Research Article

Al-Iraqia Medical College Journal (AIMCJ)
ISSN (Online): 3104-4565
ISSN (Print): 3104-4557

Assessment of the Anti-Inflammatory Effect of Vitamin D in Rotavirus Infection among Iraqi Children

Mazin Wafi Abdullrazzaq[1], Fadia Thamir Ahmed[2], Hussein Abdul Kareem Noah[3]

[1] Clinical pharmacist/ Al-Kadhimiya Pediatric Hospital, Baghdad, Iraq
[2] Clinical Pharmacy Department, College of Pharmacy, University of Baghdad, Baghdad, Iraq.
[3] Al-Kadhimiya Pediatric Hospital, Baghdad, Iraq.

ARTICLE INFO
Received: 9/11 / 2025
Revised: 26/ 12/ 2025
Accepted: 27/ 12/ 2025
Publish online: 15 /4 / 2026

*Corresponding Author: Fadia Thamir Ahmed
Email: fadia.ahmed@copharm.uobaghdad.edu.iq

CITATION
Mazin Wafi Abdullrazzaq, Fadia Thamir Ahmed, Hussein Abdul Kareem Noah. Assessment of the Anti-Inflammatory Effect of Vitamin D in Rotavirus Infection among Iraqi Children. *AIMCJ*. 2026;3(1):85-93.

DOI: https://doi.org/10.58564/AIMCJ3.1.2026.140

Abstract

Rotaviruses are a leading cause of severe gastroenteritis in newborns and young children. The fat-soluble vitamin D plays an important role in immune regulation and in gut health.

The current study aimed to evaluate the anti-inflammatory effect of vitamin D in pediatric patients with rotavirus gastroenteritis.

A prospective, non-randomized clinical study was conducted at Mohammed Baqir Al-Hakim Hospital on 60 children under 5 years of age with vitamin D deficiency and confirmed rotavirus infection. Participants were divided into two equal groups: Group I (control) received conventional rotavirus gastroenteritis treatment. In contrast, Group II received the same treatment plus a single oral dose of vitamin D of 100000 IU for ages less than 1 year and 300000 IU for ages more than 1 year. Serum vitamin D levels were measured at baseline and after 7 days. Laboratory parameters were measured on days 1, 4, and 7.

According to baseline characteristics, there were no significant differences in demographic and baseline laboratory parameters between groups I and II. Significant time-related changes in C-reactive protein (CRP) and lymphocyte-to-monocyte ratio (LMR) were observed in both groups ($P < 0.05$). In Group I (control), CRP decreased from 32.8 ± 13.15 to 27.80 ± 10.39, and LMR showed a minimal change from 3.07 (2.49–3.51) to 3.11 (2.56–3.61). In Group II (vitamin D), more pronounced improvements were noted, with CRP declining from 33 (24–36) to 12 (6–12) and LMR increasing from 2.34 (2.10–3.69) to 4.75 (4.30–5.12) ($P < 0.001$).

The findings indicated that vitamin D acts as an immunomodulatory and anti-inflammatory agent, particularly by lowering pro-inflammatory markers in individuals with baseline deficiency or high inflammation.

Keywords: Anti-inflammatory; Gastroenteritis; Pediatrics; Rotavirus; Vitamin D.

AIMCJ. (2026),3; (1):85-93
https://doi.org/10.58564/AIMCJ3.1.2026.140

Introduction

Rotavirus gastroenteritis (RG) is a leading cause of severe gastroenteritis in newborns and young children (1,2). It has been demonstrated that rotaviral gastroenteritis accounts for about 40% of all outpatient visits to pediatric primary care practices for acute gastroenteritis in babies and young children (3).

Particularly in underdeveloped nations, diarrhea and its consequences continue to be a leading cause of morbidity and mortality in children. It ranks as the second most frequent cause of death for kids younger than five (4).

