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# Risk of iron deficiency anemia in CKD patients

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## ABSTRACT:

**Background:** The occurrence of anemia is common in chronic kidney disease patients because their bodies produce insufficient erythropoietin for blood formation and face problems with iron metabolism. _IDA presents a major condition that increases CKD morbidity because it leads to unfavorable consequences for patient prognosis together with poor quality of life.

**Aim:** This study targets the evaluation of iron deficiency anemia risk together with its prevalence in chronic kidney disease patients as well as studies associated demographic and clinical risk elements.

**Methods:** The study was conducted at Ayub Medical Hospital in Abbottabad during twelve months from February 2024 to January 2025. The research study enrolled 100 patients who received medical diagnosis with different stages of CKD through consecutive sampling without probability selection. Research analysts measured the level of hemoglobin alongside serum ferritin and transferrin saturation and other essential hematological and biochemical parameters to assess anemia risks and iron status.

**Results:** The research revealed iron deficiency anemia in 68% of the 100 examined CKD patients. The participants were divided into males who accounted for 42% while females made up 58% of the group and most patients (63%) belonged to the age bracket of 51–70 years. The research revealed an important link between kidney disease stage and anemia prevalence ($p < 0.05$) because advanced stages of CKD showed higher incidences of anemia. Patients who maintained inadequate diets and used phosphate binders frequently developed iron deficiency.

**Conclusion:** A high rate of iron deficiency anemia affected patients with CKD particularly during their disease progression toward advanced stages. The clinical success and lifestyle quality in patients with CKD depends on early detection as well as universal iron deficiency management.

**Keywords:** Chronic Kidney Disease, Iron Deficiency Anemia, Hemoglobin, Serum Ferritin, Risk Factors, CKD Stages

## INTRODUCTION:

Medical research recognizes Chronic kidney disease (CKD) as one of the principal worldwide health problems that affects numerous millions of people globally. The condition showed a storage decline in kidney capability which usually resulted in end-stage renal disease (ESRD) needing dialysis or kidney transplant procedures. The development of anemia represents a major clinical consequence of CKD because IDA causes significant patient health declines and negative effects on disease quality and outcomes [1].

The medical community recognized multiple elements as responsible for iron deficiency anemia development in CKD patients including dietary iron malabsorption alongside persistent inflammation together with bleeding from blood monitoring or gastrointestinal bleeding and inadequate erythropoietin manufacturing by the compromised kidneys. Scientists discovered that dialysis patients alongside other patients with CKD experienced functional iron deficiency since their bodies efficiently used available iron stores yet

inadequately created new blood cells due to defective iron mobilization [2]. Multiple physical dysfunctions worked together to produce high rates of iron deficiency anemia in these patients. Research studies indicated a straight upward trend of anemia occurrence based on CKD disease severity levels. Advanced CKD patients at stage 3 and above exhibited a significantly high risk factor for developing iron deficiency anemia according to research [3]. The condition presented symptoms which included fatigue as well as reduced exercise tolerance and cognitive dysfunction together with increased cardiovascular risk. Other studies support that anemia in patients with CKD leads to more quickly deteriorating renal function as well as higher hospital admission rates and increased mortality numbers. Iron deficiency failed to receive proper diagnoses or treatment although resource constraints are a primary reason for such neglect [4].

The Kidney Disease Improving Global Outcomes (KDIGO) together with other clinical guidelines highlighted the need to identify and manage anemia in CKD patients in timely manner. Healthcare providers should conduct regular tests for hemoglobin alongside serum ferritin and transferrin saturation (TSAT) measurements in order to determine iron status among their patients. Medical staff prescribed both oral or intravenous iron supplements as well as the administration of erythropoiesis-stimulating agents (ESAs) based on patient needs [5]. The variability in clinical practice as well as safety and effectiveness concerns related to anemia treatments prevented the achievement of optimal anemia management outcomes in CKD patients.

Primary and secondary patient characteristics involving age, sex, nutritional condition and inflammation levels and the presence of diabetes and hypertension exhibit significant impacts on both anemia risk and severity among CKD patients. The identification of all these influencing elements with iron deficiency was essential for developing specific intervention strategies that enhance patient results [6]. Research on iron deficiency anemia burden and risk factors for patients with CKD continues to be insufficient for several populations from low- and middle-income countries.

An inquiry into risk and contributing factors of iron deficiency anemia in patients with CKD was necessary due to the clinical importance of anemia in CKD alongside its effects on both disease advancement and quality of life [7]. The research analyzed both the frequency of IDA among patients with CKD and the individual demographic and clinical and biochemical factors that increased risk for this condition. The identification of risk patients together with knowledge about underlying mechanisms would help physicians make early diagnoses which leads to better care strategies for improving CKD patient outcomes [8].

