ORIGINAL ARTICLE

Effects of Phototherapy on Vitamin D and Calcium Serum Levels in neonates with hyperbilirubinemia

Asmaa M Ismail[1], Osman OM Osman[1], Hanan M Ali[1], Omr El Henawy[2], Sherin A Taha[3], Magda F Gabri[1*]

[1]Pediatrics Department, Faculty of Medicine, Aswan University
[2]Clinical Pathology Department, Faculty of Medicine, Aswan University
[3]Pediatrics Department, Faculty of Medicine, Suez University

ABSTRACT

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***Corresponding author:**
Magda Farghali Gabri
Email: magda.farghly@med.aswu.edu.eg

Tel: 01063439319

Background: Phototherapy is the most common way to help babies with severe jaundice. It can treat and stop it from getting worse. Hypocalcemia is one of its complications. **Objectives:** to evaluate how phototherapy affects the levels of calcium and vitamin D in newborns with high bilirubin levels and to assess the effect of using different types and duration of phototherapy on Ca++ ion levels. **Methods:** The current Prospective cohort study was conducted in pediatric department, Aswan University hospital on neonates diagnosed with unconjugated hyperbilirubinemia and receiving phototherapy. Our study included 114 neonates divided into 2 groups: group A, which had full-term babies, and group B, which had preterm babies. All cases were subjected to history, examination, and investigation which included complete blood count, total and ionized calcium, vitamin D, and bilirubin levels at admission and 48 hours after phototherapy application. **Results:** preterm and full-term babies have statistically different levels of vitamin D and calcium levels after being treated with phototherapy for 48 hours. The levels were higher in preterm babies compared to full-term babies, with P value < 0.05. **In conclusion,** phototherapy has a big impact on the levels of calcium and vitamin D in the blood. Low calcium in the blood can happen with phototherapy

INTRODUCTION

Neonatal jaundice is the yellow coloring of a newborn baby's skin and sclera that is brought on by a buildup of bilirubin in the mucous membranes and skin [(1)]. High levels of bilirubin are usually not harmful, but in a tiny percentage of newborns can cause acute bilirubin encephalopathy, which can subsequently result in kernicterus. In developed nations, 0.5 to 1.3 newborns out of every 100,000 live births have kernicterus [(2)]. Early detection and strong treatment can stop these severe effects of hyperbilirubinemia [(3)].

Because of its non-invasive nature and safety, phototherapy has become the primary form of treatment for neonatal hyperbilirubinemia [(4)]. It lowers the plasma levels of unconjugated bilirubin, which helps prevent a serious condition called kernicterus and decreases the need for exchange transfusion [(5)]. Phototherapy can have some complications like bronze baby syndrome, hyperthermia, damaging DNA and causing mutations, retinal damage, and affecting the bond between mother and baby [6]. Hypocalcemia is one of its complications **[7].**

Hypocalcemia is defined as the total serum level of calcium < 7 mg/dl (1.75 mmol/L) in preterm and less than 8 mg/dl (2 mmol/L) in full-term babies. It can cause severe complications like neuromuscular irritability, myoclonic jerks, jitteriness, seizures, cyanosis, apnea, laryngospasm, etc… **[8].**

Vitamin D is very important for our body. It helps keep our bones and muscles strong and helps our immune system work well. Calcium absorption from the intestine can be increased via the active form of vitamin D. So, babies with a calcium ion disorder may have their vitamin D levels change during phototherapy [9].

So, this study aimed to evaluate how phototherapy affects the levels of calcium and vitamin D in neonates with unconjugated hyperbilirubinemia and to assess the effect of using different types and duration of phototherapy on Ca level.

METHODOLOGY

This study was a prospective cohort study that was carried out in the Neonatal Intensive Care Unit (NICU) at our hospital for 9 months (**from March 1st to December 1st, 2022.**).

Inclusion criteria: all neonates more than 32 weeks gestation, admitted to NICU with unconjugated hyperbilirubinemia and in need of phototherapy in the first 2 weeks of life.