Compared with other viral infections that cause gastroenteritis, rotavirus causes more severe illness; children are more likely to present with fever, dehydration, and metabolic acidosis, and they are more likely to be admitted or readmitted to the hospital (5). In the absence of dehydration, physical examination findings for rotavirus infection are often normal (6).

As rotavirus gastroenteritis severity increased, children with acute gastroenteritis may have a low lymphocyte-to-monocyte ratio (LMR). In the differential diagnosis of infantile diarrhea, serum C-reactive protein (CRP) levels were highly significant (7).

There is no specific treatment for a rotavirus infection. Antibiotics and antivirals cannot be used to treat a rotavirus infection. The ailment often clears up in three to seven days, but staying hydrated is crucial (8).

Vitamin D (calciferol) is a fat-soluble vitamin that can be bought as a dietary supplement, added to other foods, and found naturally in some foods. Furthermore, the skin produces it naturally when ultraviolet (UV) rays from the sun initiate vitamin D synthesis (9).

The assessment of vitamin D deficiency entails determining serum levels of the 25-hydroxy form; levels between 20 and 30 ng/mL suggest insufficiency, while values below 20 ng/mL indicate deficiency (10).

Vitamin D is most likely safe when taken at the recommended dosages (11). Despite being uncommon, a vitamin D overdose can have serious consequences that impact both long-term renal function and the short-term vital prognosis. In developing nations, vitamin D poisoning is still a concern (12).

Serum 25(OH)D concentrations >30 ng/mL were observed as early as 1 day after 600,000 IU of D3 and 540,000 IU of D3; the largest increases in serum 25(OH)D consistently happened between days 1 and 30. Peak levels were detected at 3 and 7 days after dose (13).

Vitamin D supplementation appears to exert its anti-inflammatory effects through several interconnected mechanisms. One key pathway is the reduction of CRP, an acute-phase reactant that rises during systemic inflammation; studies consistently show that restoring or maintaining adequate vitamin D status is associated with lower CRP concentrations (14,15).

Vitamin D augments lymphocyte regulatory function by facilitating the development and activity of regulatory T cells, promoting regulated lymphocyte proliferation, enhancing the secretion of the anti-inflammatory cytokine IL-10, and diminishing lymphocyte apoptosis by inhibiting inflammatory and oxidative pathways. Collectively, these mechanisms sustain or enhance circulating lymphocyte numbers, thereby augmenting the lymphocyte-to-monocyte ratio (16).

AIMCJ. (2026),3; (1):85-93
https://doi.org/10.58564/AIMCJ3.1.2026.140

This study aims to evaluate the anti-inflammatory effect of vitamin D in pediatric patients with rotavirus gastroenteritis.

Material and Methods:

Study design and setting:

A prospective, non-randomized clinical research study was conducted at Mohammed Baqir al-Hakim Hospital from December 2024 to May 2025.

Study population:

A total of 60 patients diagnosed with RG according to the inclusion criteria were enrolled in the study. Participants were selected from those attending the Mohammed Baqir al-Hakim Hospital. The current study included patients who were conveniently selected and had confirmed rotavirus infection. The study population was divided into 30 RG patients in group I and 30 RG patients in group II as follows:

Group I (control): received standard treatment, including rehydration and antipyretic therapy.

Group II (Treatment) group: received a single oral dose of vitamin D 100000 IU for age < 1 year and a dose of 300000IU for age> 1 year in addition to standard treatment. The study lasted 6 months, with follow-ups at 7-10 days (10,17).

Inclusion Criteria

The following were the study's inclusion criteria:

1. Children with confirmed rotavirus infection by rotavirus stool examination by the rotavirus rapid test from CerTest BIOTEC company in Spain.
2. Serum vitamin D levels indicate deficiency (below 20 ng/mL).

Exclusion Criteria

The following were the study's exclusion criteria:

1. Children with other major infections, severe dehydration, or underlying health conditions.
2. Children with current vitamin D supplementation.

