



Characteristics of Neonatal Intracranial Hemorrhage at RSUP Haji Adam Malik during the Year 2022-April 2025

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ABSTRACT

Introduction: The neonatal state is a vulnerable period where rapid physiological transitions happen. In Indonesia, in the year 2020, the Infant Mortality Rate was 19.83 per 1,000 live births, including a Neonatal Mortality Rate of 9.30. This state is also a part of the critical period of a postnatal brain development. Disruption to the brain during this time window can cause problems in the neurodevelopmental process. One of the examples being intracranial hemorrhage in neonates, which the true prevalence and incidence rates of are unclear, but which have high mortality and morbidity rates. The objective this study is to determine the characteristics of neonatal intracranial hemorrhage at Haji Adam Malik General Hospital in 2022- April 2025.

Methods:

Results: This study used a descriptive design through a retrospective cross- sectional study and a sample of neonates with intracranial hemorrhage at Haji Adam Malik General Hospital through saturated sampling. It was found that incidence rate was 6.24 per 100, with the most common bleeding location being intraventricular 25 (89.3%), the majority of neonates were premature, namely 19 (67.9%), low birth weight 19 (67.9%), the most common symptoms were seizures and respiratory distress 15 (53.6%), and 11 (39.3%) neonates made a good recovery.

Conclusion:

Keyword: Neonate, Intracranial Hemorrhage, NICH, Intraventricular Hemorrhage.



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1. Introduction

The neonatal period is a more vulnerable stage of life which experiences a rapid physiological transition from life intrauterine to extrauterine, as seen in respiratory and circulatory systems, which occurs in just a couple of minutes and can affect other systems. Furthermore, a lot of important physiological functions are immature during this period, which includes the hormonal and neurogenic control systems of the body, metabolic and liver functions that influence glucose levels and blood

clotting factors [1]. Nutritional insufficiencies can also occur, the most common being vitamin K deficiency of which it plays a part in activating blood clotting factors [2].

In Indonesia during 2020, the infant mortality rate was 19.83 per 1,000 live births, including an Infant Mortality Rate of 16.85 and a Neonatal Mortality Rate of 9.30 [3]. This figure is still above the most recent predicted target of the Indonesian SDGs roadmap [4,5]. In North Sumatra during the same year, the Infant Mortality Rate was 18.28 per 1,000 live births. This figure is higher than the national average [6]. The most common reasoning being from low birth weight (LBW) and prematurity, asphyxia, perinatal complications, infections, and sepsis, many of which are preventable deaths [7].

The critical period in the postnatal brain development, both anatomically and functionally, is the first 1,000 days or three years since said birth [8]. A disruption to the brain during this time window could cause significant problems in a person's neurodevelopmental process, the extent of which is determined by the level of maturity of the brain, the location and size of the lesion, the cause, and other underlying diseases [9].

A potential contributing factor could be neonatal intracranial hemorrhage, which the actual prevalence and incident rate still remain unclear, but has a high known mortality and morbidity rate [10]. In Indonesia itself, national figures for intracranial hemorrhage, particularly in neonates, have not been obtained. A systematic review and meta-analysis by Datta D et al. found that 29.8% of symptomatic neonates and 5.8% of asymptomatic neonates had intracranial hemorrhage [11]. Another systematic review by Siffel C et al. reported a global incidence range of 5-52% for intraventricular hemorrhage, a type of intracranial hemorrhage that's more common among neonates than the other variety [12].

Due to the lack of data in Indonesia, including in the North Sumatra Province, regarding intracranial hemorrhage, especially in neonates, this study aims to record a descriptive look on neonatal intracranial hemorrhage (NICH) and will be conducted at Haji Adam Malik General Hospital, Medan, a top referral hospital in North Sumatra.