Exclusion criteria: Newborns with conjugated hyperbilirubinemia, those with hypocalcemia, sepsis, or apparent major congenital anomalies (as Di George, etc….), newborns who need exchange transfusions, fed with cow's milk, or on anticonvulsants, whose mothers had a history of taking anticonvulsants, and infants of diabetic mother were excluded from this study.

Sample size: With the G power program version 3.1.3 and t-test for comparison of differences among 2 independent means with an impact size of 0.47, sample size had been determined **[10]**. The chance of an alpha error is 0. 05, power (1- beta error probability of 0.80), & allocation ratio of 1:1.

The minimum required sample size was 114 neonates (57 neonates in each group).

Group A: the full-term group included 57 neonates (57 term neonates >37 weeks).

Group B: the preterm group included 57 neonates (57 preterm neonates from 32 -37 weeks).

One of the preterm groups was excluded during the analysis due to maternal diabetes.

We looked at all the cases carefully, checked their medical history, and did physical exams, and lab tests. The investigation included complete blood count (CBC) with Reticulocyte count, blood type of both mother and newborn (had been analyzed antisera technique), serum Ca, vitamin D, and total and direct serum bilirubin.

3 ml of blood from a vein was sent to the lab to check calcium, vitamin D, and levels of bilirubin at the time of admission and again 48 hours after starting phototherapy. We used the Diazo method to measure the levels of total and direct bilirubin. We used a method called Arsenazo to measure the level of calcium in the serum. This method measures the absorbance of the Ca-Arsenazo III complex at 660/700 nm.

Vitamin D level was checked using a test called the enzyme-linked immunosorbent assay (ELISA), using a kit for 25-(OH) vitamin D.

Phototherapy was started for babies born at 35 weeks or more as per the 2022 guidelines from American Academy of Pediatrics (AAP) [11]. For babies born before 35 weeks, the treatment was

started according to the published suggestions of a group of US experts [12]. The choice of either conventional or intensive light therapy for treatment was based on serum bilirubin concentrations.
Intensive phototherapy was utilized for newborns who were at high risk for exchange transfusion and was subsequently changed to conventional phototherapy once bilirubin decreased to the intermediate risk **[13]**.
Conventional phototherapy systems comprise six white and blue, fluorescent tubes (PhilipsTL52/20W, Buenos Aires, Argentina) placed 20 cm over the newborn child, while intensive phototherapy systems contain 12 white and blue, fluorescent tubes (Philips TL03, ON, Canada). Phototherapy is placed 20 cm under and above the infant's front and back. The newborn was placed naked, except for a diaper and eye patches, in an incubator or intensive phototherapy unit (Bilicrystal, Medes-time, or Bilisphere 360, Marcinelle, Belgium). The light energy of the phototherapy units was measured using a standard photometer (Light Meter VF, Minolta, Japan); conventional phototherapy units were 12–16 μW/cm2 nm and intensive phototherapy units were 30–34 μW/cm2/nm in the 430–490-nm band.
Ethical approval: All the participants' parents were introduced to the researcher, who then asked them to take part in the research by outlining its objectives. All participants' parents verbally consented after being fully informed and information confidentiality had been guaranteed. Moreover, permission from the faculty of medicine's ethics committee & institutional review board approval were acquired, IRB:535/6/21.
Statistical analysis: Version 20 of the Statistical Software for Social Science had been used for data analysis (SPSS Inc., Chicago, IL, USA). Mean & standard deviation were used to characterize quantitative variables. Numbers & percentages had been used to define qualitative factors. We used a student t-test to compare parametric quantitative variables between 2 groups. When frequencies fell below 5, the Chi-square test or Fisher's exact test was used to compare qualitative variables. To evaluate the relationship among 2 normally distributed variables, Pearson correlation coefficients were used. A p-value of <0.05 or lower is regarded as significant when the variable has not been normally distributed.