Outcome Measures:

1. Measuring lymphocyte to monocyte ratio (LMR) and C-reactive protein (CRP) at admission, after 4 days, and after 7 days in both groups. LMR was measured by calculating the percentage of blood cells from complete blood count (CBC) tests performed in the hospital using an automated hematology analyzer.
   CRP was measured in the hospital using an agglutination test with a kit produced by Linear Chemicals S.L. (Barcelona, Spain) (16).
2. Measuring serum vitamin D at admission and after 7 days. Serum vitamin D was measured by electrochemiluminescence (ECL) using the Roche serum vitamin D Kit in Germany. Electrochemiluminescence (ECL) is a sophisticated immunoassay for serum 25-hydroxyvitamin D. Its excellent sensitivity, specificity, and dynamic range are enabled by electrochemical activation and light signal detection. When electrically stimulated, antibodies labeled with ruthenium bind vitamin D in the sample and emit light. Light intensity correlates with vitamin D levels, allowing

AIMCJ. (2026),3; (1):85-93
https://doi.org/10.58564/AIMCJ3.1.2026.140

rapid, precise quantification. Due to their reliability, compatibility with automated systems, and low analytical variability, clinical laboratories use ECL tests (18-20).

Statistical Analysis:

Data was entered and analyzed using IBM SPSS Statistics (Version 24). Descriptive statistics were used to summarize participants' baseline characteristics. Continuous variables (e.g., lab data) were presented as mean ± standard deviation (SD). A normality test was performed on the data using the Shapiro-Wilk test. The paired t-test (for normally distributed variables) or the Wilcoxon signed-rank test (for non-normally distributed variables) was used to compare laboratory data on rotavirus infections within the same group. In contrast, the Mann-Whitney test (for non-normally distributed variables) was used to compare laboratory data of rotavirus infections between group I (control) and group II (treatment). Spearman's correlation analysis was used to examine associations between changes in vitamin D levels and non-normally distributed laboratory parameters.

Results:

The study recruited 60 pediatric patients: 30 in group I (control) and 30 in group II (treatment). Group I includes 21 males (70%) and nine females (30%), and group II includes 22 males (73.3%) and 8 females (26.6%). The average age of the patients in group I was 4 (3.75–6) months. The average age of the patients of group II was 4 (3–6.25) months. There was no significant difference between the two groups regarding sex and age, as shown in Table 1.

Baseline laboratory parameters between group I (control) and group II (treatment) before intervention showed no statistically significant differences ($P > 0.05$), as shown in Table 2.

Table 1: Demographic characteristics of study participants.

Parameter		Group I	Group II	P value
Age (in months) Median (IQR)		4 (3.75–6)	4 (3–6.25)	0.946*
Gender n (%)	Male	21 (70%)	22 (73.3%)	0.082#
	Female	9 (30%)	8 (26.6%)	

*****Statistical analysis was done using the Mann-Whitney test*
 # Statistical analysis was done using the Chi-square test

Table 2: Baseline lab data of the patients.

Parameter	Group I	Group II	P value
CRP1 Median (IQR)	36 (24–42)	33 (24–36)	0.856*
LMR1 Median (IQR)	3.07 (2.49–3.51)	2.34 (2.10–3.69)	0.1*
VIT D1 Median (IQR)	15 (13.75–18)	16 (14–17)	0.709*

*****Statistical analysis was done using the Mann-Whitney test*

AIMCJ. (2026),3; (1):85-93
https://doi.org/10.58564/AIMCJ3.1.2026.140

Table 3: Association between Vitamin D Level Change and the laboratory Change between day 1 and day 4

Parameter	Group I (Control)			Parameter	Group II (Treatment)		
	Day 1	Day4	P value		Day 1	Day4	P value
CRP (Mean±SD)	32.8± 13.15	27.80±10.39	<0.001*	CRP Median (IQR)	33 (24–36)	12 (6–12)	<0.001#
LMR Median (IQR)	3.07 (2.49–3.51)	3.11 (2.56–3.61)	0.002#	LMR Median (IQR)	2.34 (2.10–3.69)	4.75 (4.30–5.12)	<0.001#