2. Methods

The data for this study was taken from the medical records of Haji Adam Malik General Hospital from 2022 to April of 2025. It uses a descriptive design through a retrospective cross-sectional study. The variables of which are incidence, sex, hemorrhage location, hemoglobin level, platelet count, prothrombin time (PT), activated partial thromboplastin time (APTT), antenatal care, birth history, symptoms, etiology of hemorrhage, and Glasgow outcome scale (GOS). All of which are taken pre-operation or before the definitive procedure, except the Glasgow outcome scale. The edited and coded data was processed in SPSS 26th edition.

3. Results

A total of 28 neonates were documented for this study, which looked into the neonatal intracranial hemorrhages in Haji Adam Malik General Hospital. By sorting the total count of neonate cases from 2022 up to April 2025, an estimated number of 449 neonates were deemed at risk. The numbers from the years 2022, 2023, 2024, and January-April 2025 are as follows: 141, 126, 127, 55.

Table 1. Case distribution of neonatal intracranial hemorrhage

Year	Frequency	Percentage (%)
2022	8	28.6
2023	11	39.3
2024	8	28.6

April 2025	1	3.6
Total	28	100.0

Based on table 1, the highest count of cases was in 2023 with 11 cases (39.3%), followed by 2022 and 2024 with a tie of 8 cases (28.6%), and the lowest count on 2025, of which at the time was just up to a third of the year, being 1 case (3.6%).

Using the incidence rate formula:

$$\begin{aligned} \text{Incidence Rate} &= \frac{\text{New cases in population}}{\text{Population at risk over a specific period of time}} \times 100\% \\ &= \frac{28}{449} \times 100\% \end{aligned}$$

It was found that during the year 2022-April 2025, the number of incidences was 28 and the incidence rate was 6.24% (6.24 per 100 neonates) in Haji Adam Malik General Hospital.

Table 2. Distribution of patients based on their characteristics

	Frequency	Percentage (%)
Sex		
Male	18	64.3
Female	10	35.7
Method of birth		
Vaginal delivery	8	28.6
Caesarean section	20	71.4
Assisted vaginal delivery	0	0.0
Gestational age		
Preterm	19	67.9
Term	9	32.1
Birth weight		
Low	19	67.9
Normal	9	32.1
1-minute Apgar Score		
Normal	7	25.0
Moderate asphyxia	16	57.1
Severe asphyxia	5	17.9
5-minute Apgar score		
Normal	16	57.1
Moderate asphyxia	12	42.9
Severe asphyxia	0	0.0

Table 2 showed that a majority of the patients were male, it being 18 neonates (64.3%) with only 10 neonates (35,7%) being female. Most of the patients were delivered through a caesarean section, 20 neonates (71.4%) whereas through vaginal delivery there 8 neonates (28.6%) and no assisted vaginal delivery. Based on gestational age there are 19 neonates (67.9%) that are premature and 9 (32.1%) that are full term. Although the numbers are the same based on birth weight, which are 19 neonates (67.9%) with low birth weight and 9 (32.1%) with normal weight, they do not all overlap. The Apgar score during the first minute has majority of the patients with moderate difficulty in breathing being 16 neonates (57.1%), followed by 7 neonates (25.0%) with normal breathing and 5 neonates (17.9%) with severe difficulty in breathing. As for the fifth minute that number has gone

down to 12 neonates (42.9%), with 16 neonates (57.1%) now breathing normally and no longer any with severe difficulty in breathing.

Table 3. Laboratory results of the patients

	Frequency	Percentage (%)
Hemoglobin		
Anemia	6	21,4
Normal	16	57,1
Erythrocytosis	6	21,4
Platelet		
Thrombocytopenia	14	50,0
Normal	13	46,4
Thrombocytosis	1	3,6

Table 3 showed that the hemoglobin level for 16 neonates (57.1%) are normal, with 6 neonates (21.4%) each being anemic and having erythrocytosis. As for the platelet count, there were 14 neonates (50%) with thrombocytopenia, similar to the amount of 13 neonates (46.4%) with a normal platelet count, and the least being 1 neonate (3.6%) with thrombocytosis. Of the lab results, it's noticeable that both the PT and APTT numbers only total up to 19. This is because unfortunately there were 9 cases that did not have PT and APTT listed. From the ones that are there, the numbers are also different from the guide used [13]. The prothrombin time has 10 neonates (52.6%) with a normal value and 9 (47.4%) with a prolonged time; the activated partial thromboplastin time has 17 neonates (89.5%) with a normal value and 2 (10.5%) with a prolonged time.

