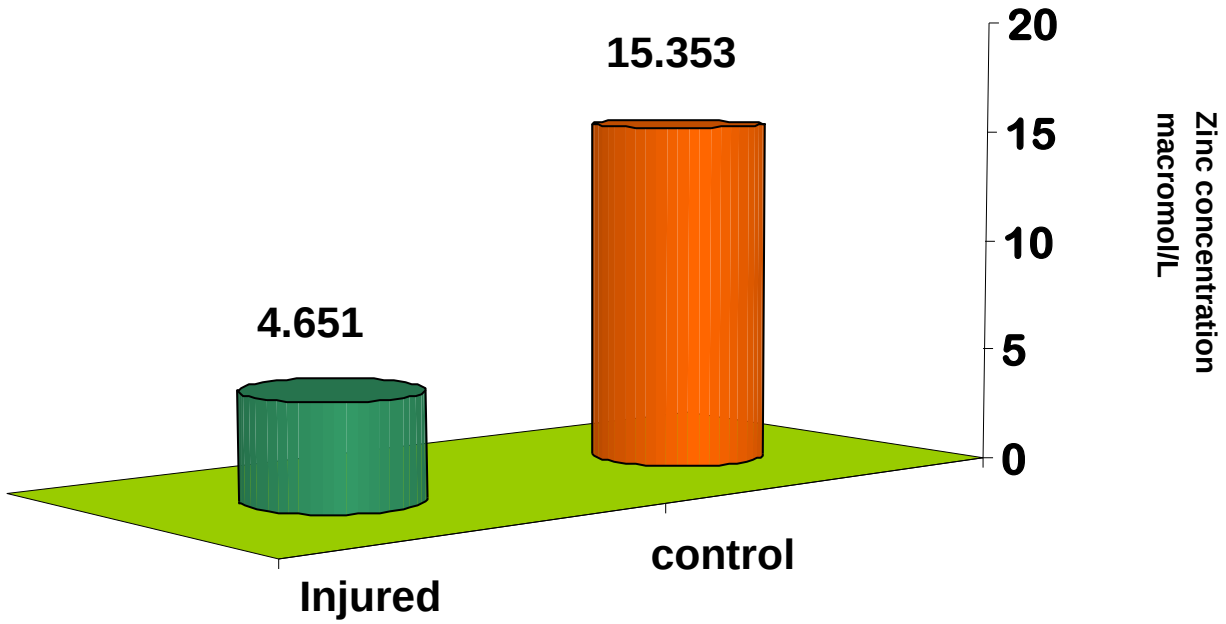
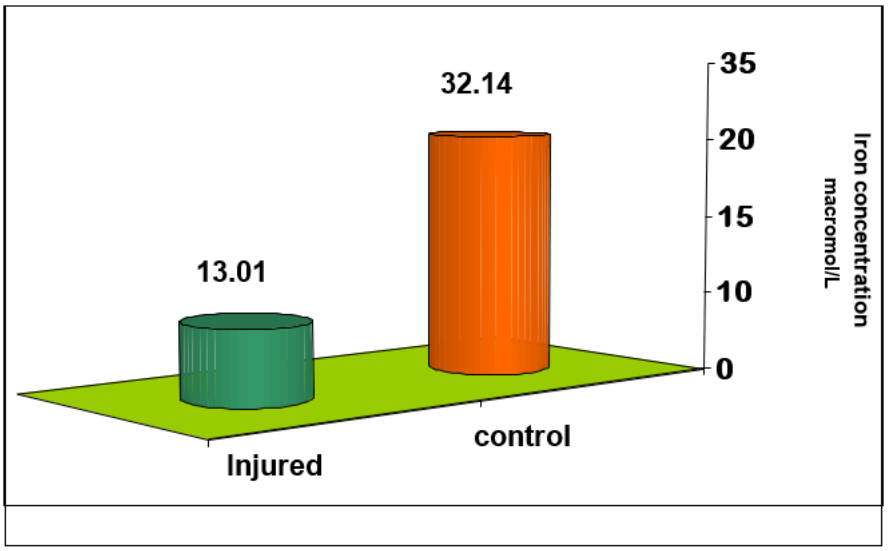


Figure (6): Zinc concentration in infected and control groups



The average iron concentration in the groups of patients was (13.011±3.121) micromoles/liter, while it was (32.143±5.113) micromoles/liter in the control group. Statistical analysis showed significant differences between the two groups (Figure 6).