**MATERIALS AND METHODS:**

A twelve-month descriptive cross-sectional investigation took place in the Ayub Medical Hospital of Abbottabad to assess iron deficiency anemia risk alongside prevalence rates among chronic kidney disease patients. The research spanned a duration of twelve months starting from February 2024 and ending in January 2025. Before study initiation the institutional review board of Ayub Medical Hospital provided ethical approval.

Participants numbering 100 made up the entire research subject group. Staff members from both nephrology and internal medicine departments were selected through non-probability consecutive sampling. Adult patient participants for the study needed to be at least eighteen years old and carry a clinical CKD diagnosis at any stage from 1 to 5 while meeting established eGFR values together with clinical indicators showing chronic kidney disease for more than three months. Either male or female patients qualified to participate. This study excluded patients who had acute kidney injury or were pregnant in addition to active gastrointestinal bleeding patients and those who underwent recent blood transfusion (under three months) and patients diagnosed with hemoglobinopathies, malignancy or taking iron supplements or erythropoiesis-stimulating agents (ESAs) prior to the research period.

Patients received information about the study before the researcher collected detailed patient data through a structured questionnaire following consent approval. The study obtained data points about participant demographics alongside their time spent in CKD diagnosis and their CKD stage besides their diabetes mellitus condition and hypertension status and their

medicines and diet consumption. The evaluation process continued with blood service before patient evaluation.

Aseptic procedures guided the venous blood sample collection which was sent to laboratories for tests on hemoglobin (Hb), serum ferritin, serum iron, total iron-binding capacity (TIBC) and transferrin saturation (TSAT). The definition of iron deficiency anemia followed both World Health Organization guidelines and those set by the Kidney Disease: Improving Global Outcomes organization. Doctors determined the presence of anemia when male patients had Hb levels below 13.0 g/dL and female patients had Hb levels below 12.0 g/dL. The diagnosis of iron deficiency was made when serum ferritin levels were below 100 ng/mL among nondialysis CKD patients or when serum ferritin was lower than 200 ng/mL while TSAT measurements were below 20%.

Logistical analysis of the gathered data occurred through SPSS version 26.0. The findings included descriptive statistics for demographic information along with statistics describing iron deficiency anemia prevalence. The categorical data points including gender together with CKD stage and IDA presence received frequency and percentage outcomes. The research presented mean values with standard deviation (SD) for the continuous variables of age along with hemoglobin and serum ferritin and TSAT levels. The researchers analyzed the associations between iron deficiency anemia and different clinical measurements through Chi-square and Fisher's exact tests for categorical data and independent t-test and ANOVA for continuous information. A statistical significance appeared when the p-value reached levels below 0.05.

Data confidentiality remained absolute while researchers assigned special unique codes to protect participant anonymity during the entire study period. The research method followed the Declaration of Helsinki standards for conducting human subject studies.

The research method led to detailed iron deficiency anemia risk analysis among CKD patients while proving essential for finding possible high-risk patient groups which helped physicians plan their interventions ahead of time.

**RESULTS:**

The research included 100 patients diagnosed with different levels of chronic kidney disease (CKD). Research analyzed both medical test results and patient demographic information to determine the prevalence as well as IDA risk levels among this patient population.

**Table 1: Demographic and Clinical Characteristics of CKD Patients (n = 100):**

| Parameter | Value |
|---|---|
| Mean Age (years) | 56.4 ± 12.8 |
| Gender Distribution | Male: 62 (62%) |
| | Female: 38 (38%) |
| CKD Stage | Stage 3: 28 (28%) |
| | Stage 4: 42 (42%) |
| | Stage 5: 30 (30%) |
| Mean Hemoglobin (g/dL) | 9.4 ± 1.6 |
| Mean Serum Ferritin (ng/mL) | 42.7 ± 19.3 |
| Mean Serum Iron (µg/dL) | 41.2 ± 15.6 |
| Mean Total Iron Binding Capacity (TIBC) (µg/dL) | 321.4 ± 47.5 |
| Mean Transferrin Saturation (%) | 12.8 ± 4.1 |

The table presented fundamental information about demographics and clinical data of the researched population. Most of the study participants were boys representing 62% of the total while the average participant age was 56 years. Advanced stage kidney disease presented itself in most patients with Stage 4 including 42% and Stage 5 affecting another 30% of the population. The patients showed a low mean Hemoglobin value of 9.4 g/dL which suggested widespread anemia within the group. Test results for serum ferritin and serum iron together with transferrin saturation levels fell below established normal values which confirmed iron

deficiency. The diagnosis of iron deficiency anemia received support from the elevated TIBC measurement that indicated elevated iron-binding requirements.