Table 4. Distribution of characteristics related to the hemorrhage

	Frequency	Percentage (%)
Location		
Intraparenchymal	3	10.7
Multiple	1	3.6
Intraventricular	24	85.7
Grade I	7	25.0
Grade II	10	35.7
Grade III	6	21.4
not Graded	2	7.1
Symptoms	0	0
Asymptomatic		
Seizure	15	53.6
Vomiting	2	7.1
Irritability	4	14.3
Enlarged fontanel	2	7.1
Pallor	11	39.3
Lethargy	11	39.3
Respiratory distress	15	53.6
Impaired consciousness	8	28.6
Etiology	19	67.9
ICH with prematurity		
Bleeding disorder	6	21.4
Infection	16	57.1

Vascular malformation	1	3.6
Idiopathic	3	10.7

Table 4 showed that based on the location of hemorrhage, the majority were in the intraventricular space with 24 cases (85.7%) total, the grading of which vary with grade I being 7 neonates (25.0%), grade II being 10 neonates (35.7%), grade III being 6 neonates (21.4%), and 2 (7.1%) being ungraded. The symptoms are listed fully as there weren't a way to differentiate which ones were more prominent and most if not all of the patients showed more than one symptom, the most common of which being seizures and respiratory distress each being 15 (53.6%), followed by pallor and lethargy 11 each (39.3%). A majority of the cause of hemorrhage being related to prematurity, 19 neonates (67.9%), and infections, 16 neonates (57.1%).

Table 5. Glasgow Outcome Scale distribution of patients

GOS Score	Frequency	Percentage (%)
Good recovery	11	39.3
Moderate disability	7	25.0
Severe disability	1	3.6
Death	9	32.1

Table 5 showed that about two-fifths of the patients made a full or decent recovery being 11 neonates (39.3%) whereas most patients didn't, of listed being 7 neonates (25.0%) with moderate disability, 1 (3.6%) with severe disability, and 9 neonates (32.1%) died.

4. Disucssion

This study looked into the medical records of the 28 documented neonates with intracranial hemorrhage treated in Haji Adam Malik General Hospital during 2022-April 2025. It had also sorted out 449 at-risk neonates from the total neonates that had undergone treatment, was born in, was transferred to, or was documented in the aforementioned hospital. And from there, the incidence rate of 6.24% in the Haji Adam Malik General Hospital was found. This rate seemed to match the global reported incidence range in the systematic review by Siffel C et al. of 5-52% for intraventricular hemorrhage [12]. However, it is important to note that this study is only done in one hospital, being a referral hospital of the province, and so in a larger population the rate might be different.

From the 28 neonates, there were 18 boys (64.3%) and 10 girls (35.7%). The number of boys were almost double the number of girls. A study done by Hanifa et al. had also procured a similar result, it even being slightly more than double the number [14]. It was also found that a majority of the patients were born through the caesarean section, it being 20 neonates (71.4%), only 8 neonates (28.6%) were delivered vaginally, and no instrumentally assisted deliveries were done. In theory, vaginal deliveries, especially prolonged ones and those assisted with vacuums or forceps, increase the risk of neonatal intracranial hemorrhage [15]. In this study, some indications for caesarean delivery included previous SC, preeclampsia, infection, and premature rupture of membranes. From the whole neonate population analysis of the neonates who had been treated at Haji Adam Malik General Hospital, along with the neonates that were not deemed at-risk, most were born through the caesarean section. From 2022 to April 2025, approximately 1,483 neonates had been treated at said hospital, 1,012 of whom were born by caesarean section, either directly at the hospital itself or had been a referral from other health facilities. This number greatly exceeds the number of vaginal

deliveries, with a ratio of 7:3 between CS to SVD (spontaneous vaginal delivery) plus assisted deliveries. This is likely because of the hospital's status as a referral center in North Sumatra, so the profile of neonates requiring its care is generally going to be different from the ones in other healthcare facilities.