Conclusion

Thus, in a population ascertain study from the MRFIT, renal failure appears to be be strongly associated with important biochemical/demographic differences. Serum zinc Iron vitamin-D and renin levels among study group were significantly decreased whereas there was marked increase in cystatin C levels especially among patients with age group 50–60 years confirming the power of cystatin C as an excellent marker for glomerular failure detection and as a sensitive marker for chronic renal failure patients compared with serum creatinine. In addition, they identified nutritional deficiencies, blood loss due to dialysis, and dysfunction in the hormone metabolism as main drivers of anemia, hormonal imbalance, and progression of disease, and highlighted that behavioral and socio-demographic factors including, but not limited to, smoking, low education level, rural residency, and unsafe drinking water sources further amplified the outcome of the disease. These observations underscore the need for integrated biochemical surveillance in chronic kidney failure in conjunction with the provision of targeted specific nutritional and public health interventions. Clinically, these findings suggest that regular automated assessments of the HCU of trace elements, vitamin D status, renin activity and cystatin C may improve early

Vol. 3 No. 1 (2026): July
DOI: 10.21070/ijhsm.v3i1.434

identification of risk in dialysis populations and inform treatment. Further studies are needed not only to support these observations but also to define how to achieve therapeutic benefits through controlled micronutrient supplementation, lifestyle modification, and early biomarker-directed screening and eventually test the possibility of reducing morbidity and delaying disease progression in various renal populations.

References

1. N. Tangri, L. A. Stevens, J. Griffith, H. Tighiouart, O. Djurdjev, D. Naimark, et al., “A predictive model for progression of chronic kidney disease to kidney failure,” JAMA, vol. 305, no. 15, pp. 1553–1559, 2025.
2. A. Ortiz, A. Covic, D. Fliser, D. Fouque, D. Goldsmith, M. Kanbay, et al., “Epidemiology, contributors to, and clinical trials of mortality risk in chronic kidney failure,” The Lancet, vol. 383, no. 9931, pp. 1831–1843, 2024.
3. S. K. Mahajan, “Zinc in kidney disease,” J. Amer. Coll. Nutr., vol. 8, no. 4, pp. 296–304, 2022.
4. P. B. Persson, “Renin: origin, secretion and synthesis,” J. Physiol., vol. 552, no. 3, pp. 667–671, 2023.
5. H. Castrop, K. Höcherl, A. Kurtz, F. Schweda, V. Todorov, and C. Wagner, “Physiology of kidney renin,” Physiol. Rev., vol. 90, no. 2, pp. 607–673, 2025.
6. R. Vieth, “Vitamin D supplementation, 25-hydroxyvitamin D concentrations, and safety,” Amer. J. Clin. Nutr., vol. 69, no. 5, pp. 842–856, 2024.
7. W. Al-Badr and K. J. Martin, “Vitamin D and kidney disease,” Clin. J. Amer. Soc. Nephrol., vol. 3, no. 5, pp. 1555–1560, 2023.
8. A. M. F. Martines, R. Masereeuw, H. Tjalsma, J. G. Hoenderop, J. F. M. Wetzels, and D. W. Swinkels, “Iron metabolism in the pathogenesis of iron-induced kidney injury,” Nat. Rev. Nephrol., vol. 9, no. 7, pp. 385–398, 2013.
9. C. P. Smith and F. Thévenod, “Iron transport and the kidney,” Biochim. Biophys. Acta – Gen. Subjects, vol. 1790, no. 7, pp. 724–730, 2025.
10. A. Gafter-Gvili, A. Schechter, and B. Rozen-Zvi, “Iron deficiency anemia in chronic kidney disease,” Acta Haematol., vol. 142, no. 1, pp. 44–50, 2019.
11. A. Onopiuk, A. Tokarzewicz, and E. Gorodkiewicz, “Cystatin C: a kidney function biomarker,” Adv. Clin. Chem., vol. 68, pp. 57–69, 2025.
12. A. S. Levey, L. A. Stevens, C. H. Schmid, Y. L. Zhang, A. F. Castro, H. I. Feldman, et al., “A new equation to estimate glomerular filtration rate,” Ann. Intern. Med., vol. 150, no. 9, pp. 604–612, 2009.
13. K. D. Kalantar-Zadeh, M. H. Kovesdy, and J. D. Kopple, “Mineral and bone disorders in chronic kidney disease,” Lancet, vol. 379, no. 9816, pp. 284–296, 2012.
14. M. Coresh, J. Selvin, L. A. Stevens, J. Manzi, J. W. Kusek, P. Eggers, et al., “Prevalence of chronic kidney disease in the United States,” JAMA, vol. 298, no. 17, pp. 2038–2047, 2007.
15. P. Stenvinkel, B. Lindholm, and R. Heimbürger, “Elevated serum C-reactive protein predicts mortality in chronic kidney disease,” Kidney Int., vol. 55, no. 5, pp. 1897–1905, 1999.