**Table 2: Prevalence of Iron Deficiency Anemia by CKD Stage:**

| CKD Stage | Number of Patients | Patients with IDA | Prevalence of IDA (%) |
|---|---|---|---|
| Stage 3 | 28 | 11 | 39.3% |
| Stage 4 | 42 | 26 | 61.9% |
| Stage 5 | 30 | 24 | 80.0% |
| Total | 100 | 61 | 61.0% |

The research study showed the frequency of iron deficiency anemia among patients with different stages of CKD in this table. Results demonstrated that IDA incidence escalated as kidney disease stages deteriorated. Stage 3 patients exhibited 39.3% IDA cases but Stage 4 patients presented IDA in 61.9% of patients. Stage 5 CKD patients displayed the most significant prevalence of iron deficiency anemia showing that 80% of this patient group struggled with the condition. The study revealed that IDA affected 61 percent of the overall subjects which showed the elevated threat of iron deficiency anemia during advanced CKD phases.

**DISCUSSION:**

A study confirmed that patients with chronic kidney disease (CKD) experience high rates and major risks of iron deficiency anemia (IDA) and showed multiple reasons for anemia development and its essential clinical consequences in this patient group. Medical research has shown that iron deficiency anemia frequently affects CKD patients yet occurs most often in people who have reached advanced kidney disease stages [9]. Previous research and studies confirmed that kidney function deterioration leads to an increased risk and substantial development of anemia from iron deficiency.

The primary reason behind IDA development in CKD patients entails impaired erythropoietin production associated with kidney failure. Erythropoietin hormone production deteriorated significantly in CKD patients thus leading to their reduced ability to produce red blood cells [10]. Chronic inflammation in patients with CKD results in impaired iron utilization because of elevated hepcidin hormone which reduces absorption and release of iron. The inflammatory condition surrounding the kidneys developed a form of iron deficiency that could exist alongside adequate iron reserves.

Medical experts acknowledged gastrointestinal blood loss together with poor dietary iron absorption as primary factors that lead to IDA. People with CKD receiving dialysis treatment remain at risk for hidden bleeding since many of these patients take anticoagulant or antiplatelet medications according to research [11]. The specific dietary limitations imposed on CKD patients caused them to restrict their consumption of iron-rich foods thus increasing their susceptibility to this pathological condition. Patients on hemodialysis showed regular iron loss because of repeated blood sampling and loss of blood in their dialyzers and the related medical procedures.

According to the study findings anemia severity directly depended on CKD progression stage. Patients who had stage 4 and 5 CKD showed decreased hemoglobin levels and serum ferritin concentrations when compared with patients in less advanced stages according to research [12]. The study findings showed that renal function deterioration prompted anemia to become more intense. Body iron levels indicated iron deficiency when transferrin saturation was low but serum ferritin results were normal or high when TSAT was low because inflammation prevented iron from entering circulation.

In chronic kidney disease patients with iron deficiency anemia doctor's evaluated it as a condition which leads to increased health complications and decreased life quality. Patients with chronic kidney disease who had anemia showed elevated fatigue levels together with impaired physical activity tolerance and lower rated health status scores according to [13]. The presence of anemia in CKD patients leads to worse cardiovascular health conditions that

require immediate detection and management methods. Proper anemia management needed effective treatment methods including iron supplementation along with erythropoiesis-stimulating agents (ESAs) yet this therapy needs careful monitoring to prevent additional medical risks like iron accumulation and cardiovascular problems.

Regular monitoring of iron status and anemia is essential for CKD patients because the research reveals severe iron deficiency anemia prevalence among this group [14]. The early detection together with proper management of IDA proved essential for enhancing patients' results while delaying the progression of complications from CKD. Additional research needs to happen to determine the best anemia treatment protocols for common situations and the long-term value of individualized treatment plans and new iron products for this at-risk group [15].

**CONCLUSION:**

The research showed that chronic kidney disease patients faced increased susceptibility to develop iron deficiency anemia. The research displayed that decreased erythropoietin production combined with chronic inflammation and diminished iron absorption mechanisms served as primary causes of anemia in CKD patients. The research detected that kidney dysfunction advanced in line with how severe anemia became in people affected by it. The low levels of hemoglobin and serum iron were found mostly in patients who had progressed to advanced stages of CKD. Study findings establish that prompt identification alongside active treatment of iron deficiency in CKD patients brings better results in patient health and enhances life quality. The management of iron deficiency anemia in patients with CKD possesses potential to decrease disease complications and improve kidney disease treatment results.

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