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Assessment of Iron Profile in Chronic Kindey Disease Patients Managed without Dialysis

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Abstract:-

- ***Aim:***

To assess the Haematological profile and Serum Iron indices in non-dialysis Chronic Kidney Disease patients

- ***Background And Objectives:***

Anemia is one of the most common condition seen in patients with Chronic Kidney Disease. It occurs due to reduced production of erythropoietin from Kidney which is required for production of RBC. As many people are landing up with CKD and it is becoming a global issue, anemia is becoming more prevalent among the population. One of the factor which also contributes to it is nutritional deficiency such as iron deficiency anemia which overlaps with reduced production of RBC due to CKD.

- ***Materials and Methods:***

It is a cross sectional study conducted over a period of 18 month in out patient department and wards of Department of Nephrology and General Medicine, Katuri Medical College and Hospital, Guntur. A sample size of 100 individuals were considered for the study. Ethical Clearances were taken and informed consent given about the same. Patients underwent needed investigations like haematological profile including Serum. Ferritin, Iron and transferrin saturation and Renal Function tests.

- ***Results:***

Our study's findings indicated that the severity of chronic renal disease increased along with a low level of hemoglobin and packed cell volume. Anaemia was present in all the individuals included in the study cases. 70% of the individuals exhibited microcytic normochromic anemia, while 10% displayed microcytic hypochromic anemia. 10 percent of the studied subjects exhibited concurrent occurrences of both forms of anemia. The observed difference was very statistically significant ($p = 0.0001$). Among the Control patients, 32% had normal levels of haemoglobin, whereas the remaining 68% presented both kinds of anemia. There were significant differences ($p < 0.05$) in the TIBC, TSAT %, and Ferritin values between the study and control cases in terms of serum iron indices. The Ferritin readings did not show any significant differences.

- ***Conclusion:***

It is imperative to make every possible attempt to determine the underlying cause of anemia in patients with chronic kidney disease (CKD) and to provide appropriate treatment for the concurrent iron deficient anemia in these individuals. Additionally, it is important to monitor other hematological parameters in order to identify any concomitant abnormalities.

I. INTRODUCTION

Chronic kidney disease (CKD) refers to a range of different processes that cause impaired kidney function and a gradual decrease in glomerular filtration rate (GFR).

Accurately assessing the burden of chronic renal disease is challenging. The estimated prevalence of chronic kidney disease (CKD) is 800 cases per one million individuals, whereas the occurrence of end stage renal disease (ESRD) is between 150 and 200 cases per one million individuals. Chronic kidney disease (CKD) is a global epidemic that is linked to several other health conditions, making it a disease with a high fatality rate.1,2

Anemia of chronic disease is a multifaceted ailment influenced by a range of causes. While the main issue is a reduction in the generation of erythropoietin by the kidney, several additional factors may also have a contributing effect. For instance, deficiencies in iron, folate, and vitamin B12 might occur as a result of inadequate nutrition or increased blood loss, shorter red blood cell (RBC) lifespan, hyperparathyroidism, moderate chronic inflammation, or aluminum toxicity. Anemia in chronic kidney disease exacerbates the co-morbidities of diabetes and hypertension, leading to unfavorable outcomes and increased mortality rates, resulting in unfavorable results and elevated fatality rates.

Untreated chronic anemia can result in several physiological diseases, such as cardiovascular issues, and can lead to higher rates of death and morbidity. The Kidney Disease Outcomes Quality Initiative (KDOQI) guidelines, published by the National Kidney Foundation in 2002, categorized chronic kidney disease (CKD) into five stages based on two factors: glomerular filtration rate (GFR) and

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indicators of kidney damage such as proteinuria, abnormal urinary sediment, structural abnormalities, and the presence of a kidney allograft.5 The staging method was revised in the 2012 Kidney Disease: Improving Global Outcomes (KDIGO) clinical practice guidelines to accurately represent the individual impacts of glomerular filtration rate (GFR), albuminuria, and the etiology of chronic kidney disease (CKD).6 Based on these guidelines, Chronic Kidney Disease (CKD) has been categorized into five distinct stages3,4. Anemia typically manifests when the glomerular filtration rate (GFR) falls below 60ml/min or during stage 3 of the disease.

Renal insufficiency is linked to a propensity for bleeding, which is caused by platelet dysfunction resulting from aberrant platelet aggregation and adhesiveness.5,6 Uremic patients may experience a decline in their white blood cell count. However, correcting anemia in these patients leads to an increase in natural killer cells and an improvement in the function of leukocyte phagocytosis. Timely detection and management of anemia in chronic kidney disease (CKD) can enhance cardiovascular health outcomes and reduce the risk of death.7 Administering prompt treatment for anemia in chronic kidney disease (CKD) can delay the development of end-stage renal disease (ESRD) and enhance overall survival.

The process of identifying, assessing, and treating anemia in CKD mostly involves conducting a complete blood count, measuring serum ferritin levels, and evaluating transferrin saturation to determine the amount of iron stored in the body and its sufficiency for red blood cell production.

The Kidney Disease Outcome Quality Initiative (K/DOQI) recommendations from the National Kidney Foundation propose that, during therapy with erythropoiesis-stimulating agents (ESA) for chronic kidney disease (CKD) patients not on dialysis, the serum ferritin level should be maintained above 100 ng/ml and the transferrin saturation (TSAT) should be kept above 20%.

When necessary, the treatment of anemia in chronic kidney disease (CKD) may include iron therapy, administration of erythropoietin, and adjustment of hemoglobin levels to a target range of 11-12 gm/dl.8 The provision of renal replacement therapy imposes a substantial financial burden on both the family and the healthcare system.

