Medical Science and Discovery
ISSN: 2148-6832

Relationship between vitamin D levels and hematological parameters

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ABSTRACT

Objective: This study aims to examine the relationship between serum vitamin D levels and hematological parameters, and body mass index.

Material and Methods: It was carried out in the internal medicine outpatient clinic of Ayancık State Hospital between April 2017 and November 2020. Information about the sociodemographic and laboratory values of the patients was obtained from the hospital information system. The patients were divided into two groups as those with vitamin D levels below 20 ng/ml and those with over 30 ng/ml. Vitamin D levels and hematological parameters of all patients were examined.

Results: Of the 343 patients included in the study, 277 were women. When vitamin D levels were evaluated, vitamin D levels were significantly lower in women (82.7%; n:244) according to gender (p=0.023). When vitamin D levels are assessed according to age, It was observed that the vitamin D level of the patients included in the study, especially in the advanced age group, was low. There was no significant difference between vitamin D levels and body mass index (p=0.138). Age, MCV, MPV, HDL, Calcium (Ca), Phosphorus, Vitamin B-12, Vitamin D levels were found to be significantly higher in female patients with adequate vitamin D levels (p<0.05).

Conclusion: In our study, it was observed that there was a significant relationship between vitamin D levels, age, gender, platelet level, monocyte, MCV, neutrophil, protein, HDL, calcium, and vitamin B12 levels. Beside the treatment and clinical examinations, it is necessary to monitor and evaluate the vitamin D levels of the patients, as well as hematological, biochemical and endocrinological parameter changes.

Keywords: Vitamin D, hematological parameters, body mass index

INTRODUCTION

Vitamin D, a steroid hormone, is very important for human health (1). Vitamin D, which is in the group of fat-soluble vitamins, is a group of sterols with hormone-like effects (2). Biologically inactive vitamin D acts by transforming into its active form, 1,25 dihydroxy vitamin D [1,25(OH)2], as a result of different biological mechanisms in the body (3). Since its only source is not a diet, it is not exactly a vitamin and is a prohormone synthesized from steroids with some steps in cases where it is not taken from outside with diet (3). The mechanism of action of vitamin D in the body is a functional hormone with a wide spectrum. In particular, its most important task was to regulate bone mineralization by providing calcium and phosphate balance in the skeletal system (4). Apart from these effects, many studies have shown that vitamin D plays an inhibitory role in the development of cardiovascular diseases, endocrinological diseases, especially diabetes, and many other diseases (5, 6).

Vitamin D deficiency is increasing rapidly all over the world. Vitamin D deficiency is common in our country (7, 8). Many hematological and hormonal parameters that show variable blood levels in vitamin D deficiency or insufficiency have been emphasized (10). There are studies showing variability in hemogram parameters such as mean platelet volume (MPV), red cell distribution width (RDW), and neutrophil to lymphocyte ratio with vitamin D deficiency (11). This study aimed to compare the hematological parameters values of subjects with vitamin D deficiency to those with normal serum vitamin D levels.

Research Article

Received 24-12-2022

Accepted 14-01-2023

Available Online: 18-01-2023

Published 30-01-2023

http://dx.doi.org/10.36472/msd.v10i1.855

MATERIAL and METHODs

In our study, the vitamin D levels of 343 patients randomly selected from 864 patients who came to the internal medicine outpatient clinic of Ayancık State Hospital between April 2017 and November 2020 and whose vitamin D levels were checked were examined. The results of each case were obtained from the electronic records of our hospital. Patients were divided into two groups as 25(OH) vitamin D levels below 20 ng/ml and above 30 ng/ml. Simultaneously, other laboratory parameters and demographic characteristics of the patients who were tested for vitamin D were recorded from the system. The ethics committee of the study was obtained from Sakarya University Faculty of Medicine (dated 18.11.2022 and numbered E-71522473-050.01.04-194705). Those who were over 18 years old and did not have a known endocrinological disease were included in the study. Pregnant and breastfeeding people under18 years old, treated with vitamin D, and had an active infection on the day of the blood sample were excluded from the study.

Statistical analysis

Data analysis was done with SPSS 24.0 and results were evaluated at 95% confidence level. In the study, while the relationship between the group and gender was analyzed with the chi-square test, the normal distribution of quantitative variables was examined with the normality test and it was determined that the normal distribution was not achieved. Accordingly, the comparison of the groups in terms of quantitative variables was made with the Mann-Whitney test.

