

# Correlation Between Vitamin D Levels and Hemoglobin Levels in Patients with End-Stage Renal Disease on Maintenance Hemodialysis

Vitamin D and Hemoglobin Levels in End Stage Renal Disease

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## ABSTRACT

**Objective:** To study the correlation between Vitamin D levels and hemoglobin levels in patients with End-Stage Renal Disease on maintenance hemodialysis.

**Study Design:** Cross sectional study.

**Place and Duration of Study:** This study was conducted at the Dialysis Unit, Nephrology Department, Shaikh Zayed Hospital Lahore from 18-06-2017 to 17-01-2018.

**Materials and Methods:** This cross sectional study was performed from 18-06-2017 to 17-01-2018. A total of 119 patients were selected in Hemodialysis Unit, Shaikh Zayed Hospital Lahore. Participants were selected through non probability consecutive sampling technique. Samples for serum vitamin D and hemoglobin levels were taken immediately before dialysis.

**Results:** The mean age of the patients was  $44.42 \pm 11.09$  years. 49.6% (n=59) of the patients had age 18-44 years, while 50.4% (n=60) of patients had age 50-70 years. Vitamin D levels were positively correlated with hemoglobin levels with Pearson correlation coefficient of 0.728.

**Conclusion:** Vitamin D levels are positively correlated with hemoglobin concentrations in ESRD patients on maintenance hemodialysis.

**Key Words:** Vitamin D, Hemoglobin, ESRD

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## INTRODUCTION

Anemia is a condition with lower red blood cell mass in the blood. Red blood cells carry oxygen to tissues and organs throughout the body and remove carbon dioxide from the tissues. Anemia is a common clinical condition encountered in medical practice.<sup>1</sup> Chronic kidney disease is defined as kidney damage or glomerular filtration rate less than  $60 \text{ ml/min/1.73m}^2$  for greater than 3 months. CKD is a worldwide public health problem. Anemia commonly occurs in patients with CKD.<sup>2</sup> As CKD progresses there is increased prevalence of anemia, with nearly all patients with CKD stage 5 having anemia.

Anemia in CKD is associated with reduced quality of life and increased incidence of cardiovascular disease, hospitalizations and mortality.<sup>3</sup> Anemia in CKD is usually normocytic, normochromic and is thought to be mainly due to deficiency of erythropoietin in the body. Erythropoietin is a hormone which is principal regulator of erythropoiesis. It is normally produced by interstitial fibroblasts in the renal cortex, in close proximity to tubular epithelial cells and peritubular capillaries. Hepatocytes and perisinusoidal Ito cells in the liver can produce erythropoietin.

When measured, erythropoietin levels are inappropriately low or normal in CKD patients with anemia. When measured in patients with anemia without CKD, these levels are 10-100 times higher than the normal levels.<sup>4</sup>

Vitamin D is a lipid soluble vitamin in the body known to have pleiotropic effects on various organs, owing to its receptors on various organs. In addition to its role on calcium and phosphorus levels in the blood and effect on bone metabolism, it has shown protective role in CKD patients.<sup>5</sup> Patients with CKD and reduced vitamin D levels have shown to have increased incidence of anemia. The possible mechanisms are as follows.<sup>6</sup> (1) High local concentrations of 1,25-dihydroxyvitamin D in hematopoietic tissues directly activate erythroid

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precursor cells (BFU-E) in a paracrine fashion. Hence, reduced vitamin D levels lead to anemia (2) Inflammatory cytokines influence erythropoiesis in CKD. Vitamin D inhibits inflammatory cytokines and hepcidin production thus improving iron availability (3) Vitamin D deficiency is associated with secondary hyperparathyroidism, which is known to induce bone marrow fibrosis and suppress erythropoiesis in CKD patients.<sup>7</sup>

Anemia in CKD is treated with Erythropoiesis Stimulating Agents (ESA). They are given parenteral to achieve hemoglobin levels up to 11mg/dl. Iron supplements are also needed to replenish iron stores in the body.<sup>8</sup> Parenteral iron has shown better results than oral iron in End Stage Renal Disease (ESRD) patients undergoing maintenance hemodialysis. Many patients with CKD show hypo-responsiveness to ESA and require higher doses than usual. This hypo-responsiveness has been postulated to decreased levels of vitamin D in the body.<sup>9</sup>