**Statistical analysis was done using the Paired T-test test*
#Statistical analysis was done using the Wilcoxon signed rank test

In Table 3, the results showed an association between Vitamin D level change and the laboratory change, with statistical comparisons between group I (control) and group II (treatment) across lab parameters (CRP and LMR). Here is a structured interpretation:
These findings revealed that all parameters have statistically significant changes in both control and treatment groups ($P < 0.05$). In Group II, all parameters demonstrated highly significant changes, including CRP and LMR (all $p < 0.001$).

Table 4 shows statistical comparisons of various laboratory parameters between the control and treatment groups on days 1 and 7. Here is a summary interpretation: Results of CRP and LMR findings showed statistically significant differences ($P < 0.001$) in both the control and treatment groups, suggesting changes over time in both groups. Vitamin D levels did not change significantly in the control group ($P = 0.161$). Significant increase in the treatment group ($P < 0.001$).

The correlation analysis revealed that greater increases in vitamin D levels were significantly associated with improvements in laboratory parameters. Specifically, moderate negative correlations were found between CRP levels. Positive correlations were seen with LMR, suggesting favorable hematological changes as shown in Table 5.

Table 4: The Change of Laboratory Data between the Two Groups between day 1 and day 7

Parameter	Group I (Control)			Parameter	Group II (Treatment)		
	Day 1	Day7	P value		Day 1	Day7	P value
CRP (Mean±SD)	32.8± 13.15	10.4±7.37	<0.001*	CRP Median (IQR)	33 (24–36)	0 (0–6)	<0.001#
LMR Median (IQR)	3.07 (2.49–3.51)	3.26 (2.66–3.68)	<0.001#	LMR Median (IQR)	2.34 (2.10–3.69)	6.85 (6.15–7.53)	<0.001#
Vit D Median (IQR)	15(13.75–18)	15 (12.75–17)	0.161#	Vit D Median (IQR)	15.5±2.16	39 (33.75–45.25)	<0.001#

**Statistical analysis was done using the Paired T-test test*
#Statistical analysis was done using the Wilcoxon signed rank test

AIMCJ. (2026),3; (1):85-93
https://doi.org/10.58564/AIMCJ3.1.2026.140

Table 5: The correlation between laboratory variables and vitamin D level change

Variable	Correlation Coefficient	P-value
CRP	–0.453	<0.001*
LMR	0.741	<0.001*

**Statistical analysis was done using the Spearman correlation test*

Discussion

This study found that Vitamin D significantly inhibits plasma CRP ($P < 0.001$), indicating that Vitamin D supplementation affects the body's inflammatory response. In this study, a single dose of vitamin D was found to significantly reduce plasma CRP levels in participants with rotavirus gastroenteritis, faster than in participants who did not receive Vitamin D. These findings agree with several studies worldwide (21-23). These findings agree with a study on the effect of vitamin D supplementation on circulating high-sensitivity C-reactive protein levels conducted in China, which found that vitamin D supplementation has a notably positive impact on reducing circulating high-sensitivity CRP (hs-CRP) levels ($p = 0.004$) (21). The current findings agree with another bidirectional Mendelian randomization study on the effect of Vitamin D deficiency and C-reactive protein conducted in the UK. That study found that raising 25-hydroxyvitamin D_3 levels in individuals with poor vitamin D status significantly reduced CRP levels ($P < 0.001$) (14).

Also, the current findings agree with a study on Vitamin D and C-Reactive Protein conducted in the Netherlands. The study concluded that there was a significant inverse relationship between blood vitamin D levels and CRP ($p = 0.027$) (22).