This study aimed to assess the hematological profile and serum iron indicators of non-dialysis chronic kidney disease (CKD) patients.

II. AIM AND OBJECTIVES

➢ *Aim:*

To assess haematological profile and serum iron indices in nondialysis chronic kidney disease patients.

➢ *Objectives:*

- To study the haematological profile and serum iron indices in non dialysis chronic kidney disease patients.
- To detect the types of anemia in patients with chronic kidney disease
- To study the prevalence of iron deficiency in non-dialysis chronic kidney disease patients according to National Kidney Foundation's Kidney
- Disease Quality Initiative (NKF-K/DOQI) Guidelines.

III. MATERIALS AND METHODS

➢ *Materials:*

The study was carried out at Katuri Medical College and Hospital from September 2022 to February 2024. The study included a cohort of one hundred individuals with chronic renal disease who were not receiving dialysis and were being managed conservatively in medicine/nephrology facilities. The study participants were recently diagnosed individuals with chronic renal disease, regardless of their gender.

Control participants were selected from a pool of healthy adult people. In order to maintain consistency between the control group and the group with Chronic Kidney Disease (CKD), healthy individuals were chosen from the friends and family members who were accompanying the CKD patients.

The haematological profile was conducted in the Pathology Department, while the renal parameters and serum iron indices in both individuals and controls were assessed in the Department of Biochemistry at Katuri Medical College.

The study received approval from the Ethical Committee of Katuri Medical College. All study participants provided informed consent.

➢ *Study design:* Cross-Sectional

The controls underwent a comprehensive physical examination, together with urinalysis and blood sugar and creatinine estimation, to confirm their overall good health.

A cohort of 50 cases and 50 controls were examined.

➢ *Period of Study:*

September 2022 to February 2024.

➢ *Diagnostic Criteria:*

- Bilateral Contracted Kidneys
- GFR <60 mL/min/1.73m2.

➢ *Exclusion Criteria:*

Conditions that could potentially affect the iron profile and red blood cell shape were eliminated based on a thorough history, clinical examination, and basic investigations.

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➢ *The Following Items are Included:*

- Age below 18 years
- Indications of recent infection or injury during the past four weeks
- Recent administration of iron injections through non-oral routes within the past 14 days.
- Recent blood transfusion history during the past month
- Hemoglobinopathies
- Malignancies
- Recent visible bleeding
- Patient undergoing dialysis and post-transplant status.

IV. METHODS

➢ *The Clinical Examination Encompassed*

- Assessment of weight, height, and vital statistics.
- Examination of Major Systems

Haematological tests include measurements of haemoglobin, red blood cell count, white blood cell count, haematocrit, differential count, mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC), platelet count, red cell distribution width (RDW), examination of peripheral smear, and assessment of bleeding time. Tests were conducted to measure clotting time, ESR (erythrocyte sedimentation rate), serum ferritin, total iron binding capacity, and serum iron. Hemogram was conducted using automated methods.

A peripheral blood smear was performed. The erythrocyte sedimentation rate (ESR) was determined using the Wintrobes method. Biochemical studies include measuring blood sugar levels, renal parameters such as blood urea and serum creatinine, serum electrolyte levels, and the urine spot protein creatinine ratio.

Serum ferritin levels were measured using an enzyme-linked immunosorbent assay (ELISA). The iron level was assessed using the Ferrozine method without the need for deproteinization.

The Spectrophotometric Assay was used to assess the Total Iron Binding Capacity (TIBC).

Transferrin saturation is determined by the formula (TSAT): TSAT = (serum iron/total iron-binding capacity) × 100.

- Ethical committee approval : Obtained
- Consent : Informed Consent obtained
- Financial Support : Nil
- Conflict of Interest : Nil

➢ *Statistical Tools*

The data gathered on all the cases selected was documented in a Master Chart. The data analysis was conducted using the Epidemiological Information Package (EPI 2010), a computer program developed by the Centre for Disease Control in Atlanta.

Utilizing this software, calculations were performed for range, frequencies, percentages, means, standard deviations, chi square, and 'p' values. The Kruskal-Wallis chi-square test was employed to assess the significance of differences between quantitative variables, whereas Yate's chi-square test was utilized for qualitative variables. A 'p' value less than 0.05 is considered to indicate a statistically significant link.

V. RESULTS AND ANALYSIS OF OBSERVED DATA

Table 1: Age Distribution among CKD Patients and Normal Individuals

Age Group	Study Cases (CKD)		Control Cases(Normal)	
	NO	%	NO	%
<20 Years	2	4.00%	5	10.00%
21-30 Years	13	26.00%	10	20.00%
31-40 Years	12	24.00%	12	24.00%
41-50 Years	9	18.00%	9	18.00%
51-60 Years	14	28.00%	14	28.00%
Total	50	100.00%	50	100.00%
Range	19-60		19-60	
Mean	39.68		40.1	
SD	12.56410501		13.45324481	

The study group had a mean age of 39.68 years with a standard deviation of 12.56 years, while the control group had a mean age of 40.1 years with a standard deviation of 13.4 years.

CKD GROUP	CONTROL GROUP
39.68	40.1

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Table 2: Sex Distribution among Cases and Controls

Sex Distribution				
	Study Cases		Control Cases	
Sex	NO	%	No	%
Male	34	68.00%	35	70.00%
Female	16	32.00%	15	30.00%
Total	50	100.00%	50	100.00%

Out of a total of 50 study cases, 34 are males and 16 are females. The male population accounts for 68% while the female population accounts for 32%. Among the 50 control cases, there are 35 males and 15 girls. The male population comprises 70% while the female population comprises 30%.