RESULTs

In our study, the electronic and file records of 343 patients were evaluated. 14% (n:48) of the patients had 25 (OH) vitamin D levels above 30 (sufficient) and 86% (n:295) below 20 (extremely insufficient) (Table 1). Of these patients, 277 (80.8%) were female, and 66 (19.2%) were male. 68.8% (n:33) of the group with vitamin D above 30 and 82.7% (n:244) of the group with vitamin D below 20 were women, and there was a statistically significant relationship between the group and gender (p. <0.05) (Table 2).

According to the results of the research, the age, Body Fat Ratio, PLT, Gran#/Neut#, MCV, Monocyte/MID#, Creatine, Protein, HDL, Calcium (Ca), HbA1C, Vitamin B-12, D vit and Urine pH were statistically significant (p<0.05). Age, Gran# / Neut#, MCV, Creatine, HDL, Calcium (Ca), HbA1C, Vitamin B-12, Vitamin D, and Urine pH values below 20 for those with Vitamin D over 30 Body Fat Rate, PLT, Geliş Monocyte/MID# and Protein values are lower than those with Vitamin D below 20 (Table 3).

According to the study results, there was a statistically significant difference between those with vitamin D above 30 and those below 20 in terms of age, Incidence HbA1C and Incidence D vit values (p<0.05). Age, HbA1C and Vitamin D vitamin D values of those with vitamin D above 30 are higher than those with vitamin D below 20 (Table 4).

According to the results of the study, age, MCV, MPV, HDL, Iron Binding Capacity, Advance Calcium (Ca), Phosphorus, Vitamin B-12, D vit and There was a statistically significant difference in terms of urine pH (p<0.05). While age, MCV, MPV, HDL, Calcium (Ca), Phosphorus, Vitamin B-12, Vitamin D and Urine pH values were higher in women with Vitamin D above 30 than those with Vitamin D below 20. Iron Binding Capacity values were lower than those with vitamin D below 20 (Table 4).

Tablo 1: Distribution of patients according to their vitamin D levels

	n	%
Vitamin D levels >30	48	14,0
Vitamin D levels <20	295	86,0
Total	343	100,0

Tablo 2: Evaluation of vitamin D levels by gender

	Vitamin D levels >30		Vitamin D levels <20		Total		Chi-Square Test	
	n	%	n	%	n	%	X^2	p
Male	15	31,3	51	17,3	66	19,2	**5,179**	**0,023***
Female	33	68,8	244	82,7	277	80,8		