As mentioned briefly before, 19 neonates (67.9%) were born prematurely, twice as many as full-term ones being 9 neonates (32.1%). The average gestational age was seen to be 32.5 weeks, with the youngest at 21 weeks and the oldest at 39 weeks. Of the 19 born preterm, 4 were very premature, namely under 28 weeks [16]. A sizeable portion of neonates in the sample, 19 neonates (67.9%) were also born with low birth weight, with the average weight of the collective being 1,949 kg and the median was 1,505kg. The highest obtained weight was 4,000 kg which is the upper limit of a normal birth weight and the lowest obtained weight was 860 kg. Although the number of LBW and preterm are the exact same and there is a lot of overlap between the two, not all neonates with a low birth weight in the sample are prematurely born. In the study by Hanifa et al., it was found that most neonates of their sample were born normal or overweight, while in the study by Hong and Lee, whose sample is different from this study and only specifically focuses on term neonates, the average also has a normal birth weight [10,14].

Most of the Apgar scores were written directly in the medical record, but some were interpreted from written narratives. The 1-minute Apgar score indicated that 16 neonates (57.1%) had moderate asphyxia and 5 neonates (17.9%) had severe asphyxia. The 5-minute Apgar score showed significant improvement, with more neonates breathing normally, 16 patients (57.1%), then those with difficulty breathing: 12 patients (57.1%) had moderate asphyxia and there were no longer any who has severe asphyxia. The average score of the 1st and 5th minute respectively were 5.29 and 6.75, both having fallen under the moderate asphyxia category though the 5th minute leaned more heavily onto a normal category, and their standard deviations are 1.843 and 1.295 respectively. In a study by Hong and Lee, the 1-minute and 5-minute Apgar scores were 6.7 and 8.0 respectively [10], both much higher than the ones obtained in this study. The mode of the 1-minute Apgar score was 6 and the 5-minute score was balanced between 6, 7, and 8. The smallest number at the first minute was flat out 0 and the largest was 8, whereas smallest number at the fifth minute of 4 was closer to the largest number of 9.

Some patients underwent periodic laboratory tests for monitoring resulting in multiple results. However, the results used in this study were the first obtained before or shortly after the patient was diagnosed with intracranial hemorrhage. Based on hemoglobin, a little more than half the patients, 16 neonates (57.1%), had normal hemoglobin levels. This might be because it was noticed before the levels had dropped significantly as when you do follow the progression, the subsequent results did tend to decrease, some even to the point of developing anemia. The number of cases with anemia and erythrocytosis are similar. This could be due to technical issues such differences in reference ranges between laboratories and the Indonesian population profile compared to the reference ranges used in the study [17]. The ranges used in the study were 11.6-16.6 g/dl for males and 11.6-16.4 g/dl for females, both of which included premature infants. The laboratory ranges did not differ between males and females, but did differ in gestational ages, with 17-22 g/dl for preterm neonates and 10.3-17.94 g/dl for term neonates. The average hemoglobin was 14.01, which is considered normal within the research range, but within the laboratory range for preterm neonates is considered anemic. The variance between the lowest and highest hemoglobin values was also large, at 8.6 g/dl and 21.7 g/dl. Half the cases presented with thrombocytopenia, 14 neonates (50%), and that number is quite even with the normal platelet count of 13 neonates (46.4%). Some counts of which went down on repeated tests. There was also one case which had thrombocytosis although their APTT and PT were found to

be prolonged. This neonate in particular was also tested for other coagulation factors and was confirmed to be deficient. The platelet count mean was 153,071.43 with a median of 128,500. The highest count was the case with thrombocytosis being 452.000 and the lowest count was a 9,000.