Sex	CKD GROUP	CONTROL GROUP
Male	34	35
Female	16	15

Table 3: Duration of Illness Among Patients with Chronic Kidney Disease

Table 3: Duration of illness	
Parameter	Duration of CKD in Months
Range	3-24
Mean	8.42
SD	4.371008383

The duration of disease varied between 3 months and 24 months, with an average of 8.57 months.

Table 4: Glomerular Filtration Rate (GFR) among patients Suffering with Chronic Kidney Disease (CKD) and their Stages

Glomerular Filtration Rate (GFR) / CKD stages		
CKD stages /GFR (ml/min/m²)	Cases	
	NO	%
Stage 5(<15)	18	36.00%
Stage 4 (15-29)	18	36.00%
Stage 3 (30-59)	14	28.00%
Stage 2 (60-89)	_	
Stage 1 (≥90)	_	
Total	50	100.00%
Range	2.09-45	
Mean	17.564928	
SD	10.97845872	

Out of the 50 cases of Chronic Kidney Disease (CKD), the Glomerular Filtration Rate (GFR) varied between 2.09 and 45 ml/min/m2. The average glomerular filtration rate (GFR) was 17.56 milliliters per minute per square meter, with a standard deviation of 10.97. None of the selected instances exhibited stage 1 or stage 2.

CKD Stages	Percentage
Stage 5	36.00%
Stage 4	36.00%
Stage 3	28.00%

Among all cases, 28% of patients had Stage 3 sickness, 36% had Stage 4, and the remaining 36% had Stage 5.

Table 5: Risk Factors seen in Patients with CKD

Risk Factors for CKD				
Risk factor	No. of Cases			
	Present		Absent	
	NO	%	NO	%
Diabetes Mellitus	13	26.00%	37	74.00%
Hypertension	24	48.00%	26	52.00%

48% of the study cases had hypertension, whereas 26% had Diabetes Mellitus.

Table 6: Other Risk Factors for Anemia

Other risk factor for Anemia	No of Cases
History of bleeding manifestation	2
Motion ova & cyst present	2
Motion for occult blood	1

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History of bleeding manifestation (gum bleeding, ecchymosis) was present in 2 cases, motion ova & cyst present in 2 cases and motion for occult blood was positive in one case.

Table 7: Haematological Profile Between Study and Control Group

Variable	Study group		Control group		P (F<=f) one-tail	Significance
	Mean	SD	Mean	SD		
Hb (gm/dl)	8.01	1.67	14.97	1.86	0.2320	Significant at 0.0001
RBC count (million/cumm)	3.17	0.70	5.33	0.58	0.0995	Not Significant at 0.0001
PCV %	25.50	4.43	45.44	4.68	0.3511	Significant at 0.0001
Platlet count (lakhs/cumm)	3.29	0.65	2.54	0.85	0.0361	Significant at 0.0001
MCV (fL)	81.11	14.50	86.16	8.59	0.0002	Significant at 0.0001
MCH (pg)	26.42	5.17	30.00	2.56	1.1493	Not Significant at 0.0001
MCHC (g/dl)	31.24	4.07	33.64	1.24	2.5791	Not Significant at 0.0001
RDW %	15.71	3.85	13.56	1.73	0.5162	Not Significant at 0.0001
ESR (mm/hr)	27.26	17.14	12.12	3.27	0.3172	Significant at 0.0001

Upon comparing the data from the study and control groups, significant statistical differences were seen in Hemoglobin (Hb), RBC count, PCV, and ESR ($p<0.005$). Hemoglobin, red blood cell count, and packed cell volume were lower, whereas erythrocyte sedimentation rate was higher, compared to the control group.

The average hemoglobin level was 8.01 gm/dl. Among males, the average hemoglobin level was 8.03 gm/dl, while among females, it was 7.71 gm/dl. The average red blood cell (RBC) count was 3.17 million per cubic millimeter (mm3), and the average packed cell volume (PCV) was 25.50%. The Mean Red Cell Distribution Width was 15.71%. The Erythrocyte Sedimentation Rate was increased in 35 cases, accounting for 64.8% of the total.In all cases, the levels of hemoglobin and packed cell volume were found to be low.There were 7 cases with an increase in neutrophil white blood cells and 3 cases with an increase in lymphocyte white blood cells. There were six patients that exhibited eosinophilia. None of the patients exhibited symptoms indicative of lymphoma or leukemia. Thrombocytosis was present in 7 individuals.

Table 8: Association between CKD Stages and other Quantiative Haematological Parameters

Parameter	Values (Mean±SD) in Cases with			P Value (ANOVA)	Significance
	CKD 3	CKD 4	CKD 5		
Hb (gm/dl)	9.04±1.65	8.6±1.07	6.98±1.59	**0.0004**	**Significant at 0.0005**
RBC (million/cumm)	3.41±0.56	3.29±0.75	2.85±0.66	0.0489	Not Significant at 0.0001
PCV %	28.43±3.58	26.2±3.77	22.51±3.93	**0.0002**	**Significant at 0.0002**
MCV (fL)	80.96±9.25	84.20±7.26	78.13±21.65	0.4633	Not Significant at 0.0001
MCH (pg)	26.50±5.28	25.38±4.78	25.38±5.47	0.7909	Not Significant at 0.0001
MCHC (g/dL)	31.08±4.03	31.45±3.56	32.27±3.01	0.6136	Not Significant at 0.0001
RDW %	15.83±4.72	15.72±4.35	15.61±2.59	0.9878	Not Significant at 0.0001
Duration (in months)	6.57±2.40	7.77±2.50	10.55±3.11	**0.0005**	**Significant at 0.0005**

Significant statistical relationships were found between the levels of Hb% ($p= 0.0005$), PCV ($p<0.0002$), and the length of sickness and the stages of chronic kidney disease (CKD).