## MATERIALS AND METHODS

It is a cross sectional study conducted in Dialysis Unit, Nephrology Department, Shaikh Zayed Hospital Lahore from 18-06-2017 to 17-01-2018 between 18 to 70 years of age. 119 patients were admitted in the Department of Nephrology through OPD & Emergency. 10ml venous sample was taken immediately before dialysis in selected patients. This sample was sent to laboratory to calculate vitamin D and hemoglobin levels. Age, gender and duration of dialysis were recorded. Quantitative variables included age, hemoglobin levels, vitamin D levels, BMI and eGFR and was expressed as mean±standard deviation.<sup>15</sup> Qualitative variables included gender, presence of DM and hypertension and were expressed as frequencies and percentages. Data was used to assess the correlation between hemoglobin and vitamin D levels in ESRD patients on maintenance hemodialysis. Karl Pearson correlation coefficient was used to calculate correlation between vitamin D levels and hemoglobin levels. Data was stratified with respect to age, gender, BMI, duration of dialysis, diabetes and hypertension. Post stratification Pearson correlation coefficient was applied with  $p < 0.05$  as significant.

## RESULTS

The mean age of the patients was  $44.42 \pm 11.09$  years. 49.6 % (n=59) of the patients had age 18-44 years, while 50.4% (n=60) of patients had age 50-70 years (Table 1). Gender distribution shows that 62.2% (n=74) were males while 38.7% (n=45) were females (Table 2). The mean duration of dialysis was 3.92 years. The mean hemoglobin and vitamin D levels were 9.94mg/dl and 8.49ng/ml respectively. The mean BMI of patients was 25.54 and mean eGFR was 4.38ml/min (Table 3). 59.7% (n=71) of the patients had diabetes and hypertension (Table 4). There was a positive

correlation between hemoglobin and vitamin D levels with Karl Pearson correlation coefficient of 0.728 (Table 5). When data was stratified with respect to age, patients with age 18-44 years had correlation coefficient of 0.945 as compared to a coefficient of 0.500 of patients aged 45-70 years (Table 6).

**Table No.1: Age Distribution (n=119)**

Age (years)	No.	%
18-44	59	49.6
45-70	60	50.4
<b>Mean±SD</b>	<b>44.42±11.09</b>	

**Table No.2: Gender Distribution (n=119)**

Gender	No.	%
Male	74	62.2
Female	45	37.8

**Table No.3: Demographic Data of Patients with Mean±SD (n=119)**

Duration of Dialysis (Years)	3.92±1.80
Hemoglobin Levels (mg/dl)	9.94±1.20
Vitamin D Levels (ng/ml)	8.49±2.12
Mean BMI	25.54±4.50
Mean eGFR (ml/min)	4.38±1.62

**Table No.4: Frequency of Diabetes, HTN (n=119)**

Variable	No.	%
<b>Diabetes</b>		
Yes	71	59.7
No	48	40.3
<b>HTN</b>		
Yes	71	59.7
No	48	40.3

**Table No. 5: Correlation between Vitamin D and Hemoglobin Levels (n=119)**

	Vit. D	Hb
<b>Vit. D</b>		
Pearson correlation	1	.728**
Sig. (2-tailed)		.000
N	11	11
<b>Hemoglobin</b>		
Pearson correlation	.728**	1
Sig. (2-tailed)	.000	
N	119	119

Data was stratified with respect to gender, males had correlation coefficient of 0.738 as compared to a coefficient of 0.774 in female patients (Table 7). When data was stratified with respect to presence of diabetes, patients with diabetes had correlation coefficient of 0.612 as compared to a coefficient of 0.870 in patients without diabetes. When data was stratified with respect to presence of HTN, patients with HTN had correlation coefficient of 0.910 as compared to a coefficient of 0.489 in patients without HTN (Table 8).

**Table 6: Stratification of Correlation Between Vitamin D and Hemoglobin Levels with Regards to Age (n=119)**

Age (years)		Value	Approx. sig.
18 – 44	Pearson’s R.	.954	.000
	No. of valid cases	59	
45 - 70	Pearson’s R.	.576	.000
	No. of valid cases	60	
Total	Pearson’s R.	.728	.000
	No. of valid cases	119	

**Table No.7: Stratification of Correlation Between Vitamin D and Hemoglobin Levels with Regards to Gender (n=119)**

Gender		Value	Approx. sig.
Male	Pearson’s R.	.738	.000
	No. of valid cases	74	
Female	Pearson’s R.	.744	.000
	No. of valid cases	45	
Total	Pearson’s R.	.728	.000
	No. of valid cases	119	

**Table No.8: Stratification of Correlation between Vitamin D and Hemoglobin Levels with Regards to HTN (n=119)**

HTN		Value	Approx. sig.
Yes	Pearson’s R.	.910	.000
	No. of valid cases	71	
No	Pearson’s R.	.489	.000
	No. of valid cases	48	
Total	Pearson’s R.	.728	.000
	No. of valid cases	119	