*P<0.05

http://dx.doi.org/10.36472/msd.v10i1.855

Tablo 3: Evaluation of all patient group parameters of vitamin D levels

	Vitamin D levels >30			Vitamin D levels <20			Mann Whitney U Test	
Age	47,08	15,39	51,00	36,51	15,66	35,00	4446,000	0,000*
Height	160,12	22,70	161,00	164,17	76,97	160,00	6078,500	0,116
Body Weight	93,10	89,71	81,70	81,78	19,46	83,00	6913,000	0,822
Skeletal Muscle Pain	27,35	5,63	25,70	27,11	13,65	25,80	6683,000	0,533
Body Fat Weight	30,24	9,65	30,25	35,50	25,53	33,50	5934,000	0,072
Body Mass Index	30,13	5,42	29,95	32,09	7,45	31,50	6134,500	0,138
Body Fat Ratio	37,59	9,12	39,20	42,21	28,90	41,35	5680,000	0,030*
Inbody PUM	65,73	8,50	65,00	63,23	11,02	63,00	6128,000	0,135
WBC	6,81	1,41	6,60	7,13	1,69	6,90	5980,000	0,232
HGB	13,63	1,34	13,60	15,32	22,37	13,20	5744,000	0,078
PLT	222,95	67,68	224,00	252,12	59,04	247,00	5232,000	0,009*
RDW-CV	16,72	9,02	13,30	16,40	8,37	13,50	6374,000	0,455
LYM#	3,11	5,56	2,30	2,68	4,97	2,20	6446,000	0,527
Gran# / Neut#	5,05	8,85	3,60	4,97	6,28	4,10	5459,500	0,029*
MCV	86,23	5,94	87,80	83,31	7,70	84,90	4915,500	0,002*
MPV	9,70	1,21	9,60	9,40	1,17	9,30	5900,500	0,115
Monocyte/MID#	0,68	0,24	0,70	0,83	1,44	0,60	3978,000	0,037*
Fasting Glucose	113,79	49,04	98,00	109,46	47,18	97,00	6502,000	0,564
Urea	26,09	8,03	24,25	24,59	9,34	23,25	6113,000	0,156
Creatine	0,94	1,05	0,80	0,78	0,43	0,70	5504,000	0,013*
ALP	53,85	26,07	58,50	69,05	33,49	63,50	153,500	0,236
GGT	19,11	7,97	20,00	28,01	47,76	18,00	949,500	0,943
LDH	181,86	41,80	167,00	169,94	59,95	166,00	144,000	0,655
AST	20,59	7,07	19,00	19,71	8,86	18,00	5700,500	0,137
ALT	23,00	10,93	20,00	22,83	21,61	18,00	5803,500	0,117
Albumin	35,13	25,39	44,00	39,28	15,12	45,00	728,500	0,132
Protein	51,83	31,30	70,00	63,81	25,36	74,00	613,000	0,036*
HDL	52,02	14,07	49,50	49,01	26,26	45,30	5114,500	0,046*
LDL	119,83	45,51	119,00	118,89	51,95	109,10	5180,000	0,402
triglyceride	127,90	65,54	117,00	130,60	85,05	111,00	5425,000	0,832
Iron	79,86	26,09	76,00	71,48	33,05	68,00	948,500	0,195
Iron Binding Capacity	249,76	70,12	234,00	266,73	75,43	259,00	615,000	0,247
Sodium	138,52	2,68	138,00	138,70	2,41	139,00	5102,000	0,786
Potassium	4,40	0,35	4,30	4,44	0,50	4,40	5097,500	0,813
Calcium (Ca)	9,75	0,52	9,80	9,54	0,44	9,60	1950,000	0,020*
Phosphorus	4,15	1,81	3,70	3,43	0,46	3,40	218,000	0,058
CRP	4,24	3,92	3,10	6,16	8,88	2,90	4377,500	0,556
RF	4,89	5,67	3,00	5,39	8,34	3,00	223,000	0,943
HbA1C	6,74	1,97	5,75	5,97	1,51	5,60	1613,500	0,007*
Free T4	1,12	0,22	1,10	1,14	0,36	1,11	5149,000	0,743
TSH	5,58	22,58	1,84	3,23	10,39	2,04	5610,500	0,753
ferritin	51,40	51,72	35,70	46,24	90,90	29,10	5105,000	0,140
Vitamin B-12	432,30	179,62	398,00	356,05	152,78	318,00	4170,500	0,001*
Folate	11,82	4,97	11,55	10,96	4,77	9,62	3786,500	0,295
PTH	57,25	39,39	57,25	51,63	26,77	57,35	3,000	0,643
sedimentation	12,93	10,78	9,00	17,64	12,10	14,00	605,500	0,067
Vitamin D	37,43	10,97	34,91	12,03	4,37	11,44	0,000	0,000*
insulin	18,04	18,92	12,08	18,13	16,06	13,50	1261,000	0,455
C-Peptide	1,99	0,84	2,26	3,11	1,91	2,54	149,000	0,060
Urine Density	255,14	449,63	1,03	124,29	334,06	1,03	1921,000	0,760
Urine pH	6,07	0,80	6,00	5,72	0,72	5,50	1363,000	0,027*

Tablo 4: The relationship between vitamin D levels of female and male patients and other parameters