The p-value is less than 0.0005. As the stage of chronic kidney disease (CKD) progresses, the level of hemoglobin and packed cell volume falls. These associations exhibit statistical significance.

Table 9: Bleeding Time and Clotting Time

Parameter	Bleeding Time in Minutes		Clotting Time in Minutes	
	NO	%	NO	%
Normal	47	94.00%	50	100.00%
Increased	3	6%	0	0.00%
Total	50	100%	50	100.00%

Three patients (6%) saw an increase in bleeding time. The clotting time was within the usual range for all patients.

Table 10: Peripheral Smear of Study and Control Population

Peripheral Smear				
Peripheral Smear	Study cases		Control cases	
	NO	%	NO	%
Normocytic normochromic anemia	35	70.00%	-	-

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Microcyctic hypochromic anaemia	10	20.00%	-	-
Both types present	5	10.00%	34	68.00%
Normal	-		16	32.00%
Total	50	100.00%	50	100.00%
P Value	**Significant at 0.0001**			

Anaemia was present in all the individuals included in the study cases. 70% of the individuals exhibited microcytic normochromic anemia, while 10% displayed microcytic hypochromic anemia. 10 percent of the studied subjects exhibited concurrent occurrences of both forms of anemia. The observed difference was very statistically significant (p = 0.0001). Among the Control patients, 32% had normal levels of haemoglobin, whereas the remaining 68% presented both kinds of anemia.

Peripheral Smear	Study cases	Control cases
Normocytic normochromic anemia	70	0
Microcyctic hypochromic anaemia	20	0
Both types present	10	68
Normal	0	32

Observed Values	Study cases	Control cases	Row total
Normocytic normochromic anemia	35	0	35
Microcyctic hypochromic anaemia	10	0	10
Both types present	5	34	39
Normal	0	16	16
Column total	50	50	100

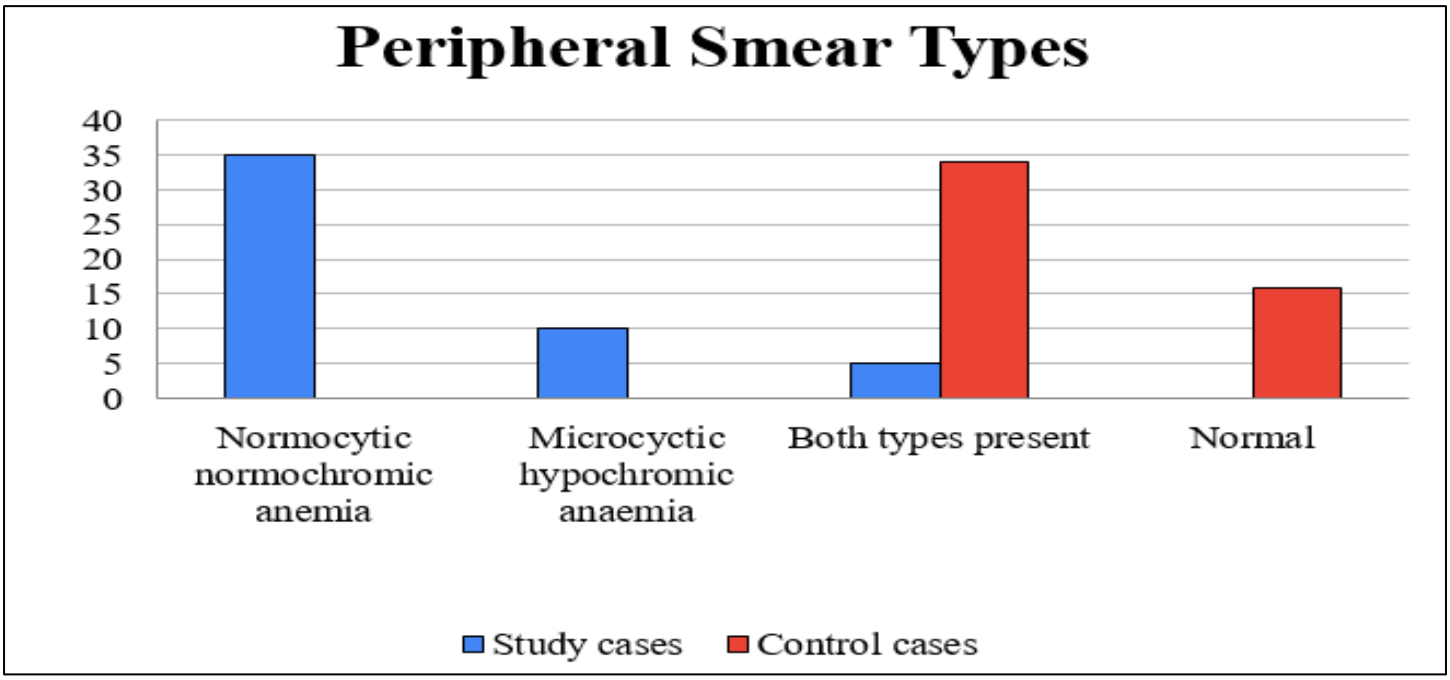

Fig 1: Variations in Peripheral Smear Seen in Patients with Chronic Kidney Disease

Table 11: Relationship between Type of Peripheral Smear and Serum Ferritin (ug/l), Transferrin Saturation %(TSAT)

Peripheral Smear type	No of Cases	Mean TSAT	Mean Ferritin
Normocytic normochromic	35	30.98	342.88
Microcyctic hypochromic	10	16.62	116.37
Both	5	22.16	170.18

There was a statistically significant correlation between the type of peripheral smear and TSAT (p=<0.001), as well as a substantial correlation between the type of peripheral smear and ferritin levels (p=<0.002). Patient with microcytic hypochromic anemia exhibited low levels of serum ferritin and transferrin saturation. The average transferrin saturation in cases of normocytic normochromic anemia is 30.98, while in cases of microcytic hypochromic anemia it is 16.62. Both

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types of anemia are observed in 22.16% of cases. The average ferritin levels in patients with normocytic normochromic anemia is 342.88, in patients with microcytic hypochromic anemia is 116.37, and in patients with both types of anemia is 170.18.