RESULTS

Demographic characteristics of the studied neonates as shown in **Table (1)** revealed that there was no variation in age between preterm & full term, the mean age in preterm was 6.07±1.142 days and 6.04±2.09 days in full term. Regarding gender, males were 71.4% in preterm & 52.6% in full-term. Weight at birth in preterm was 2077.41±365.07 gm and 2759.65±407.06 gm in full term. No variation regarding the time of jaundice appearance (3.55±0.76 days and 3.88±1.59 days respectively), or type of delivery among preterm & full term, and most neonates were delivered by cesarean section (80.4% and 66.7% respectively). Regarding type of feeding, there had been variation among preterm & full-term, as breastfeeding was more in full term and the bottle was more in preterm babies. Regarding maternal risk factors, there was a statistically significantly higher percentage of multiple pregnancies in preterm compared to full-term. Regarding type of phototherapy used, intensive type used in 60% of preterm and 67% of full-term babies and duration of intensive type were significantly less than that of conventional type.
There was no variation among preterm & full-term regarding total and ionized serum Ca before phototherapy. However, after 48 hours of phototherapy, there was statistically significant higher mean serum Ca (total and ionized) in full term (9.11±1.65, 1.25 ± 0.15) in comparison to preterm (8.59 ± 1, 1.03 ± 0.2133), with P value <0.05. In addition, it was significantly less after 48 hours of

phototherapy and hypocalcemia developed in about 7% of preterm and 35% of full-term babies. There had been a statistical increase in serum vitamin D levels in preterm and full-term groups after 48 hours of phototherapy (45.89±20.70 and 45.89±14.88 respectively) than before phototherapy (42.57±18.79 and 44.05±18.50 respectively), p-value>0.05. It had been significant in the preterm group, p-value <0.05.

There was insignificant variation in total serum Ca regarding type of phototherapy in both preterm and full-term babies. Although ionized serum Ca was less in intensive phototherapy than conventional type in preterm group with p value < 0.05

Comparing CBC values before and 48 hours after phototherapy as shown in Table 3, hemoglobin level, reticulocyte, and platelet count were significantly decreased while both WBCs and lymphocyte count were significantly increased after 48 hours of phototherapy, both in preterm and full-term babies.

There was a mild positive correlation between WBC count and variation in total serum calcium (before and 48 hours after phototherapy) in preterm babies, (r=0.279, P value=0.038). There had been a mild negative correlation between birth weight & difference in ionized serum calcium (Before and 48 hours after phototherapy) in preterm, (r= -0.333, P value=0.012). There was a statistically moderate positive correlation between the duration of jaundice, DSB level, WBCs count, and differences in ionized serum calcium (before phototherapy and 48 hours after phototherapy) in preterm, (r=0.401, P value=0.004, r=0.701, P value<0.001, r=0.292, P value=0.029, respectively).

DISCUSSION

Hyperbilirubinemia is the foremost common abnormal physical finding within the first week of life in neonates and is watched in about 60% of term neonates and 80% of preterm newborn children. In Egypt, around 20.4% of neonates develop jaundice annually, the frequency of jaundice was found to be higher in low-birth-weight neonates (35.6%) compared with normal birth-weight newborn children (16.9%) [(14)]. Phototherapy is the foremost utilized intervention to treat and prevent severe jaundice. It decreases the hazard of exchange transfusion [(15)]. This common treatment brings down the serum bilirubin level by transforming bilirubin into water-soluble isomers that can be removed without conjugation within the liver [(16)]. However, this method of treatment had a few complications. Hypocalcemia is one of them [(7)].

The current prospective cohort study was conducted in our unit on neonates diagnosed with unconjugated hyperbilirubinemia and requiring phototherapy. The characteristics of the studied neonates showed that there was no variation regarding age, time of jaundice appearance, or type of delivery among preterm & full-term. Males were more than females in both preterm and full-term babies. Breastfeeding was more in full-term and bottle feeding in preterm group. Multiple pregnancies were more in preterm compared to full-term babies.