**Table No.9: Stratification of Correlation Between Vitamin D and Hemoglobin Levels with Regards to eGFR (n=119)**

eGFR		Value	Approx. sig.
1-5	Pearson’s R.	.762	.000
	No. of valid cases	94	
5.1-10	Pearson’s R.	.687	.000
	No. of valid cases	25	
Total	Pearson’s R.	.728	.000
	No. of valid cases	119	

When data was stratified with respect to duration of dialysis, patients with duration of dialysis 1-5 years had correlation coefficient of -0.395 as compared to a coefficient of 0.340 of patients on dialysis for 6-10 years. When data was stratified with respect to eGFR, patients with eGFR 1-5ml/min had correlation coefficient of 0.762 as compared to a coefficient of 0.687 of patients with eGFR 5.1-10 ml/min (Table 9).

**DISCUSSION**

This cross sectional study was carried out to calculate the correlation between hemoglobin and vitamin D levels in ESRD patients on maintenance hemodialysis. Anemia is a major problem in ESRD patients associated with increased cardiovascular disease and mortality.<sup>10</sup> The mean age of the patients was 44.42±11.09 years. 49.6% (n=59) of the patients had age 18-44 years, while 50.4% (n=60) of patients had age 50-70 years. In a study reported by Nani et al, the mean age of the patients was 60 years which is slightly high with our study.<sup>10</sup> In another similar study the mean age of the patients was 45.20±10.40 which is comparable with our study.<sup>11</sup> A study reported by Filipov the mean age of the patients was 60.5 ± 10.9 which is comparable with our study.<sup>12</sup> Gender distribution shows that 62.2% (n=74) were males while 38.7% (n=45) were females. (The mean duration of dialysis was 3.92 years. The mean hemoglobin and vitamin D levels were 9.94 mg/dl and 8.49ng/ml respectively. In a study done by Ammara, the Hb level increased significantly from 8.34±0.9 to 9.48±0.9 g/dl (P=0.000) which is comparable with our study.<sup>13,14</sup> In another study reported by Ernst, the mean Hb was 12.5 g/dL which is comparable with this study.<sup>15</sup> The mean BMI of patients was 25.54 and mean eGFR was 4.38ml/min. 59.7% (n=71) of the patients had diabetes and hypertension. In a similar study carried out by Emst, the mean BMI was 30.4±4.4 which is comparable with this study.<sup>15</sup> There was a positive correlation between hemoglobin and vitamin D levels with Karl Pearson correlation coefficient of 0.728. This showed that anemia is associated with reduced vitamin D levels in ESRD patients.<sup>7</sup> Thus vitamin D deficiency could be a contributing factor in resistant anemia. When data was stratified with respect to age, patients with age 18-44 years had correlation coefficient of 0.945 as compared to a coefficient of 0.500 of patients aged 45-70 years. Younger patients had more strong association between hemoglobin and vitamin D levels. When data was stratified with respect to gender, males had correlation coefficient of 0.738 as compared to a coefficient of 0.774 in female patients. There was no major difference in correlation with respect to gender. When data was stratified with respect to presence of diabetes, patients with diabetes had correlation coefficient of 0.612 as compared to a coefficient of 0.870 in patients without diabetes. Presence of diabetes was also not a major contributing factor. When data

was stratified with respect to presence of HTN, patients with HTN had correlation coefficient of 0.910 as compared to a coefficient of 0.489 in patients without HTN. Patients with hypertension had more strong correlation as compared to patients without hypertension. When data was stratified with respect to duration of dialysis, patients with duration of dialysis 1-5 years had correlation coefficient of -0.395 as compared to a coefficient of 0.340 of patients on dialysis for 6-10 years. Hemoglobin was negatively correlated with vitamin D levels in patients with duration of dialysis 1-5 years. However it was positively correlated once duration increased to 6-10 years. When data was stratified with respect to BMI, patients with BMI 15-25 had correlation coefficient of 0.784 as compared to a coefficient of 0.801 of patients with BMI. There was no difference in correlation when data was stratified with regards to BMI.

When data was stratified with respect to eGFR, patients with eGFR 1-5ml/min had correlation coefficient of 0.762 as compared to a coefficient of 0.687 of patients with eGFR 5.1-10 ml/min. No major difference was found in correlation after stratifying data with regards to eGFR.

## CONCLUSION

Hemoglobin levels are positively correlated with vitamin D levels in ESRD patients on maintenance hemodialysis with Pearson correlation coefficient of 0.728.

### Author's Contribution:

Concept & Design of Study:	Muhammad Faisal Hashmi
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**Conflict of Interest:** The study has no conflict of interest to declare by any author.

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