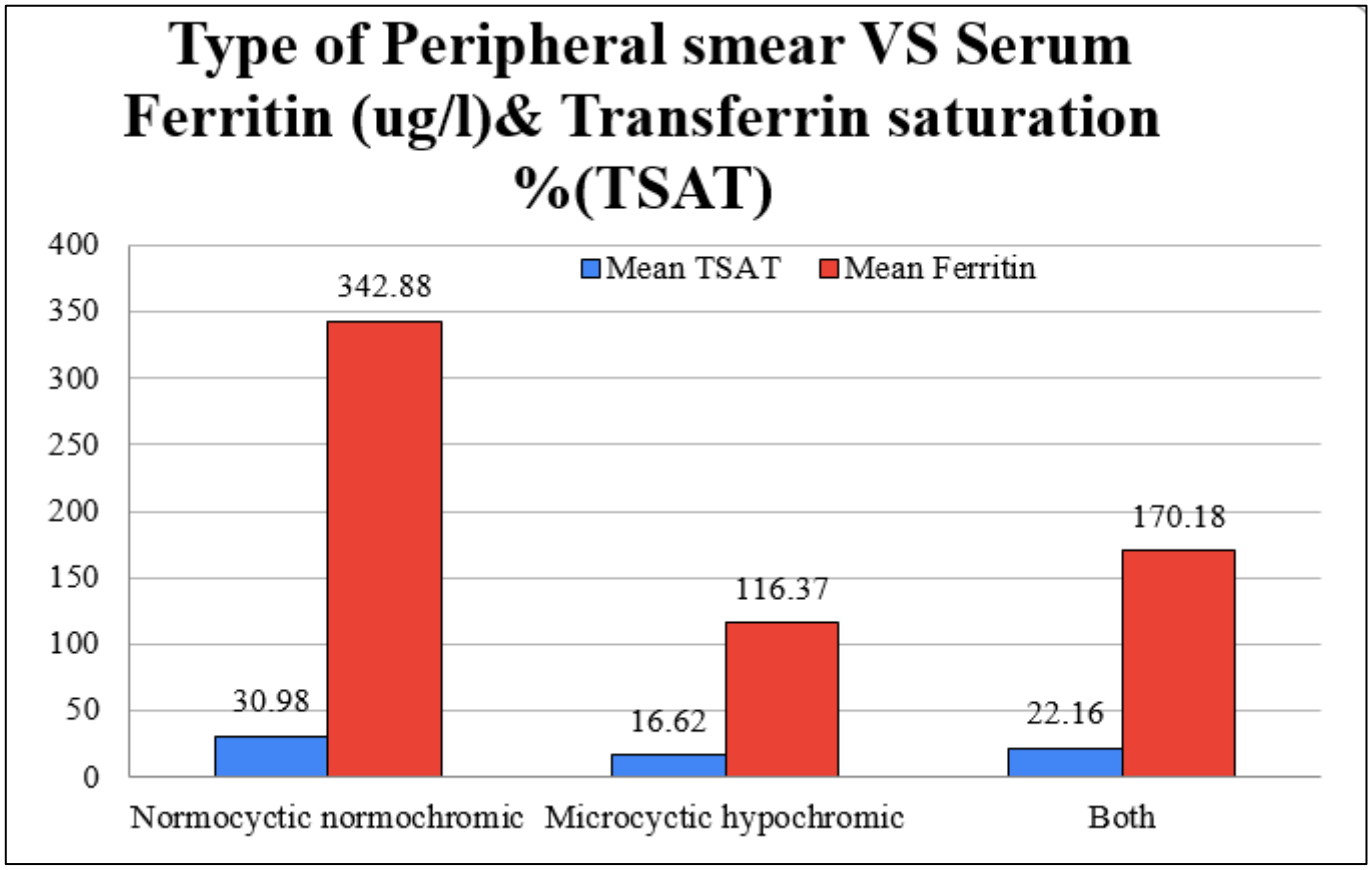

Fig 2: Types of Peripheral Smear vs Serum Ferritin & Transferrin Saturation

Table 12: Hemoglobin and Left Ventricular Hypertrophy (LVH)

LVH	No of Cases	Mean Hb(gm/dl)	SD
Present	17	8.22	1.41
Absent	33	7.89	1.8

Left ventricular hypertrophy was observed in 34% of individuals with chronic kidney disease, specifically in 17 cases. A statistically significant correlation was observed between the hemoglobin level and LVH. The p-value is less than 0.001.