In agreement with our study, **Faulhaber et al.** [(5)] noted that there was a statistically insignificant difference between either group regarding gestational age and mode of delivery. **Yadav et al.** [(10)] found that most of their studied neonates were less than 5 days, with a mean age of 8.35±6.74 days, gestational age was 39.08±1.37 weeks, and mean duration of jaundice was 2.4±1.20 days.

Our study showed that there was a statistically significant difference between preterm & full-term regarding total and ionized serum calcium after 48 hours of phototherapy treatment in comparison to their levels before phototherapy, which was more in preterm than full-term group, with P value < 0.05.

In agree with our study, a study done by **Bahbah et al.** [14] in Egypt, **Wang et al.** [17]**,** they found that there was a highly statistically significant decrease in serum calcium levels after phototherapy as compared with its levels before phototherapy and this hypocalcemia was higher among the preterm than term neonates. **Basnet et al.** [18], **Khan et al.** [19], **Gaafar et al.** [20]**, Shahriarpanah et al.** [21] in Iran, **Eghbalian & Monsef.** [22]**, Arora *et al.*** [23]**, and Yadav et al.** [10] found that there was a significant decrease in calcium levels after phototherapy but the difference between our and their study was that they had measured the ionized calcium levels rather than total serum calcium levels. **Barak et al.** [24] showed that calcium level was reduced significantly, 24, 48, and 72 hours after phototherapy.

In our study, hypocalcemia was developed in 7% of preterm and 35% of full-term group. **Elshenawi et al.** [25] documented in their study that hypocalcemia increased from 12% in their cases pre-phototherapy to 38% after use of phototherapy and 28% of cases experienced symptoms (Jitteriness and convulsion). **Kargar et al.** [26] stated that hypocalcemia was developed in 39% of term and 53% of preterm neonates after being subjected to phototherapy for more than 48 hours. **Alizadeh-Taheri et al.** [27] in their case-control study**,** noted that hypocalcemia was found in 26**%** of their cases after 48 hours of phototherapy. **Sethi et al.** [28] **reported** that 90% of preterm infants and 75% of full-term infants during phototherapy developed hypocalcemia.

Romagnoli et al. [29] were the first to suggest the association of hypocalcemia in newborns following phototherapy. **Hankinson et al.** [30] hypothesized that phototherapy inhibits the secretion of melatonin from the pineal gland which blocks the effect of cortisol on bone calcium. Cortisol exerts a direct hypocalcemic effect by decreasing the absorption of Ca and PO_4 ions from the intestine by antivitamin D action and by increasing the renal excretion of these ions which also accelerates the bone uptake of calcium [31].

Kim and Park, [32] suggested that decreased secretion of parathyroid hormone is the cause of hypocalcemia in phototherapy. **Zecca et al.** [33] reported that administration of 25-hydroxy vitamin D3 was not able to lower the incidence of phototherapy-induced hypocalcemia in preterm infants. They concluded that vitamin D was unlikely to play an important role in the pathogenesis of phototherapy-induced hypocalcemia. In addition, urinary calcium excretion is increased after exposure to phototherapy [34]**.**

Hakanson et al. [30] reported that when young rats were exposed to white, fluorescent light, the serum concentration of calcium decrease. They showed that this calcium drop was accompanied by a decrease in serum melatonin concentration. This effect can be prevented by shielding the occiput, inhibiting corticosterone synthesis, and by administration of exogenous melatonin. They also reported that propranolol could reduce serum calcium by inhibiting the synthesis of melatonin.

The reason for a higher incidence of hypocalcemia in preterm infants may be due to higher penetration of light in premature infants, as reported by **Karamifar et al.** [35]**,** they reported that phototherapy-induced hypocalcemia in moderate premature neonates was more than in borderline premature neonates.