Of the 28 cases, there were nine without PT or APTT readings leaving the valid amount to be 19, and the laboratory standard numbers themselves differed significantly from the guideline used. By the guideline calculations, prolonged PT was found in only 9 neonates (52.6%) out of 19, while APTT was even lower, with only two neonates (10.5%). The normal PT range according to the guide used was 10.6-16.2 seconds, while most of the control results in the laboratory were around 11-13 seconds. Similarly, for APTT, the normal range according to the guide is 53.6-79.4 seconds and for term neonates is 34-51.2 seconds, while controls, both preterm and term, had values around 23-35 seconds. By using the numbers provided by the controls from the laboratory in the medical records, prolonged PT and APTT were found in 16 (84.2%) out of 19 cases, with only one neonate having both normal PT and APTT. In the study done by Hanifa et al. which was specifically on vitamin K deficiency related intracranial hemorrhages, it was found that the majority, respectively 2:1 and 3:1, had prolonged PT and APTT, and in these cases the average platelet count was within the normal range [14]. The average PT value was 23.4 seconds, with a median of 16.2 seconds, while the average APTT value was 52.1 seconds, with a median of 40.7 seconds. The smallest PT value was 11.3 seconds and the largest was over 80.0 seconds; the smallest APTT value was 28.9 seconds and the largest was over 120.0 seconds.

Based on the location, the most common place of the hemorrhage was intraventricular which was found in 24 cases (85.7%). There was also one case of overlap between multiple hemorrhages, which had subarachnoid, intraparenchymal, and intraventricular hemorrhages. Variation in the study was primarily found in the degree of bleeding, the most cases being grade II bleeding with 10 neonates (35.7%). Interestingly, this was followed by grade I with 7 neonates (25.0%) when usually the majority of grade I intraventricular cases are asymptomatic and therefore go unnoticed [12]. Intraventricular hemorrhages being the highest among the other locations matches the known theory that the most common hemorrhage location in preterm neonates are intraventricular, particularly in the germinal matrix (GMH-IVH) [18], of which fits many of the neonates in the sample's profiles. The bleeding was also more localized in a single site with the exception of the one multiple hemorrhage case, in contrast to the study on ICH and vitamin K deficiency by Hanifa et al. which was dominated by multiple hemorrhage cases [14]. Neither epidural nor subdural hemorrhage was found. This may be due to the cases being non-traumatic, whereas the main cause of epidural and subdural bleeding is trauma—both in the birth canal and outside of it, deliberate or accidental—and surgery [10,19].

The table about the symptoms, as mentioned, was compiled differently from the other data and features multiple responses for the same patients. This was because based on the information provided, it was impossible to distinguish the more prominent symptoms and besides that it was decided that all experiences were to be recorded. Therefore, the total largely exceeds 100%. In terms of symptoms, the most common were cases of seizures and respiratory distress, each experienced by 15 patients (53.6%), some of which also overlapped. Respiratory distress itself is not specific to intracranial hemorrhage; seizures can be more indicative of neurological symptoms. The most common combination of symptoms was seizures, respiratory distress, and/or pallor. Most patients (96.4%) had more than one symptom, none of which were asymptomatic. From the study by Hanifa et al., the clinical manifestations were fairly uniform, with seizures and a bulging fontanel being the most common, followed by pallor and then vomiting [14].

A majority of the cases remained to be those that were associated with prematurity (67.9%), and the second most common case was infection, involving 16 neonates (57.1%). The samples obtained showed that the bleeding (GMH-IVH) they experienced corresponded to the type of bleeding often experienced by premature neonates [18]. Some of the patients had experienced infections before birth. Some patients developed sepsis several days later. Bleeding disorders were found in the form of persistent thrombocytopenia and a lack of coagulation factors, one of which was confirmed by coagulation factor testing. There were 3 cases (10.7%) in which no proper cause was found.

