JURNAL Healthsains
Printed ISSN: 2722-7782
Electronic ISSN:2722-5356
jurnal.healthsains.co.id

RELATIONSHIP OF 25(OH)D UMBILICAL LEVELS WITH NEONATAL HYPERBILIRUBINEMIA

Jeanette I. Ch. Manoppo1, Rocky Wilar1, Felicia Halim1,2, Ernestine Vivi Sadeli2
Department of Child Health RSUP Kandou
Faculty of Medicine Universitas Sam Ratulangi, Manado
North Sulawesi, Indonesia
Email: j.manoppo@yahoo.com, wilarrocky@gmail.com, vlicehalim@yahoo.com, ernestine.vivi@gmail.com

Keywords:
VitaminD;Hyperbilirubinemia; Neonate; Deficiency; Insufficiency.

ABSTRACT
The purpose of this study was to determine the relationship between vitamin D levels in the umbilical cord with the occurrence of hyperbilirubinemia in neonates. This study used an analytical observational design in a cohort prospective. This study compared two groups based on the results of vitamin D measurements. Each group, then followed up to examine the occurrence of hyperbilirubinemia. This research will be conducted from October 2022 to January 2023. Sample selection is done by consecutive sampling technique. RESULTS: Of the 19 or 79.2% of infants with 25-hydroxy-vitamin D deficiency, they had hyperbilirubinemia. While in the group that did not experience deficiency, only 3 or 10.7% experienced hyperbilirubinemia. There was a difference in the incidence of hyperbilirubinemia between infants who had 25-hydroxy-vitamin D deficiency compared to those without 25-hydroxy-vitamin D deficiency, with an RR of 6.71, which was statistically significant (p<0.001). 25-hydroxy-vitamin D deficiency was shown to be a factor associated with hyperbilirubinemia with an adjusted RR of 6.63. In conclusion, there is a strong relationship between 25(OH)D levels in the umbilical cord and neonatal hyperbilirubinemia, where 25(OH)D deficiency is a risk factor for hyperbilirubinemia. Neonates with 25(OH)D deficiency are 6.63 times more likely to develop hyperbilirubinemia than those without 25(OH)D deficiency.

INTRODUCTION

Vitamin D, or calciferol, is a general term and refers to a group of fat-soluble compounds with a four-ring cholesterol backbone. 25- hydroxyvitamin D (25[OH]D) is a form of vitamin D in circulation.1,2,3 Vitamin D is needed throughout life, not only necessary for bone formation but may also play an important role in several other physiological systems. Vitamin D deficiency and inadequacy is a global problem with a high prevalence even in developing and tropical countries4.

Children, pregnant and lactating women, and young adults are at just as high a risk as the elderly population. Almost 76% of mothers and 81% of newborns were found to be deficient in Vitamin D.5 In Indonesia, the prevalence of vitamin D deficiency (serum 25(OH)D <25nmol/L) is 0%, insufficiency (25-49nmol/L) is 45.1%, inadequate (50-74nmol/L) is 49.3%, and sufficiency (≥75 nmol/L) is 5.6%.6 The prevalence of vitamin D insufficiency in Manado, North Sulawesi is 34% and vitamin D deficiency is 64% in adolescents aged 10-18 years.6,7

Several studies have revealed the presence of 25-hydroxy vitamin D receptors on cells of the liver, nervous, pancreatic, and genitourinary (prostate) systems. Components of the immune system such as lymphocytes and macrophages also contain vitamin D receptors. The metabolism of bilirubin and vitamin D are two very different pathways that are very different, but there is at least one part of the synthesis that occurs in the same organ, the liver. As a consequence, the metabolism or synthesis of one can have an effect on the other. Recent studies have linked neonatal vitamin D levels to the risk of jaundice in neonates. There was a meta-analysis that collected six case-control studies with a total of 690 neonates and more than 409 neonates diagnosed with hyperbilirubinemia. The report showed that vitamin D levels in neonates with hyperbilirubinemia were 5.35 ng/mL lower than in healthy neonates and statistically significantly different.8,9,10