To prevent hypocalcemia within phototherapy, there are two suggestions: 1- oral calcium supplementation during phototherapy, 2- covering the head during phototherapy to prevent the reaching of light to the pineal gland and prevention of melatonin reduction, which eventually leads to the prevention of hypocalcemia [36]**.**

In our study, there was a statistical increase in serum vitamin D levels in preterm and full-term groups after 48 hours of phototherapy than before phototherapy, which was more significant in the preterm group, p-value < 0.05. In agreement with **Shahriarpanah et al.** [21]**,** they noticed that there was a significant increase in mean vitamin D level after phototherapy in addition to a significant decrease in the serum Ca level. **Gillies et al.** [37] in their study on 33 infants, plasma levels of vitamin D increased in 17-term and pre-term infants 48 hours after phototherapy, although the increase was not significant.

In our study, CBC values before and 48 hours after phototherapy showed that hemoglobin level, reticulocyte, and platelet count were significantly decreased while both WBCs and lymphocyte count were significantly increased after 48 hours of phototherapy, both in preterm and full-term babies. In agreement with our study, **Kurt et al.** [38] reported a significant rise in total WBC at 36 hours and 72 hours after phototherapy ($P < 0.05$), a drop of WBC to reach near normal levels occurred on day 7 after phototherapy was stopped. In contrast, the **Kurt et al.**, [38] study documented that hemoglobin levels and red blood cells did not have any significant effect ($P > 0.05$) all through the treatment period.

We found a positive correlation between WBCs count and differences in total and ionized serum Ca level before and 48 hours of phototherapy treatment. In addition, there was positive correlations between differences in ionized serum Ca and these variables; time of jaundice appearance and direct bilirubin level before phototherapy. **Jain et al., (39)** reported in their study that the prevalence of hypocalcemia was higher in patients with high concentrations of serum bilirubin. The difference, however, was not statistically significant. **Karamifaret al.,** [35] could not detect any correlation between hypocalcemia and serum bilirubin level. **Sreeram et al.** [40] noted that there was a statistically significant relation between Ca (post phototherapy) and duration of phototherapy ($p < 0.001$).

We found that birth weight and duration of phototherapy were correlated negatively to difference in ionized Ca level, but this correlation was insignificant in duration of phototherapy. **Basnet et al.** [18] showed insignificant negative correlation between the duration of phototherapy and hypocalcemia in term neonates during correlation analysis, (r of -0.043 and p=0.92). They indicated that the duration of phototherapy causes little or no significant hypocalcemia in term neonates before the discharge.

There was insignificant variation in total serum Ca regarding type of phototherapy in both preterm and full-term babies. Although ionized serum Ca was less in intensive phototherapy than conventional type in preterm group with p value < 0.05. No similar studies have been published to date that could determine the correlation between the type of phototherapy and hypocalcemia after 48 hours of phototherapy treatment.

Before concluding, some limitations to this study should not be ignored when the findings are interpreted, for example, the lack of a control group of healthy newborns. In addition to limited sample size, which also was limited to neonates at our NICU.

CONCLUSION

This study documented that phototherapy significantly affect serum Ca and vitamin D levels. Hypocalcemia is an important complication in neonates with unconjugated hyperbilirubinemia after continuous phototherapy and did not affect by type and duration of phototherapy.

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Table (1): Demographic characteristics of the studied neonates admitted to NICU