Table 13: Serum Iron Indices

Serum Iron Indices	Study Group		Control Group		P Value	SIGNIFICANCE
	Mean	SD	Mean	SD		
Iron (ug/I)	87.11	121.92	114.1	32.63	0.074	Not Significant
TIBC (ug/I)	282.96	78.27	325.96	59.29	0.0037	Significant at 0.005
TSAT %	26.64	17.34	36.7	9.37	0.0004	Significant at 0.0005
Ferritin (ug/I)	280.31	345.63	187.7	84.76	0.0320	Significant at 0.05

There were significant differences ($p < 0.05$) in the TIBC, TSAT %, and Ferritin values between the study and control cases in terms of serum iron indices. The Ferritin readings did not show any significant differences.

Serum Iron Indices	Study Group	Control Group
Iron (ug/I)	87.11	114.1
TIBC (ug/I)	282.96	325.96
TSAT %	26.64	36.7
Ferritin (ug/I)	280.31	187.7

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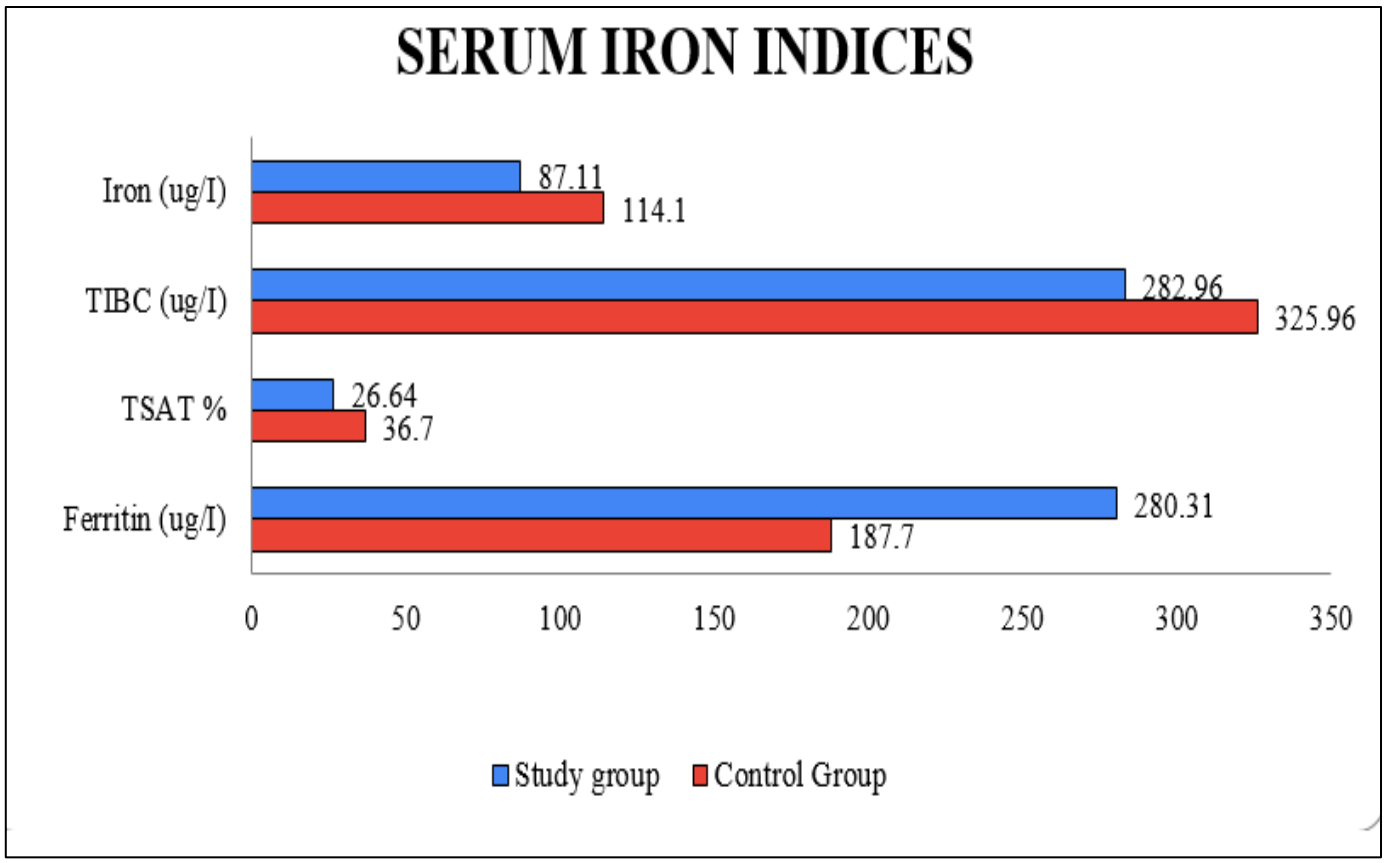

Fig 3: Serum Iron Indices in CKD Patients

Table 14: Serum Iron Indices and CKD Stage

CKD Stage	Value (Mean±SD) of			
	Iron (ug/I)	TIBC (ug/I)	TSAT %	Ferritin (ug/I)
3	121.40±225.22	297.85±63.63	23.53±10.90	164.64±200.76
4	66.5±32.14	295.5±73.11	12.45±18.38	88.45±444.17
5	53.6±40.47	274.5±94.14	7.25±20.43	42.05±293.76
P VALUE	0.4628	0.6224	0.5706	0.1180
Significance	Not Significant	Not Significant	Not Significant	Not Significant

There was no statistically significant association between serum iron indices, severity of CKD, and serum iron profile.

Table 15: % TSAT and CKD Stage

CKD Stage	TSAT %					
	< 20%		≥20 %		Mean	SD
	No	%	No	%		
3 (14)	6	42.85714	8	57.14286	23.53	10.9
4 (18)	7	38.88889	11	61.11111	29.96	18.38
5 (18)	10	55.55556	8	44.44444	25.74	20.43
TOTAL	23	46	27	54	79.23	49.71

46% of the study cases have a prevalence of Transferrin saturation (TSAT) below 20%. There is no significant correlation between the stage of chronic kidney disease (CKD) and transferrin saturation. Transferrin saturation (TSAT) was found to be greater than 20% in 54% of the instances.