	Female								Male							
	Vitamin D levels >30			Vitamin D levels <20			Mann Whitney U Test		Vitamin D levels >30			Vitamin D levels <20			Mann Whitney U Test	
	X	SS	Median	X	SS	Median	U	p	X	SS	Median	X	SS	Median	U	p
Age	46,97	14,94	51,00	36,63	15,51	35,00	2515,500	0,001*	47,33	16,89	42,00	35,98	16,49	35,00	248,500	0,040*
Height	159,39	6,33	158,00	162,97	84,50	158,00	3716,000	0,472	161,73	40,43	172,00	169,92	9,20	171,00	356,000	0,684
Body Weight	96,12	108,16	78,20	80,39	19,19	81,45	3716,000	0,473	86,45	14,48	90,70	88,59	19,53	90,40	354,500	0,750
Skeletal Muscle Pain	24,68	3,66	24,40	25,95	14,40	25,10	3502,500	0,225	33,23	4,70	33,20	32,66	7,00	34,00	378,500	0,951
Body Fat Weight	31,56	9,57	31,30	36,54	27,43	34,70	3424,500	0,164	27,31	9,50	29,90	30,52	12,05	29,30	356,000	0,685
Body Mass Index	30,49	5,61	30,10	32,42	7,70	31,85	3503,000	0,226	29,34	5,07	29,80	30,55	5,91	30,10	363,000	0,765
Body Fat Ratio	40,76	7,51	42,20	44,05	31,16	43,10	3559,500	0,296	30,61	8,62	32,40	33,43	9,99	33,20	322,000	0,355
Inbody PUM	64,88	8,86	64,00	63,06	10,90	63,00	3668,500	0,408	67,60	7,60	68,00	64,08	11,67	65,00	313,500	0,291
WBC	6,77	1,40	6,60	7,09	1,69	6,80	3318,500	0,296	6,89	1,49	6,70	7,33	1,70	7,10	325,000	0,436
HGB	13,18	1,13	13,25	15,46	24,63	13,00	3450,500	0,351	14,58	1,26	15,00	14,65	1,44	14,60	380,500	0,976
PLT	228,38	71,64	232,00	254,77	60,38	249,50	3054,500	0,052	211,37	58,94	223,00	239,30	50,70	242,00	289,500	0,183
RDW-CV	17,15	9,69	13,50	16,85	8,66	13,60	3594,500	0,557	15,79	7,61	13,30	14,27	6,50	13,20	361,500	0,748
LYM#	3,46	6,73	2,20	2,38	1,91	2,20	3631,500	0,592	2,37	0,62	2,60	4,09	11,21	2,50	347,000	0,662
Gran# / Neut#	5,62	10,69	3,65	4,49	3,92	4,10	3139,500	0,094	3,83	1,31	3,60	7,26	12,28	4,20	271,000	0,105
MCV	86,37	6,28	88,40	83,10	8,07	84,90	2535,000	0,002*	85,92	5,36	84,10	84,29	5,56	85,10	349,000	0,608
MPV	9,92	1,17	9,90	9,44	1,20	9,30	2876,000	0,018*	9,22	1,19	9,00	9,22	1,01	9,10	363,000	0,765
Monocyte/MID#	0,66	0,26	0,60	0,78	1,39	0,60	2495,500	0,204	0,74	0,19	0,80	1,08	1,68	0,60	181,000	0,142
Fasting Glucose	111,72	45,10	97,50	106,94	39,15	97,00	3748,000	0,797	118,20	58,04	99,00	121,37	73,64	98,00	357,000	0,696
Urea	24,44	7,09	22,00	23,92	9,10	22,60	3697,000	0,490	29,71	8,99	27,70	27,84	9,87	26,30	325,000	0,436
Creatine	0,75	0,10	0,70	0,74	0,22	0,70	3318,500	0,100	1,35	1,84	0,80	0,99	0,90	0,90	354,500	0,661
ALP	52,83	27,99	56,00	65,75	26,79	63,00	114,500	0,249	61,00		61,00	90,29	60,52	75,00	3,000	0,826
GGT	17,47	6,66	17,00	28,73	51,81	17,00	596,500	0,692	25,25	10,50	20,00	24,19	12,57	20,50	25,000	0,507
LDH	184,33	45,22	167,50	165,64	60,76	166,00	90,000	0,580	167,00		167,00	183,64	57,88	176,00	5,000	0,885
AST	19,09	5,73	19,00	19,36	9,32	17,00	3368,000	0,304	24,00	8,76	21,00	21,38	6,03	22,00	303,000	0,444
ALT	20,97	9,48	19,00	21,20	22,49	17,00	3285,000	0,128	27,79	12,90	24,50	30,62	14,58	28,00	305,000	0,464

doi http://dx.doi.org/10.36472/msd.v10i1.855

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Tablo 4: The relationship between vitamin D levels of female and male patients and other parameters

