SEASON OF BIRTH AND NEONATAL JAUNDICE

Tatyana ITOVA

University of Ruse ‘Angel Kanchev’, Bulgaria

Introduction

Neonatal jaundice (NJ) is a yellow coloration of the skin, mucous membranes, and sclera of the newborn (NB) because of increased levels of total bilirubin (BR). NJ affects at least 60% of full-term and 80% of preterm NBs. The level of total BR considered pathological for term NBs at values above 5 mg/dL (85.5 µmol/L) on the first day, 10 mg/dL (171 µmol/L) on the second day, above 12-13 mg/dL (205.2-222.3 µmol /L) on the third and every subsequent day. Although hyperbilirubinemia (HB) is usually a benign physiological condition, very high levels of BR can occur in certain pathological conditions and can cause damage to the central nervous system. Seasons of the year may influence the frequency and severity of neonatal HB.

Objective

To investigate the influence of annual seasons on the frequency and severity of NJ in full-term newborns.

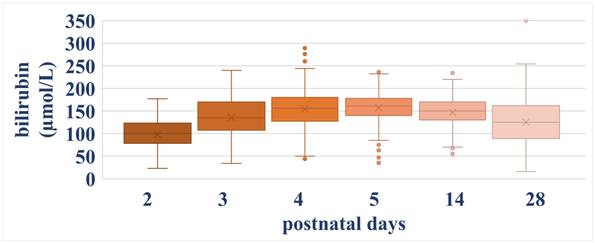

Fig.1. Mean levels of transcutaneous bilirubin by postnatal days in µmol/L

Material and methods

This study was conducted from January 2017 to November 2020 in Neonatology Department at the University Hospital "Medica Ruse". It includes 566 full-term newborns. The children included in the present observation are residents of Ruse and Ruse region, at the following geographical coordinates: 3° 51' 00" N/ 25° 58' 00" E. The average altitude of the region is 45 m. The average daily air temperature for the period 2017-2020 is lowest in January (-0.08ºC) and highest in August (23.38ºC). For the same period, the fluctuations of the average highest daily temperatures are between 21.5 and 44.7ºC. The average duration of sunshine is greatest in August – 10.5 hours, and the shortest in December – 2.8 hours. The amount of rainfall is highest in May-June – 71.9 L/m², and lowest in August – 29.7 L/m². BR was measured transcutaneously in µmol/L on the forehead of NB with bilirubinometer KJ-8000.

Table 1. Characteristics of the study population

	Total	Winter	Spring	Summer	Autumn	p
N	566	123	171	151	121	NS
Weight (g)	3316.3±385.5	3206.8±317.7	3346.4±356.4	3304.1±385.1	3368.0±450.1	NS
Gestational age (weeks)	38.8±1.1	38.8±1.1	38.7±1.1	38.8±1.1	38.7±1.1	NS
Gender ♀:♂(%)	48.8/51.6	53.0/47.0	40.9/59.1	51.8/48.2	50.4%/49.6	NS
PN/SC (%)	43.5 / 56.5	56.6 / 43.4	42.7 / 57.3	38.7 / 61.3	43.0 / 56.0	NS
Apgar 1st min	8.3±1.5	8.1±1.5	8.3±1.5	8.5±1.4	8.3±1.4	NS

Results

Randomized in the study were 566 newborn children, of which 274 (48.4%) were girls and 292 (51.6%) were boys. Average weight of the observed group was 3316.3±385.5 g. The average gestational age was 38.8±1.1 weeks. There were no significant differences in birth weight, gestational age, mechanism of birth, Apgar score on the 1st minute in distribution of children according to birth season. (Table 1)

The average values of BR from the 2nd to the 5th postnatal days are respectively: 135.5±40.5 µmol/L, 154.4±38.8 µmol/L, 157.2±32.6 µmol/L, 147.3±31.1 µmol/L for the whole group. Pathological NJ occurs on the second postnatal day in 15.5% of children with a tendency to decrease in the following days - 10% on the third, 4.1% on the fourth and 2.3% on the fifth postnatal day. As of Day 14, the average level of BR was 125.3±49.5 µmol/L and 12% of the whole group had HB. As of Day 28, the average level of BR was 77.6±45.6 µmol/L of which 82 children or 14.5% of the whole group had HB(Figure 2).

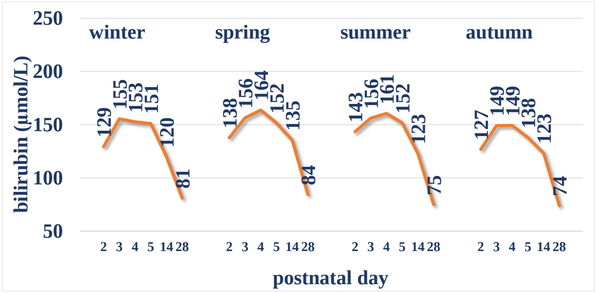

Fig. 2. Mean levels of total bilirubin in newborns in the observed population according to birth season

When Comparing average BR levels, we found a significant difference depending on the birth season for the period from the 2nd to the 5th postnatal day. Children born in summer have the highest average levels of BR, followed by those in spring. The lowest values are those born in the autumn. By the 14th and 28th day, the highest levels are those born in the spring, and for the 28th day this difference is significant (Figure 2).