Some studies link vitamin D levels in the umbilical cord with poor outcomes in neonates. The findings of various studies show an increase in vitamin D deficiency during pregnancy and this is related to side outcomes for the mother and fetus, such as gestational diabetes mellitus, preeclampsia, small gestation, preterm birth, hyperbilirubinemia and others. Vitamin D levels in the umbilical cord depend on 25(OH)D levels and various maternal risk factors depend on low maternal-fetal 25(OH)D concentrations11. The purpose of this study was to determine the relationship between vitamin D levels in the umbilical cord with the occurrence of hyperbilirubinemia in neonates.

RESEARCH METHODS

This study used an analytical observational design in a cohort prospective. This study compared two groups based on the results of vitamin D measurements. Deficiency and insufficiency as the exposed group, normal levels as the unexposed group. Each group was then followed up to examine the occurrence of hyperbilirubinemia to be compared. All neonates selected as samples were checked for vitamin D levels. In the other hand, neonates who had clinically jaundice based on Kramer findings are examined for bilirubin (total and direct).

This research was conducted from October 2022 to February 2023 in Prof. Dr. R. D. Kandou Manado Hospital, Faculty of Medicine, Sam Ratulangi University. The target population is neonatal who was born or treated in Prof. Dr. R. D. Kandou Manado hospital. The inclusion criteria in this study are: 1) Full-term newborns, with spontaneous vaginal delivery methods and sectio caesaria. 2) Infants aged 0 days – 28 days. 3) Babies are born and cared for from October 2022 to December 2022. The exclusion criteria for this study were as follow: 1) Premature newborns. 2) Infants with multiple congenital anomalies at birth and prenatal examinations. 3) Babies with unstable hemodynamics at birth for whom sampling is not possible. 4) Infants with sepsis within the observation period. 5) Babies of mothers with HIV. 6) Infants of mothers with Hepatitis B. 7) Patients loss to follow up. 8) Patients with parents who refuse blood drawing after informed consent (attachment). Information about factors that can affect vitamin D levels is obtained through questionnaires by parents or guardians of children, namely the history of consumption of maternal vitamin D

supplementation, maternal diet, complaints during pregnancy, gestational age and delivery method.

RESULTS AND DISCUSSION

Characteristics of Research Subjects

The study sample was full-term newborns, born by the method of spontaneous vaginal delivery and sectio caesaria, aged 0 to 28 days, who were born and treated at RSUP Prof. Dr. R. D. kandou, Manado. Sample selection was carried out on 64 subjects by consecutive sampling. Of the 64 subjects selected, there were 12 subjects who were excluded due to sample loss to follow up on the second sampling, prematurity, and lysis samples, so that the eligible subjects were 52 subjects.

Table 1 Data on demographic characteristics of mothers and neonates

Parameter	Average±SD	Minimal-Maximum
Mother's Age	27.92±6.11	16-38
Birth weight (gram)	3069.04±392.65	2350-4000
Birth length (cm)	47.75±1.64	45-52
Apgar 1 minute	6.38±0.79	3-8
Apgar 5 minute	8.36±0.76	5-9
Until 25(OH)D umbilical	22.65±6.72	11.80-37.10
Bilirubin Up (H2-3)	10.86±4.32	4.71-17.89

	Sum (%)
Gender	
Woman	30 (57.7)
Man	22 (42.3)
Gravid	
First	19 (36.5)
Second	11 (21.2)
Third	15 (28.8)
Fourth	6 (11.5)
Fifth	1 (1.9)
Delivery method	
Sectio Caesaria	22 (42.3)
Spontaneous	30 (57.7)
Retrieval age bilirubin (day) **Sample**	
Two	30 (57.7)
Three	22 (42.3)

From this study, 52 babies were obtained with a diagnosis of full-term babies according to the period of pregnancy. Most of the subjects were 30 girls (57.7%) and other subjects were 22 boys (42.3%). The subjects obtained were mostly from the first pregnancy at 36.5% and at least from the fifth pregnancy at 1.9%.