The current results align with a 2024 study in China exploring the impact of vitamin D supplementation and C-reactive protein and systolic and diastolic blood pressure in postmenopausal women, which found that vitamin D supplementation significantly correlates with decreased CRP levels ($p < 0.001$) (23).

The current study's findings agree with a study from China, which found a significant inverse relationship between Vitamin D and C-Reactive Protein in newborns ($p < 0.001$). The study showed that neonates with low 25(OH)D levels or those born in winter or spring had cord blood CRP levels inversely linked to vitamin D levels (24).

This action of vitamin D on CRP occurs by increasing anti-inflammatory T regulatory cell activity to reduce excessive immune responses and by downregulating pro-inflammatory cytokines such as IL-6 and TNF-α that stimulate the liver's production of CRP (25).

The current findings do not agree with a 2014 study conducted in Iran that examined the impact of vitamin D supplementation on C-reactive protein levels in patients with non-alcoholic fatty liver disease. The results showed that, as compared to the placebo group, vitamin D supplementation did not affect CRP or other variables in the intervention group ($p = 0.2$) (26).

This may result from the dosage, duration, and initial vitamin D status of the subjects, which likely affected the response; a brief supplement.

AIMCJ. (2026),3; (1):85-93
https://doi.org/10.58564/AIMCJ3.1.2026.140

Durations or near-normal baseline levels frequently do not yield significant biochemical alterations (27).

The current study found that LMR was significantly higher in group II receiving Vitamin D than in group I (P<0.001). This agrees with a study conducted in Turkey on the relationship between vitamin D insufficiency and hemogram-derived inflammatory biomarkers in children, in which Vitamin D levels were significantly positively correlated with LMR (correlation coefficient = 0.218) (P<0.001) (28).

Vitamin D augments lymphocyte regulatory function by facilitating the development and activity of regulatory T cells, promoting regulated lymphocyte proliferation, enhancing the secretion of the anti-inflammatory cytokine IL-10, and diminishing lymphocyte apoptosis by inhibiting inflammatory and oxidative pathways. Collectively, these mechanisms sustain or enhance circulating lymphocyte numbers, thereby augmenting the lymphocyte-to-monocyte ratio (15).

Limitations

Limitations of the present study include the relatively small sample size, constrained by the limited study duration, and the inability to reassess serum vitamin D levels on Day 4 to evaluate the short-term biochemical response.

Conclusion

The findings indicated that vitamin D acts as an immunomodulatory and anti-inflammatory agent, particularly by lowering pro-inflammatory markers in individuals with baseline deficiency or high inflammation.

Ethical Approval:

The proposal for the current study was submitted to the "College of Pharmacy, University of Baghdad," and approval was obtained from the "Scientific and Ethical Committee" under approval number (REC06202507R) on 5-1-2025. In addition, approval of the Ministry of Health was obtained according to approval number (120624) on 31-12-2024. At the same time, verbal consent was obtained from patients. This study was registered in the Clinical Library of Medicine in (clinicaltrials.gov) according to approval number (NCT07167797) on 2025-09-19, and informed consent was taken from the parents of all participants.

Author contributions

All authors contributed to the collection of data, the preparation of the draft, and the review and approval of the final version of the manuscript.

Conflict of Interest: None to declare

Funding: Nil

References:

1. Caddy S, Papa G, Borodavka A, Desselberger U. Rotavirus research: 2014–2020. *Virus research*. 2021 Oct 15;304:198499.
2. Kubba RM, Shanshal RM, Shanshal AM, Hussain SA. Relationship Between the Route of Transmission, Environmental Tolerance, and Mutation Rate of Some RNA Viruses with Their Pathogenicity. *Al-Iraqia Medical College Journal*. 2025 Dec 4;2(2):15-41.
3. Bernstein DI. Rotavirus overview. *The Pediatric Infectious Disease Journal*. 2009 Mar 1;28(3):S50-3.