	Female								Male							
	Vitamin D levels >30			Vitamin D levels <20			Mann Whitney U Test		Vitamin D levels >30			Vitamin D levels <20			Mann Whitney U Test	
	X	SS	Median	X	SS	Median	U	p	X	SS	Median	X	SS	Median	U	p
Albumin	35,81	26,41	43,50	39,57	14,86	45,00	516,000	0,176	31,50	23,40	44,00	37,79	16,79	45,00	17,500	0,465
Protein	52,15	31,36	70,00	63,33	25,67	73,00	459,500	0,098	50,13	37,93	70,00	66,31	24,33	75,00	10,000	0,137
HDL	55,70	14,41	52,10	50,75	28,27	47,70	2579,000	0,015*	43,89	9,37	44,10	41,24	11,40	40,70	293,000	0,307
LDL	117,42	48,10	110,20	116,24	46,75	111,00	3022,000	0,518	125,64	39,89	125,35	130,81	70,13	107,30	287,500	0,824
triglyceride	119,39	63,37	107,50	125,89	80,71	108,00	3069,500	0,768	147,75	68,97	142,50	151,98	100,66	128,50	276,500	0,675
Iron	78,59	27,08	76,00	67,22	30,49	65,50	613,500	0,129	85,25	24,06	75,50	96,50	37,36	96,50	25,000	0,508
Iron Binding Capacity	243,57	75,61	218,50	278,19	70,04	271,50	338,000	0,040*	278,67	25,54	287,00	206,14	76,37	203,00	7,000	0,077
Sodium	138,43	3,04	138,00	138,69	2,47	139,00	2893,500	0,819	138,71	1,77	138,00	138,73	2,11	139,00	265,500	0,772
Potassium	4,41	0,32	4,40	4,43	0,53	4,40	2994,500	0,862	4,38	0,42	4,20	4,46	0,35	4,40	220,000	0,406
Calcium (Ca)	9,80	0,44	9,80	9,54	0,45	9,60	1092,000	0,015*	9,63	0,72	9,60	9,52	0,39	9,60	108,000	0,620
Phosphorus	4,47	2,09	4,00	3,42	0,46	3,40	96,000	0,018*	3,43	0,66	3,40	3,46	0,51	3,45	15,500	0,932
CRP	4,20	2,73	4,00	6,20	7,72	3,00	2872,500	0,871	4,37	6,52	2,00	5,93	13,58	2,50	146,500	0,294
RF	5,13	6,01	3,00	6,02	9,24	3,00	156,000	0,857	3,00		3,00	2,90	0,32	3,00	4,500	0,752
HbA1C	6,52	1,88	5,70	5,92	1,45	5,60	986,500	0,087	7,21	2,18	6,50	6,18	1,75	5,60	80,000	0,043*
Free T4	1,16	0,19	1,10	1,11	0,21	1,08	2649,000	0,228	1,03	0,26	1,11	1,26	0,71	1,18	178,000	0,060
TSH	2,27	1,19	1,84	2,83	5,72	2,16	3224,000	0,777	13,24	41,10	1,84	5,11	21,62	1,72	298,500	0,900
ferritin	40,30	36,41	30,05	32,76	31,88	24,20	2844,500	0,085	79,13	72,81	71,90	112,22	197,90	71,85	250,000	0,482
Vitamin B-12	452,97	206,24	408,00	354,92	156,23	313,00	2242,500	0,004*	389,50	98,45	392,00	361,51	136,30	362,50	296,500	0,506
Folate	12,50	5,61	11,62	11,00	4,79	9,53	2004,500	0,280	10,51	3,23	10,90	10,78	4,70	9,85	235,000	0,795
PTH	57,25	39,39	57,25	63,73	13,98	65,90	3,000	1,000				15,30		15,30		
Sedimentation	15,10	11,90	10,00	18,67	12,03	15,00	358,500	0,219	8,60	7,27	5,00	12,80	11,51	10,00	41,500	0,562
Vitamin D	37,31	10,60	34,92	11,56	4,33	11,01	0,000	0,000*	37,69	12,11	32,67	14,32	3,85	15,09	0,000	0,000*
Insulin	12,37	7,39	11,46	17,11	12,99	13,23	603,000	0,127	32,77	31,33	17,19	22,11	24,55	15,57	63,000	0,450
C-Peptide	2,06	0,65	1,78	2,84	1,42	2,45	64,000	0,094	1,88	1,20	2,33	3,80	2,78	3,39	13,000	0,182
Urine Density	319,14	487,33	1,03	126,93	337,13	1,03	1085,500	0,906	127,15	356,73	1,03	111,27	324,10	1,03	87,000	0,279
Urine pH	6,03	0,67	6,00	5,74	0,76	5,50	700,000	0,045*	6,13	1,06	5,75	5,62	0,48	5,50	91,000	0,324

DISCUSSION

Vitamin D deficiency is increasing rapidly all over the world, especially in developing countries (12). It is stated that the prevalence varies between 40% and 100% especially in the North Asian and Middle Eastern regions (13). Vitamin D deficiency is also seen at high rates in our country. Deficiency occurs especially with the decrease in physical activity with advanced age, decrease in sun exposure, decrease in vitamin d synthesis and decrease in vitamin d absorption with age (14). In addition, studies have revealed that vitamin D deficiency is more common in women (15). Our study, consistent with the literature, showed that vitamin d deficiency occurs more frequently in women with age.