From the descriptive analysis, the lowest level of 25(OH)D was 11.80 ng / mL and the highest was 37.10 ng / mL, obtained an average of 22.65 ng / mL with a standard deviation of 6.72. The lowest bilirubin level was 4.71 mg/dL with the highest bilirubin level was 17.89 mg/dL, and an average of 10.86 mg/dL was obtained with a

standard deviation of 4.32. In table 11. Showed that spontaneous labor, with 30 (57.7%) samples more dominant than cesarean delivery as many as 22 (42.3%) samples.

Table 2 Classification of subjects determine by bilirubin levels

No Hyperbilirubinemia	Hyperbilirubinemia	
	Indicated for Phototherapy	Not-indicated for Phototherapy
2 (3.8)	22 (42.3)	28 (53.9)

Table 2 illustrates that of the 52 neonates, 50 neonates had bilirubin levels ≥ 5 mg/dL, with 22 (42.3%) of them indicated for phototherapy according to the curve criteria using the Bhutani curve based on the age of the neonate.

Table 3. Classification of subjects determine by 25(OH)D levels

	Profound deficiency	Deficiency	Insufficiency	Normal
Vitamin D status	0 (0)	24 (46.1)	18 (34.7)	10 (19.2)

In this study, a classification of 25 (OH) D levels was taken based on IDAI guideline criteria, where normal 25-hydroxy vitamin D (25 (OH)D) levels were 30-100 ng / ml, insufficiency 21-29 ng / ml, deficiency <20 ng / ml, severe deficiency <5 ng / ml. Table 13 illustrates 25(OH)D levels in 52 samples, of which 24 (46.1%) neonates had 25(OH)D deficiency, 18 (34.7%) neonates were within the range of insufficiency values and only 10 (19.2%) neonates had normal 25(OH)D levels.

Table 4 Distribution of characteristics of subjects by category of 25-hydroxy vitamins D(25(OH)D)

Variables	**Vitamin D Category**		**P**
	Deficiency	**Normal**	
Sex			0.931*
Male	10 (41.7%)	12 (42.9%)	
Female	14 (58.3%)	16 (57.1%)	
Gravida			0.380*
First	8 (33.3%)	11 (39.3%)	
Second	3 (12.5%)	8 (28.6%)	
Third	8 (33.3%)	7 (25.0%)	
Fourth	4 (16.7%)	2 (7.1%)	
Fifth	1 (4.2%)	0 (0.0%)	
Delivery method			**0.006***

Spontan	9 (37.5%)	21 (75%)	
Sectio Caesaria	15 (62.5%)	7 (25%)	
Days taken sample			
Second	8 (33.3%)	22 (78.6%)	**0.003***
Third	16 (66.7%)	6 (21.4%)	

Description: *based on Pearson Chi-Square test

In the 25-hydroxy-vitamin D deficient group, 10 (41.7%) were male, and most of the other 14 (58.3%) were female. In the group that was not deficient in 25-hydroxy vitamin D there were 12 (42.9%) and most of the remaining 16 (57.1%) were female. There were no differences in sex distribution by deficiency category and no 25-hydroxy-vitamin D deficiency (p = 0.931).

Based on gravida, in the group with 25-hydroxy-vitamin D deficiency, most 8 (33.3%) were from the first and third 3 pregnancies (12.5%), while the remaining 3 (12.5%) were second pregnancies, 4 (16.7%) were fourth pregnancies and 1 (4.2%) were fifth pregnancies. In the non-25-hydroxy-vitamin D deficiency group, most 11 (39.3%) were from the first pregnancy, while the remaining 8 (28.6%) were second pregnancies, 7 (25.0%) were third pregnancies, 2 (7.1%) were fourth pregnancies and none were from fifth pregnancies. There was no difference in sex distribution by deficiency category and no 25-hydroxy-vitamin D deficiency (p = 0.380).