AIMCJ. (2026),3; (1):85-93
https://doi.org/10.58564/AIMCJ3.1.2026.140

4. Mohammed SI, Sabry AT, Sabry DT, Mohammed BH. Knowledge and malpractices in pediatric diarrhea management by Iraqi mothers. *Asian J Pharm Clin Res*. 2018;10(8):503-7.
5. Karampatsas K, Osborne L, Seah ML, Tong CY, Prendergast AJ. Clinical characteristics and complications of rotavirus gastroenteritis in children in East London: A retrospective case-control study. *PloS one*. 2018 Mar 22;13(3):e0194009. https://doi.org/10.1371/jounal.pone.0194009
6. Pawłuszkiewicz K, Ryglowski PJ, Idzik N, Błaszczyszyn K, Kucharczyk E, Gaweł-Dąbrowska D, Siczek M, Widelski J, Paluch E. Rotavirus infections: Pathophysiology, symptoms, and vaccination. *Pathogens*. 2025 May 14;14(5):480. https://doi.org/10.3390/pathogens14050480
7. Al-Ezzy AI. The Accuracy of ELISA Versus Latex Agglutination Tests in the Diagnosis of Rotavirus Acute Gastroenteritis and the Clinical Usefulness of C-Reactive Protein in Iraqi Children. *South East European Journal of Immunology.* 2016 Dec 24;2(1):1-5.
8. Al-Nema ZM, Mohammed SI, Ahmed FT. Effect of Administration of Crystalloid IV Fluids Preoperatively on Postoperative Pain. *Iraqi Journal of Pharmaceutical Sciences*. 2012;21(1):34-8. doi:10.31351/vol21iss1pp34-38.
9. Yawuz MJ, Ahmed MQ, Mohammed SA. Determination of the level of 25-hydroxy vitamin D3 in patients with multiple sclerosis and its effect on disease activity. *J Pure Appl Microbiol.* 2019 Mar 1;13(1):545-51. DOI: 10.22207/JPAM. 13.1.61.
10. Al-Jalehawi A, Mohammed SI. Pharmacological Supplements Efficacy in Management of chronic pain associated with Sickle Cell Disease: A narrative review. *Maaen Journal for Medical Sciences*. 2024;3(2):1.1. DOI: 10.55810/2789-9136.1046.
11. Grant WB, Wimalawansa SJ, Pludowski P, Cheng RZ. Vitamin D: evidence-based health benefits and recommendations for population guidelines. *Nutrients*. 2025 Jan 14;17(2):277. Published 2025 Jan 14. doi:10.3390/nu17020277.
12. Garcia-Lopes MG, Pillar R, Kamimura MA, Rocha LA, Canziani ME, Carvalho AB, Cuppari L. Cholecalciferol supplementation in chronic kidney disease: restoration of vitamin D status and impact on parathyroid hormone. *Annals of Nutrition and Metabolism*. 2012 Aug 7;61(1):74-82.
13. Williams CE, Williams EA, Corfe BM. Vitamin D supplementation in people with IBS does not affect symptom severity and quality of life: results of a randomized controlled trial. *European Journal of Nutrition*. 2022 Feb;61(1):299-308. https://doi.org/10.1007/s00394-021-02633-w
14. Zhou A, Hyppönen E. Vitamin D deficiency and C-reactive protein: a bidirectional Mendelian randomization study. *International journal of epidemiology.* 2023 Feb 1;52(1):260-71.
15. Dhamad GD, Mahmood WT, Kareem NG, Jafar AK. Association between diabetes mellitus type-1 and celiac disease in growth retardation iraqi patients. *Indian Journal of Forensic Medicine & Toxicology*. 2022 Jan 1;16(1):1375-9.
16. Jafri L, Khan AH, Siddiqui AA, Mushtaq S, Iqbal R, Ghani F, Siddiqui I. Comparison of high-performance liquid chromatography,