<20 %	≥20 %
46	54

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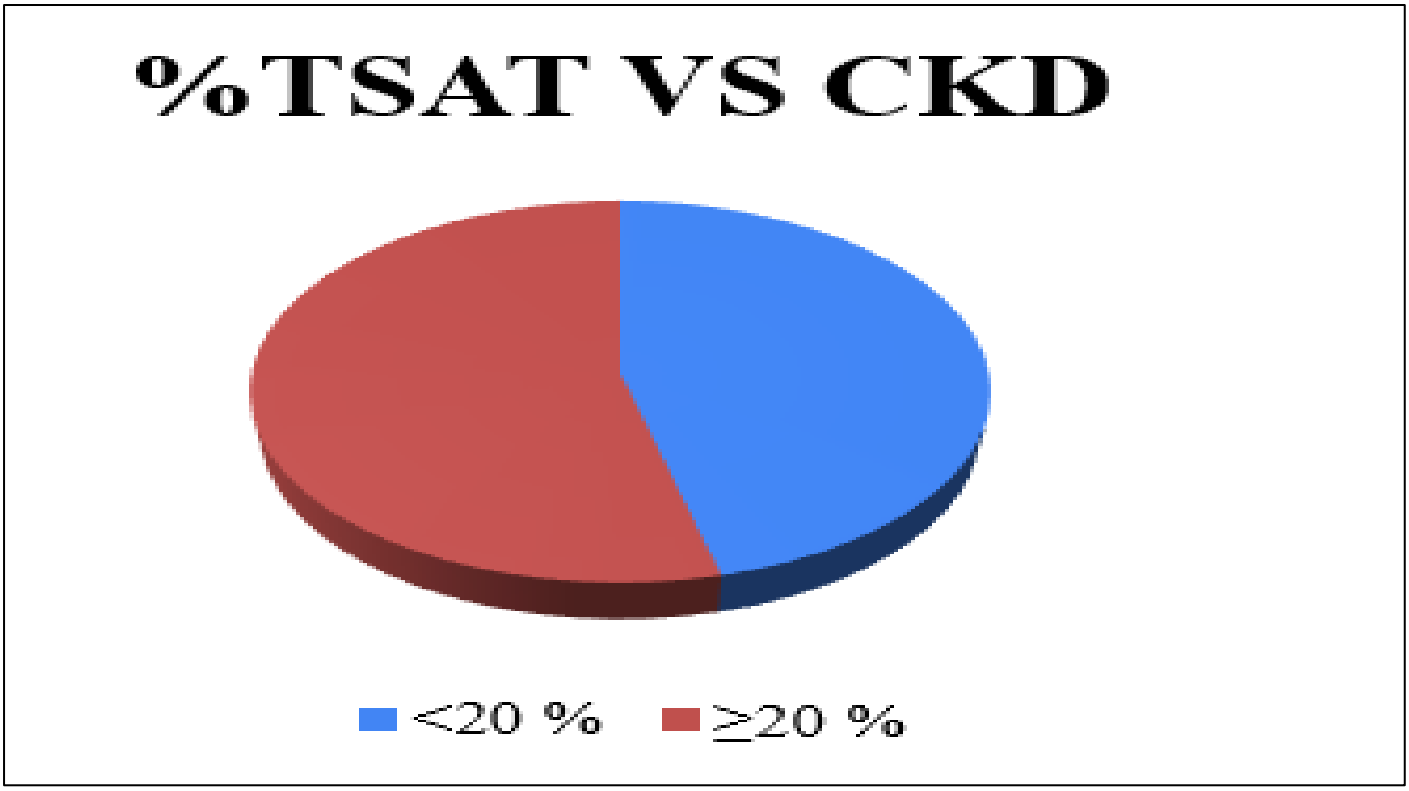

Fig 4: Variation between Transferrin Saturation and CKD Stages

Table 16: Ferritin(ug/L) and CKD Stage

CKD Stage	Ferritin					
	<100 microg/L		≥100 microg/L		Mean	SD
	No	%	No	%		
3 (14)	9	64.28571429	5	35.71429	164.64	200.76
4 (18)	3	16.66666667	15	83.33333	408.41	444.17
5 (18)	7	38.88888889	11	61.11111	242.18	293.76
TOTAL (50)	19	38	31	62	815.23	938.69
P Value	**0.1180 NOT SIGNIFICANT**					

38% of the study cases have a serum ferritin level below 100 micro gm/L. There is no significant correlation between the stage of chronic kidney disease (CKD) and the level of serum ferritin. 62% of the cases had a serum ferritin level more than 100 nano gm/L.

<100 microg/L	≥100 microg/L
38	62

VI. DISCUSSION

Chronic kidney disease is a significant global public health issue and a leading cause of illness and death. The incidence of early stages of CKD is significantly higher than that of advanced stages.However, in clinical practice, the prevalence of stage 4 and 5 is higher due to the fact that first stages are typically asymptomatic, and individuals seek medical attention when the severity of symptoms escalates.

The etiology of anemia in chronic renal disease is multifaceted. The renal community has long acknowledged that anemia can detrimentally affect the quality of life of patients and result in irreversible cardiac repercussions.[33,34]. (Levy AS et al)

Anemia, a condition that can be easily reversed in end-stage renal disease, is a separate risk factor for both cardiac disease and death in individuals with end-stage renal disease[33,34].