In the other hand, the 25-hydroxy-vitamin D deficient group, 9 (37.5%) were born spontaneously, while most of the remaining 15 (62.5%) were born by sectio caesaria. In the group that was not deficient in 25-hydroxy vitamin D, 21 (75%) were born spontaneously, while the other 7 (25%) were born by sectio caesaria. There are differences in the distribution of delivery methods based on the categories of deficiency and non-deficiency of 25-hydroxy-vitamin D (p = 0.006).

In the group with 25-hydroxy-vitamin D deficiency, 8 (33.3%) came from sampling on the second day, while most of the remaining 16 (66.7%) came from sampling on the third day. In the group that was not deficient in 25-hydroxy vitamin D, 22 (78.6%) came from the second day of sampling, while the other 6 (21.4%) came from the third day of sampling. There was a difference in the distribution of sampling days by category of deficiency and non-deficiency of 25-hydroxy-vitamin D (p = 0.003).

Table 5 Bivariate Analysis 25-hydroxy-vitamin D with neonatal hyperbilirubinemia

	Hyperbilirubinemia	**Non-hyperbilirubinemia**	**RR**	**p**
Deficiency ≤ 20 ng/mL	19 (79.2%)	5 (20.8%)	6.71*	< 0.001*
Normal (> 20 ng/mL)	3 (10.7%)	25 (89.3%)		

Description: *based on Pearson Chi-Square test

In infants who have 25-hydroxy-vitamin D deficiency, there are 19 or 79.2% who have hyperbilirubinemia. While in the group that did not experience deficiency, only 3 or 10.7% experienced hyperbilirubinemia. There was a difference in the incidence of hyperbilirubinemia between infants with 25-hydroxy-vitamin D deficiency compared to those without 25-hydroxy-vitamin D deficiency, with an RR of 6.71, which is statistically significant (p<0.001). This means the risk occurrence of hyperbilirubinemia in infants with 25-hydroxy-vitamin D deficiency is 6.71 times compared to non-25-hydroxy-vitamin D deficiency.

Table 6 Results of Poisson Regression Analysis

Parameters	Adjusted RR	95% CI	p
Deficiency 25(OH)D	6.63*	1.87 – 23.53	0.003*
Method of delivery	0.75	0.3 – 1.86	0.54

Description: *based on Poisson Regression Test

Table 6 Explains the relationship between 25-hydroxy-vitamin D deficiency and hyperbilirubinemia after controlling for delivery method as a confounding It was found that 25-hydroxy-vitamin D deficiency was proven to be a factor associated with hyperbilirubinemia after controlling for delivery method as a confounding variable/covariate, with an adjusted RR of 6.63 and statistically meaningful, 95% CI did not exceed 1 and p value < 0.05. This means that there is a pure effect of vitamin D deficiency on the occurrence of hyperbilirubinemia, where 25-hydroxy-vitamin D deficiency in neonates can increase the risk of 6.63 times hyperbilirubinemia requiring therapy compared to those who do not have 25- hydroxy-vitamin D deficiency.

Almost 76% of mothers and 81% of newborns are found to be deficient in Vitamin D.5 In Indonesia, the prevalence of vitamin D deficiency (serum 25(OH)D <25nmol/L) 0%, insufficiency (25-49nmol/L) 45.1%, inadequate (50-74nmol/L) 49.3%, and sufficiency (≥75 nmol/L) 5.6%.6 The prevalence of vitamin D insufficiency in Manado, North Sulawesi is 34% and vitamin D deficiency is 64% in adolescents aged 10-18 years.7 Indonesian Pediatric Society determines the criteria for normal 25-hydroxy vitamin D (25(OH)D3) levels of 30-100 ng/ml, insufficiency 21-29 ng/ml, deficiency <20 ng/ml, severe deficiency <5 ng/ml12.