AIMCJ. (2026),3; (1):85-93
https://doi.org/10.58564/AIMCJ3.1.2026.140

radioimmunoassay, and electrochemiluminescence immunoassay for quantification of serum 25-hydroxy vitamin D. Clinical Biochemistry. 2011 Jul 1;44(10-11):864-8. https://doi.org/10.1016/j.clinbiochem.2011.04.020

17. Abu-Shana JH, Abdulkareem NG, Jasim AO, Abbood YH. Effect of diabetes mellitus type 2 on the correlation of vitamin D with lipid profile in Iraqi patients. *Iraqi Journal of Science.* 2024 Sep 30:4881-9.
18. Ali I. T., Haddad N. I. A., Hussein E. A. Correlation of Serum Adiponectin and C-reactive protein with Other Biochemical Parameters in Iraqi Pregnant Women. *Chem. Methodol.,* 2022; 6(5): 357-365. doi: 10.22034/chemm.2022.328177.1435
19. Faraj MF, Muhammad SJ. Evaluation of Vitamin D3 and Vitamin E levels in Rheumatoid Arthritis Patients. *Al-Iraqia Medical College Journal*. 2025 Dec 15;2(3):26-33.
20. Abdulla MM, Haddad NI, Hussein EA. Correlations of serum vitamin D and thyroid hormones with other biochemical parameters in Iraqi pregnant women with preeclampsia. *J Glob Pharma Technol*. 2019;11(2):441-50.
21. Chen N, Wan Z, Han SF, Li BY, Zhang ZL, Qin LQ. Effect of vitamin D supplementation on the level of circulating high-sensitivity C-reactive protein: a meta-analysis of randomized controlled trials. *Nutrients.* 2014 Jun 10;6(6):2206-16.
22. Liefaard MC, Ligthart S, Vitezova A, Hofman A, Uitterlinden AG, Kiefte-de Jong JC, Franco OH, Zillikens MC, Dehghan A. Vitamin D and C-reactive protein: a Mendelian randomization study. *PloS one*. 2015 Jul 6;10(7):e0131740.
23. Jiang Q, Prabahar K, Saleh SA, Adly HM, Velu P, Adi AR, Baradwan S, Hajkhalaf MI, Baredwan A, Gari F, Kord-Varkaneh H. The effects of vitamin D supplementation on C-reactive protein and systolic and diastolic blood pressure in postmenopausal women: a meta-analysis and systematic review of randomized controlled trials. *Journal of the Academy of Nutrition and Dietetics.* 2024 Mar 1;124(3):387-96.
24. Tao RX, Zhou QF, Xu ZW, Hao JH, Huang K, Mou Z, Jiang XM, Tao FB, Zhu P. Inverse correlation between vitamin D and C-reactive protein in newborns. *Nutrients*. 2015 Nov 10;7(11):9218-28.
25. Fisher SA, Rahimzadeh M, Brierley C, Gration B, Doree C, Kimber CE, Plaza Cajide A, Lamikanra AA, Roberts DJ. The role of vitamin D in increasing circulating T regulatory cell numbers and modulating T regulatory cell phenotypes in patients with inflammatory disease or in healthy volunteers: A systematic review. *PloS one*. 2019 Sep 24;14(9):e0222313.
26. Foroughi M, Maghsoudi Z, Ghiasvand R, Iraj B, Askari G. Effect of vitamin D supplementation on C-reactive protein in patients with nonalcoholic fatty liver. *Int J Prev Med.* 2014;5(8):969-975.
27. Mazidi M, Rezaie P, Vatanparast H. Impact of vitamin D supplementation on C-reactive protein: a systematic review and meta-analysis of randomized controlled trials. *BMC Nutrition*. 2018 Feb 2;4(1):1.
28. Konuksever D, Karakaya SP, Bölük O, Koçak M, Kılıç BO, Saç RÜ. The association of vitamin D deficiency with hemogram-derived inflammatory biomarkers in children. *Nutrition, Metabolism and Cardiovascular Diseases*. 2022 Oct 1;32(10):2418-23.