Vitamin D has hormone-like effects on the body, and its deficiency has been shown to affect the course of many diseases. Deficiency affects prognosis negatively and increases mortality rates, especially in diseases progressing with inflammatory process. It has been shown to affect the course of many chronic diseases, especially hypertension, cardiopulmonary diseases, valve failure, and diabetes (16-20).

The relationship between obesity and vitamin D deficiency is not clear. However, due to the fact that vitamin D is a fat-soluble vitamin, it is withdrawn from the circulation in obese individuals and creates a deficiency. Many studies have shown low vitamin D levels in obese individuals (21). In particular, a relationship was found between body composition measurements such as body mass index and fat ratio and vitamin d level (22). Contrary to the literature, our study did not find a correlation between vitamin d levels and body mass index. However, studies are showing that there is a correlation between body fat ratio and vitamin D levels. It has been shown that there is a negative correlation between body fat ratio and serum vitamin d levels in older ages. High fat ratios are associated with low vitamin d levels (23). Contrary to the literature, our study found the fat ratio to be statistically higher in those with vitamin d above 30 ng/ml.We examined the relationship level between anemia parameters and vitamin d levels. However, contrary to the studies, we could not find a significant relationship between vitamin d levels and Hgb, iron, and ferritin levels in our study. Many studies have shown that high vitamin D levels have a positive effect on Hgb synthesis and increase Hgb (24). In addition, it has been shown that it increases erythrocyte synthesis in the bone marrow, therefore, severe deficiency causes anemia by inhibiting erythropoiesis (25).

The relationship between vitamin D levels and inflammation markers is a subject that has been studied and studied recently (26,27). It has been shown that chronic inflammation plays a role in the etiology of cardiac diseases, cancers, and many other specific diseases (28,29). It has been shown that vitamin D is a very important hormone, especially in many immunological and inflammatory processes (30). Experimental studies have shown that such diseases can be treated with vitamin D replacement (31). For this reason, inflammatory markers that may correlate with vitamin D levels were examined. C-reactive protein (CRP), Neutrophil-lymphocyte ratio (NLR) and platelet-lymphocyte ratio (PLR), erythrocyte sedimentation rate are among the methods that correlate with the prognosis of inflammatory diseases (32-34). One of the important points is that these methods are cheap, easily measurable, and reproducible. Again, one of the points supporting the relationship between vitamin D and inflammation is the presence of significant studies with endothelial dysfunction (35-38). In addition, there are studies revealing the relationship between NLR, PLR and endothelial dysfunction (39,40).

When evaluated within this framework, there is a significant relationship between vitamin D and inflammatory markers. However, our study did not find a significant relationship between the inflammatory marker and vitamin d levels.

Vitamin D has a very important effect on calcium and phosphorus hemostasis. It regulates this balance with its effect on the parathyroid gland, bones, intestines and kidneys (41). Vitamin D regulates serum calcium levels with a synergistic effect with parathormone (42). Vitamin D deficiency results in low calcium and phosphorus levels (43). In our study, there was a statistically significant difference in the levels of calcium (Ca) and phosphorus ($p<0.05$) (Table 4) between those with vitamin D above 30 and those below 20 in female patients. However, no significant difference was found in male patients (Table 4).

Limitations

The most important limitation of our study is that it is a single-center and retrospective study. In addition, the diet of the participants, their exposure to the sun, and not knowing whether they have recently used vitamin D are other factors limiting our study.

CONCLUSION

In our study, we found that there was a significant relationship between vitamin D levels, age, gender, platelet level, monocyte, MCV, neutrophil, protein, HDL, calcium and vitamin B12 levels. Along with the treatment and clinical examinations, it is necessary to monitor and evaluate the vitamin D levels of the patients, as well as hematological, biochemical, and endocrinological parameter changes.

Acknowledgments: None

Conflict of interest: The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article. This research did not receive and a specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Author Contributions: HE, ZE, IY, AO, MU, CK, SG, and GK: Concept, Data collection and/or processing, Analysis and/or interpretation, Literature review**, HE, ZE, IY, AO, MU, CK, SG, and GK:** Writing, Revision.

Ethical approval: All procedures performed in studies involving human participants were in accordance with the institutional and/or national research committee's ethical standards and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

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