About 60%-80% of newborns yellow in the first week after birth. Hyperbilirubinemia occurs in about 60% of full-term infants and 80% of under-term infants.13 An Indonesian study (Hasan Sadikin Hospital, Bandung) reported the incidence of neonatal jaundice in 2014 reached 8.04% of 2,531 neonates with male neonates (56.9%) having higher bilirubin levels than female neonates. Neonates born

at full term age (55.2%) have a tendency to experience hyperbilirubinemia with low birth weight characteristics (51.7%)14.

Hyperbilirubinemia is when total serum bilirubin (TSB) rises above the 95th percentile for age (high-risk zone) during the first week of life79. Some literature defines it as a serum total bilirubin level of >5 mg/dL (86 mol/L)15,16. Neonatal jaundice is a yellowish change in skin color and sclera color in newborns due to excess unconjugated bilirubin. Clinical jaundice will begin to appear in newborns when bilirubin levels are 5-7 mg / dL17.

Until now, studies looking for the relationship between vitamin D levels in the umbilical cord and the risk of neonatal jaundice have not been widely conducted. In fact, in the first months of life, neonatal vitamin D levels correlate with maternal vitamin D levels due to transplacental vitamin D transfer18. In addition to being representative enough to describe vitamin D levels in neonate, transplacental vitamin D level examination can be safer because it reduces the need for minimally invasive measures (blood specimen collection) from neonates directly.

In recent years there has been no systematic review or meta-analysis that reported on the relationship between vitamin D levels in the umbilical cord and the incidence of neonatal jaundice. There is also no optimal range value of umbilical cord vitamin D that can be used as a parameter for assessing the risk of adverse outcomes for neonates. Based on the exposure to the data above, this study aims to determine the picture of the incidence of vitamin D deficiency in neonate, especially newborns, and its relationship with the incidence of hyperbilirubinemia in neonates, especially those who need therapy. The results of this study are expected to be used to determine the need for vitamin D supplementation in pregnancy to prevent the occurrence of neonatal adverse outcomes, one of which is neonatal hyperbilirubinemia.

Characteristics of Research Subjects

The results of this study the average age of mothers was 27.92 years which is the average childbearing age, the youngest age is 16 years and the oldest age is 38 years. This is in accordance with research conducted by Sadr et al, Mutlu et al, Mehrpisheh et al, Gupta et al, Aletayeb et al, and Abed et al, that the maternal age range is in childbearing or productive age19,20. The characteristics of the study subjects compared in this study were gender, gravida, method of delivery and age at the time of sampling. This is based on the suspicion that these factors can be a confounding factor to the results of this study. In conclusion, to be able to compare these two study groups, the characteristics of subjects between the 25(OH)D and non-deficiency 25(OH)D levels must be comparable.

In this study, it was found that most of the subjects were baby girls, namely 30 babies (57.7%) and other subjects were 22 baby boys (42.3%). This finding is also similar to research conducted by Abed et al and Aletayeb et al, that most infants who have indirect hyperbilirubinemia and with vitamin D deficiency are women21.

The subjects obtained were mostly from the first pregnancy at 36.5% and the least from the fifth pregnancy at 1.9%. The findings are similar to research conducted by Sadr et al, in which babies with the most vitamin D deficiency were born from the

first 130 pregnancies. Subjects born by sectio caesaria were more than spontaneous, 30 (57.7%) compared to 22 (42.3%). This finding is similar to research conducted by Abed et al and Aletayeb et al, that most subjects with hyperbilirubinemia with vitamin D deficiency were born by sectio caesaria delivery, but in their studies they did not differ significantly20,21. In this study found in the group with 25-hydroxy-vitamin D deficiency, most samples were taken on the third day 16 (66.7%), which corresponds to most samples born by sectio caesaria. Both by method of delivery and day of sampling showed significant differences in distribution.