In the observed group of 566, NBs 82 children (14.5%) were found with Prolongated NJ (PrNJ). The largest number of them were born in summer – 37%, followed by those in autumn – 23%, winter – 22% and the smallest number in spring – 19% (p<0.001) (Figure 3A). By Day 28, a statistically significant difference was reported between the average levels of the BR of those born in summer (155.4±31.8 µmol/L) and autumn (134.4±19.9 µmol/L) (p=0.018). In the duration of PrNJ according to the season of birth, a statistically significant difference was also found: the longest is the icterus of those born in summer (64.7±15.2 days) and there is a statistically significant difference with those born in winter (53.8±11.1 days, p=0.018) and autumn (55.0±10.5 days, p=0.008) (Figure 4).

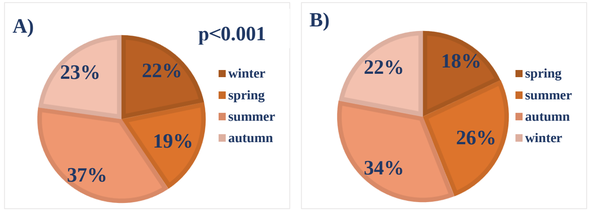

Fig. 3. A)Distribution of newborns with prolonged neonatal jaundice according to season of birth; B) Frequency of pathological neonatal jaundice according to season of birth

In 34% of NBs born in summer, jaundice was pathological, while in the other seasons the frequence of pathological jaundice was lower, the lowest in winter (for spring - 26%, for autumn - 22%, and for winter - 18%) (Figure 3B).

A stepwise analysis was conducted by multiple linear regression to assess the impact of the independent variables average monthly temperature (in ºC), maximum monthly temperature (in ºC), average rainfall for a month (in L/m²) and monthly sunshine duration (in hours) on BR levels by postnatal days (Table 2). A significant influence of their combination on the values of BR at NB were found on Day 4 (p=0.014), Day 5 (p=0.016) and Day 14 (p=0.004). An independent role is played by the monthly average temperature on the values of BR for Day 4 (p=0.052), Day 5 (p=0.005) and Day 14 (p=0.002). For Day 4, 5 and 14, a positive linear relationship between these two factors was found, while for Day 28 it was inverse. A similar regularity was found between maximum monthly temperature and BR levels for the same days.

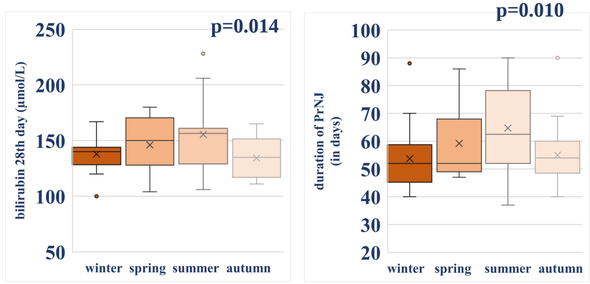

Fig. 4. Transcutaneous bilirubin (µmol/L) levels at Day 28 and duration of prolonged neonatal jaundice (PrNJ) by birth seasons

Duration of sunshine also has an individual influence for the levels of BR (on Day 4 – p=0.037 and Day 5 – p=0.002) (Tab. 4). The amount of rainfall plays a significant independent role on the value of BR (on Day 5 – p=0.018, and Day 14 – p=0.034). A straight linear relationship is observed on Day 28 and Day 14, while it is reversed on Day 4.

Table 4. Multiple linear regression between bilirubin levels on Day 4, Day 5, Day 14 and month of birth, average monthly temperature, maximum monthly temperature, mean rainfall per month, monthly sunshine (from https://www.stringmeteo.com)

	factors	F	p	R²	p
Day 4	total factors	2.882	0.014	0.039	
	average monthly temperature				0.052
	duration of sunshine				0.037
Day 5	total factors	2.87	0.016	0.064	
	average monthly temperature				0.005
	rainfall for a month				0.018
	duration of sunshine				0.002
Day 14	total factors	3.502	0.004	0.048	
	average monthly temperature				0.002
	rainfall for a month				0.034

Conclusion

For the first time in Bulgaria, an attempt was made to assess the impact of the birth season on the manifestation of the NJ. Our observations suggest that the birth season along with meteorological factors affects the frequency of pathological NJ. The present study focuses only on climatic factors, and the NJ is a multifactorial condition. Several pre-, intra- and postnatal factors influence the metabolism of BR.

taniaitova@abv.bg