The existing evidence clearly indicates that: In order to form red blood cells, both iron and erythropoietin are necessary. Therefore, if there is not enough iron available, erythropoietin will have limited effectiveness. The TSAT and serum ferritin are the most reliable indications of the body's iron status that we currently have, however no tests are completely accurate in assessing iron reserves. The numbers are 35, 36, and 37. Considering the high occurrence of iron deficiency in patients with chronic kidney disease (CKD), as well as the accuracy of TSAT and serum ferritin in identifying iron deficiency, it may be concluded that there is a significant

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probability of iron deficit when TSAT is below 20% and serum ferritin is below 100 ng/mL. Hence, it is imperative to ensure that the TSAT (Transferrin Saturation) and serum ferritin levels are kept above 20% and 100 ng/mL, respectively, in all patients with non-dialysis chronic renal disease.

This study was conducted to examine the hematological profile and determine the prevalence of iron deficiency anemia in non-dialysis chronic renal disease patients.

The study group had a mean age of 39.68 years with a standard deviation of 12.56 years, while the control group had a mean age of 40.1 years with a standard deviation of 13.4 years. Out of a total of 50 study cases, 34 are males and 16 are females. The male population accounts for 68% while the female population accounts for 32%. Among the 50 control cases, there are 35 males and 15 girls. The male population comprises 70% while the female population comprises 30%. The duration of disease varied between 3 months and 24 months, with an average of 8.57 months.

Out of the 50 cases of Chronic Kidney Disease (CKD), the Glomerular Filtration Rate (GFR) varied between 2.09 and 45 ml/min/m2. The average glomerular filtration rate (GFR) was 17.56 milliliters per minute per square meter, with a standard deviation of 10.97. None of the selected instances exhibited stage 1 or stage 2. 48% of the study cases had hypertension, whereas 26% had Diabetes Mellitus.

History of bleeding manifestation (gum bleeding, ecchymosis) was present in 2 cases, motion ova & cyst present in 2 cases and motion foroccult blood was positive in one case.In their investigation, Akisola et al.[41] observed a 25.6% increase in bleeding time. Therefore, it is important to exercise caution during surgical procedures in patients with chronic kidney disease (CKD) who experience increased bleeding time. Additionally, correcting anemia may help improve the abnormal bleeding time.

Upon comparing the data from the study and control groups, significant statistical differences were seen in Hemoglobin (Hb), RBC count, PCV, and ESR ($p<0.005$). Hemoglobin, red blood cell count, and packed cell volume were lower, whereas erythrocyte sedimentation rate was higher, compared to the control group.

The average hemoglobin level was 8.01 gm/dl. Among males, the average hemoglobin level was 8.03 gm/dl, while among females, it was 7.71 gm/dl. The average red blood cell (RBC) count was 3.17 million per cubic millimeter (mm3), and the average packed cell volume (PCV) was 25.50%. The Mean Red Cell Distribution Width was 15.71%. The Erythrocyte Sedimentation Rate was increased in 35 cases, accounting for 64.8% of the total.

VII. LIMITATION OF THE STUDY

Due to the limited size of the study population, it is necessary to conduct larger investigations in order to confirm the findings of this study. Iron deficiency in chronic kidney disease (CKD) should be evaluated using alternative and more recent techniques, such as soluble transferrin receptors, zinc protoporphyrin, percentage of hypochromic cells, reticulocyte hemoglobin content, and the most reliable way, bone marrow testing for stainable iron. Hepcidin level was not measured.

In our patients, the likely factors contributing to iron deficiency, such as hidden or concealed Upper gastrointestinal endoscopy did not rule out gastro intestinal blood loss. Assays for folic acid and vitamin B12 are not conducted.

Due to the nature of this cross-sectional investigation, we were unable to ascertain the long-term persistence of the findings. Ultimately, this study merely demonstrates a correlation and is unable to establish a causative relationship. Conclusive evidence can only be obtained through interventional research to establish a cause-and-effect link.

VIII. CONCLUSION

- Our investigation has revealed that chronic renal disease primarily impacts individuals in the middle age demographic.
- All the participants in this study were classified as being in stage 3, 4, or 5 of Chronic Kidney Disease (CKD).
- All of our patients had severe anemia, which significantly contributes to the high rates of death and illness in individuals with End Stage Renal Disease (ESRD).
- Hemoglobin and Packed Cell Volume decreased significantly as the severity of CKD stage increased.
- Three patients (6%) had an increase in bleeding time. The clotting time was within the usual range for all patients.
- Anaemia was present in all the individuals included in the study cases. 70% of the individuals exhibited microcytic normochromic anemia, while 10% displayed microcytic hypochromic anemia. 10 percent of the studied subjects exhibited concurrent occurrences of both forms of anemia. The observed difference was very statistically significant ($p = 0.0001$). Among the Control patients, 32% had normal levels of haemoglobin, whereas the remaining 68% presented both kinds of anemia.
- There were significant differences ($p < 0.05$) in the TIBC, TSAT %, and Ferritin values between the study and control cases in terms of serum iron indices. The Ferritin readings did not show any significant differences.
- Prior to the start of dialysis or erythropoietin therapy, it is recommended to administer sufficient iron supplements either orally or through the parenteral route in order to achieve the desired outcomes as per the guidelines provided by the National Kidney Foundation (NKF).

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- Efforts must be made to determine the source of anemia in patients with chronic kidney disease (CKD) and to treat the concurrent iron deficiency anemia. Additionally, it is important to monitor other hematological parameters to identify any coexisting abnormalities.

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