Characteristics of Research Subjects based on 25(OH)D Levels

From this study it was found that most newborns had levels of 25(OH)D levels below normal where 24 (46.1%) neonates had deficiency levels of 25(OH)D, 18 (34.7%) neonates were in the range of insufficiency values and only 10 (19.2%) neonates had normal 25(OH)D levels. This finding is similar to research conducted by Sadr et al, where vitamin D levels in the umbilical are mostly below normal22.

Subjects born by sectio caesaria were more than spontaneous, 30 (57.7%) compared to 22 (42.3%). In the group with 25-hydroxy-vitamin D deficiency, it was more common in infants born by sectio caesaria at 15 (62.5%). This finding is similar to research conducted by Abed et al and Aletayeb et al, that most subjects with hyperbilirubinemia with vitamin D deficiency were born by sectio caesaria delivery, but in their study they did not differ significantly20,21.

In studies conducted by Merewood A et al, Kalliokoski P, Scholl T et al, that in pregnant women with vitamin D deficiency, the risk of birth by sectio caesaria increases due to an increased risk of pre-eclampsia, weakness of smooth muscles, cephalopelvic disproportion, decreased immune system23,24.

Relationship of 25-Hydroxy-Vitamin D Levels in Hyperbilirubinemia and Non-Hyperbilirubinemia Groups

Based on the results of the research described above, it was found that there were significant differences in the group with 25 (OH) D deficiency and non-deficiency of 25 (OH) D levels based on the method of delivery and age at the time of sampling so that the subject group must be comparable, thus it is expected that bias due to labor method and age at the time of sampling can be excluded and the two groups can be compared with 24 (46.1%) subjects in the study It has 25-hydroxy-vitamin D levels below the value of ≤20 ng/mL.

In the hyperbilirubinemia group requiring therapy, 19 subjects (79.2%) were included in the deficiency category (≤20 ng/mL) and 3 subjects (10.7%) were included in the non-deficiency category (>20 ng/mL). This study proves the relationship between 25-hydroxy-vitamin D deficiency as a risk factor for hyperbilirubinemia. Neonates with 25-hydroxy-vitamin D deficiency had a 6.71-fold risk of hyperbilirubinemia compared to non-25-hydroxy-vitamin D deficiency.

The results of this study are in accordance with previous studies by comparing levels of 25-hydroxy-vitamin D3 in serum and umbilical20,21 with the incidence of hyperbilirubinemia in neonates. A meta-analysis conducted by Huang J et al, reported from six case-control studies with a total of 690 neonates, more than 409 neonates were diagnosed with hyperbilirubinemia.13

In this study it was found that vitamin D levels in neonates with hyperbilirubinemia have a tendency to be lower than neonates without hyperbilirubinemia. It is possible that neonates with lower vitamin D levels have a higher risk of developing hyperbilirubinemia.16

Research conducted by Mutlu et al, showed that low serum vitamin D levels may be associated with hyperbilirubinemia in full-term neonates. There is an association between indirect hyperbilirubinemia and serum vitamin D levels in newborns with neonatal jaundice at levels requiring phototherapy.16,22 A case-control study conducted by Mehrpisheh et al. in 60 full-term infants, there was a difference in mean and standard deviation of serum 25-hydroxyvitamin D levels of 10.76 ± 8.6 ng/dl in the case group and 14.88 ± 11.38 ng/dl in the control group. 18,19

Abed et al, obtained a very significant reduction in vitamin D levels among patients rather than controls and a significant negative correlation between vitamin D levels and serum bilirubin in neonates. Aletayeb et al, mentioned vitamin D levels in newborns with jaundice significantly lower compared to those in the healthy group. Elfarargy MS et al, revealed that there was a decrease in serum levels of Vitamins C, D, and E in the jaundice group.18,19

In a case-control study conducted by Bhat JA et al, there was a significant difference only in newborn vitamin D levels and the negative correlation of vitamin D levels in case infants and their serum bilirubin was statistically significant.8 Gupta M et al, found a strong association between severe vitamin D deficiency and neonatal jaundice25. Sadr Z, et al. in a prospective cohort study explained there was a significant association between normal maternal vitamin D levels and the incidence of neonatal jaundice in neonates at day 14 22.