Variables	Preterm (n=56)	Full term (n=57)	P-Value*
Age (days)			
Mean ± SD	6.07±1.142	6.04±2.096	0.909**
Gender			
• Male	40 (71.4%)	30 (52.6%)	0.06*
• Female	16 (28.6%)	27 (47.4%)	
Weigh at birth (gm)	2077.41±365.07	2759.65±407.06	**<0.001****
Weight at study time (gram)	2080.86±362.49	2741.93±392.65	**<0.001****
Time of appearance of icterus (days)	3.55±0.76	3.88±1.59	0.172**
Type of delivery			
• Vaginal	11 (19.6%)	19 (33.3%)	0.099*
• CS	45 (80.4%)	38 (66.7%)	
Type of Feeding			
• Breast feeding	16 (28.6%)	40 (70.2%)	**<0.001***
• Bottle feeding	25 (44.6%)	10 17.5%)	
• Mixed feeding	15 (26.8%)	7 (12.3%)	
Maternal risk factors			
• Hypertension	15 (26.8%)	10 (17.5%)	0.237*
• Anemia	14 (25.0%)	10 (17.5%)	0.333*
• Multiple pregnancy	17 (30.4%)	5 (8.8%)	**0.004***
• Cardiac diseases	0 (0.0%)	2 (3.5%)	0.496*
Type of phototherapy			
• Conventional phototherapy	22 (39.2%)	19 (33.3%)	0.244 *
• Intensive phototherapy	34 (60.7%)	38 (66.7%)	
Duration of Phototherapy (hrs.) Mean ± SD			
• Conventional phototherapy	41.45±9.84	40.29±11.14	0.787**
• Intensive phototherapy	**13.47±7.63**	**15.26±6.14**	0.274**
• **P-Value**	**<0.001**	**<0.001**	

Data were expressed as frequency and % or mean ± SD.
*Chi square test /fisher exact test compare proportions between preterm and full-term
**Independent sample T test compare mean variation among preterm & full-term.
Significance considered when P value <0.05.

Table (2): Serum calcium (total and ionized) and vit D among preterm & full term before and after (48 hrs) phototherapy

Serum calcium	Preterm (n=56)	Full term (n=57)	P-Value*
Total serum calcium			
• Before phototherapy	9.68±1.31	9.95±1.67	0.360
• 48 hrs. after phototherapy	8.59±1.33	9.11±1.65	**0.014**
Difference (before-48 hrs.)	1.09±0.16	0.83±0.27	0.764
P-Value**	**0.001**	**0.004**	
Ionized serum calcium			
• Before phototherapy	1.10±0.14	1.29±0.16	0.261
• 48 hrs. after phototherapy	1.03±0.21	1.25±0.15	**0.043**
Difference (before-48 hrs.)	0.08±0.03	0.04±0.02	0.971
P-Value**	**0.005**	**0.05**	
48 hrs. after phototherapy			
• Normal Ca level	52 (92.9%)	44 (77.2%)	**0.033**
• Hypocalcemia	4 (7.1%)	20 (35.0 %)	
P-Value**	0.125	0.146	
Serum Vitamin D			
• Before phototherapy	42.57±18.79	44.05±18.50	0.755
• 48 hrs. after phototherapy	45. 89±20.70	45.89±14.88	0.999
P-Value**	**0.024**	0.278	
Total serum bilirubin (TSB)			
• Before phototherapy	14.98±1.60	17.13±3.45	**<0.001**
• At the end of phototherapy	6.68±1.48	7.54±1.70	**0.008**
• 48 hrs. after phototherapy	7.37±2.78	9.45±3.60	**0.001**
P-Value**	**<0.001**	**<0.001**	
Direct serum bilirubin (DSB)			
• Before phototherapy	0.48±0.38	0.53±0.34	0.259
• At end of phototherapy	0.57±0.29	0.58±0.36	0.557
• 48 hours after phototherapy	0.46±0.21	0.56±0.33	0.049
P-Value**	**0.041**	0.614	

Data had been expressed as mean ± SD.
*Independent sample T test compare mean difference among preterm & full-term
**Paired sample T test compare mean difference between same group.

Table (3): Complete blood count for preterm and full term before and 48 hours after phototherapy.