Deficiency of 25-hydroxy-vitamin D3 (vitamin D) can occur through several mechanisms, although the metabolism of bilirubin and vitamin D are 2 different and very different pathways, at least one part of the synthesis process occurs in one common organ, namely the liver. Therefore, the metabolism or synthesis of one can affect the other25.

Indirect bilirubin is most abundantly decomposed by erythrocytes where erythropoietin becomes the main hormone that triggers erythrocyte production. If there is a vitamin D deficiency that causes disruption of erythropoietin and subsequently ineffective erythropoiesis occurs in the bone marrow, it can cause an increase in erythrocyte degradation and cause hyperbilirubinemia. It is also mentioned that neonatal erythrocytes are more susceptible to oxidative disorders and vitamin D is an antioxidant that can provide protection against oxidative stress, so some experts state that vitamin D can prevent an increase in bilirubin due to oxidative damage to erythrocytes.16

Vitamin D in the body adequately, can reduce the risk of liver ischemia and hepatorenal injury. This is because vitamin D has a role as an antioxidant and anti-inflammatory. Vitamin D is able to mitigate oxidative stress and inflammatory processes in the liver by minimizing lipid peroxidation and cytokine secretion. It is also played by the role of the immune system (macrophages, dendritic cells, T cells

and B cells) to release CYP27A1 or CYP27B1 enzymes and metabolize 25(OH)D into calcitriol.

Vitamin D will inhibit the activation of M1 proinflammatory macrophages and interfere with the recruitment of monocytes or macrophages during tissue inflammation, as well as increase the activation of M2 anti-inflammatory macrophages (increase the effect of IL-10), so that in further phases it will decrease the expression of macrophagous HO-1 to maintain tissue associated with decreased direct bilirubin levels. Heme oxygenase-1 (HO-1), encoded with the Hmox1 gene, is an anti-inflammatory molecule that catalyzes free heme to produce three components namely carbon monoxide (CO) gas, free iron which causes the expression of heavy chain ferritin (H-). and biliverdin which is converted into bilirubin through biliverdin reductase. HO-1 is triggered, in addition to hem, by various stressors such as endotoxins, cytokines, and oxidant26.

The results of this study show the importance of vitamin D supplementation in accordance with the recommendations, especially in newborns, pregnant and lactating women, especially those who have risk factors for vitamin D deficiency. It can be considered for examination of vitamin D levels in pregnant women especially and in newborns for screening, especially those with risk factors, as well as comprehensive therapy planning. It is also stated that from this study, it have important significance in improving clinical management and efforts to prevent hyperbilirubinemia in neonates, and also have an important impact on maternal and child health programs. The results of this study show the importance of maintaining normal levels of 25-hydroxy-vitamin D since pregnancy. Therefore, it is important to provide vitamin D supplementation in pregnant women

CONCLUSION

The results of this study provide an overview of the relationship between umbilical 25(OH)D levels in neonates with the incidence of neonatal hyperbilirubinemia, more specifically obtained:

The lowest levels of 25(OH)D umbilical in newborns were found in hyperbilirubinemia subjects requiring therapy and the highest levels in subjects who did not have hyperbilirubinemia. It was found that most full-term newborns have 25(OH)D deficiency and only a small percentage have 25(OH)D levels within the normal range.

It was found that newborns with neonatal hyperbilirubinemia who needed therapy had levels of 25(OH)D in the deficiency range. There is a strong association between 25(OH)D levels in the umbilical cord and neonatal hyperbilirubinemia, where 25(OH)D deficiency is a risk factor for hyperbilirubinemia. Neonates with 25(OH)D deficiency are 6.63 times more likely to develop hyperbilirubinemia than those without 25(OH)D deficiency.

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