CBC	Preterm (n=56)	Full term (n=57)	P-Value*
Hgb			
▪ **Before phototherapy**	16.47±1.72	15.97±2.08	0.461
▪ **48 hrs. after phototherapy**	14.85±1.49	14.71±1.59	0.965
P-Value**	**<0.001**	**<0.001**	
WBC(x1000)			
▪ **Before phototherapy**	9.78±3.15	10.07±2.70	0.444
▪ **48 hrs. after phototherapy**	10.88±3.48	11.71±2.51	0.152
P-Value**	**0.003**	**<0.001**	
Lymphocytes%			
▪ **Before phototherapy**	55.93±16.25	58.68±14.22	0.614
▪ **48 hrs. after phototherapy**	59.68±14.32	60.48±13.57	0.941
P-Value**	**<0.001**	**0.038**	
Neutrophils%			
▪ **Before phototherapy**	33.43±15.57	34.50±30.76	0.683
▪ **48 hrs. after phototherapy**	31.49±13.73	29.48±11.36	0.695
P-Value**	0.108	0.773	
Platelets (x1000)			
▪ **Before phototherapy**	448.77±147.00	450.93±160.90	0.999
▪ **48 hrs. after phototherapy**	432.30±125.14	391.98±116.89	0.067
P-Value**	0.056	**0.001**	
Reticulocyte counts			
• **Before phototherapy**	2.69±1.11	3.14±2.57	0.227
• **48 hrs. after phototherapy**	1.57±0.27	1.51±0.67	0.827
P-Value**	**<0.001**	**<0.001**	
Types of Phototherapies	**Difference in total serum Ca before and after phototherapy**		
• **Conventional**	1.11±0.40	1.10±0.71	0.260
• **Extensive**	1.32±0.21	0.99±0.18	0.216
P-Value**	0.091	0.121	
Types of 1st Phototherapy	**Difference in ionized serum Ca before and after phototherapy**		
▪ **Conventional**	-0.02±0.03	0.68±0.67	0.581
▪ **Extensive**	0.13±0.04	-0.19±0.24	0.128
P-Value**	**0.002**	0.797	

Data had been expressed as mean ± SD.

*Independent sample T test compare mean difference among preterm & full-term

**Paired sample T test compare mean difference between same group.

Table (4): Correlation between difference in total serum calcium and other variables in preterm and full term

Variables	Difference in total serum calcium (Before phototherapy-48 hrs.)			
	Preterm (n=56)		Full term (n=57)	
	r	p	R	P
Weigh at birth (gm)	-0.028	0.837	-0.184	0.171
Time of jaundice appearance	0.163	0.231	0.058	0.667
TSB before phototherapy	-0.101	0.458	0.200	0.136
DSB before phototherapy	-.097	0.479	-0.017	0.988
Duration of phototherapy	-0.068	0.619	-0.002	0.988
Reticulocyte before phototherapy	-0.076	0.578	0.134	0.319
Hgb	0.156	0.249	-0.024	0.859
WBC(x1000)	**0.279**	**0.038**	0.118	0.380
PLT(x1000)	-0.180	0.184	-0.215	0.108
Lymph%	-0.209	0.125	-0.143	0.298
Neutrophils%	0.216	0.113	0.074	0.592

r: Spearman relationship coefficient, p: p value, significant <0.05

Table (5): Correlation between difference in ionized serum calcium and other variables in preterm and full term

Variables	Difference in ionized serum calcium (Before phototherapy-48 hrs.)			
	Preterm (n=56)		Full term (n=57)	
	r	P	R	p
Weigh at birth (gm)	**-0.333**	**0.012**	-0.215	0.109
Time of jaundice appearance	**0.401**	**0.004**	-0.010	0.942
TSB before phototherapy	0.179	0.186	0.100	0.460
DSB before phototherapy	**0.701**	**<0.001**	-0.116	0.391
Duration of phototherapy	-0.179	0.187	0.227	0.089
Reticulocyte before phototherapy	0.200	0.140	-0.079	0.561
Hgb	0.194	0.152	0.151	0.261
WBC(x1000)	**0.292***	**0.029**	-0.033	0.964
PLT(x1000)	-0.143	0.294	.163	0.225
Lymph%	-0.090	0.514	-0.151	0.272
Neutrophils%	-0.037	0.788	0.067	0.625

r: Spearman relationship coefficient, p: p value <0.05