Of those 28 neonates, most did not recover well, including 7 with moderate disability (25.0%), 1 with severe disability (3.6%), and 9 deaths (32.1%). Patients who recovered well or decently with mild complications were 11 neonates (39.3%). From the study by Hanifa et al., most of the patients (87.5%) survived after treatment without further information on how well they recovered [14].

5. Conclusion

Based on this study, in the Haji Adam Malik General Hospital, it was found that the incidence of intracranial hemorrhages in neonates was 28 neonates and the incidence rate was 6.24%. Based on sex, there were 18 male neonates (64.3%) and 10 female neonates (35.7%). Based on the history of the birth, the method of delivery were 8 neonates through vaginal delivery (28.6%) and 20 neonates through caesarean section (71.4%); the gestational age were 19 preterm neonates (67.9%) and 9 term neonates (32.1%); the birth weight were 19 neonates with low birth weight (67.9%) and 9 neonates with normal birth weight (32.1%); the 1- minute Apgar score were 7 neonates with normal breathing (25.0%), 16 with moderate asphyxia (57.1%), and 5 neonates with severe asphyxia (17.9%); the 5-minute Apgar score were 16 neonates with normal breathing (57.1%) and 16 with moderate asphyxia (57.1%).

Based on the lab results, for the hemoglobin level, there were 6 anemic neonates (21.4%), 16 neonates with normal hemoglobin levels (57.1%), and 6 neonates with erythrocytosis (21.4%); the platelet count were 14 neonates with thrombocytopenia (50.0%), 13 neonates with a normal thrombocyte level (46.4%), and 1 neonate with thrombocytosis (3.6%); PT were normal in 10 neonates (52.6%) and prolonged in 9 neonates (47.4%); APTT were normal in 17 neonates (89.5%) dan prolonged 2 neonates (10.5%).

On the things directly relating to the NICH itself, the location of hemorrhage are divided into mostly 24 neonates with intraventricular (85.7%), 3 neonates with intraparenchymal (10.7%) and 1 neonate with multiple locations (3.6%); the most common symptoms being seizures and respiratory distress, 15 neonates each (53.6%), followed by pallor and lethargy, 11 neonates each (39.3%), and 8 neonates with impaired consciousness (28.6%). The most common etiologies are ICH in relation to prematurity with 19 neonates (67.9%) and infection with 16 neonates (57.1%).

References

- [1] Guyton AC, Hall J. Guyton and Hall Textbook of Medical Physiology 14th Ed. 14th ed. Philadelphia: Elsevier; 2021.
- [2] Hand I, Noble L, Abrams SA, Cummings JJ, Aucott SW, Goldsmith JP, Hand IL, Puopolo KM, Adams-Chapman IS, Kaufman DA, Martin CR, Couto J. Vitamin K and the Newborn Infant. *Pediatrics* 2022;149. <https://doi.org/10.1542/peds.2021-056036>.
- [3] Badan Pusat Statistik. Hasil Long Form Sensus Penduduk 2020. Berita Resmi Statistik No. 09/01/Th. XXVI. 2023.

- [4] Alisjahbana ASalsiah, Murniningtyas Endah. Tujuan pembangunan berkelanjutan di Indonesia : konsep, target, dan strategi implementasi. Unpad Press; 2018.
- [5] Bappenas. Peta Jalan SDGs Indonesia Menuju 2030. 2021.
- [6] Badan Pusat Statistik. Angka Kematian Bayi/AKB (Infant Mortality Rate/IMR) Menurut Provinsi , 1971-2020. 2023.
- [7] Rosa-Mangeret F, Benski AC, Golaz A, Zala PZ, Kyokan M, Wagner N, Muhe LM, Pfister RE. 2.5 Million Annual Deaths—Are Neonates in Low-and Middle-Income Countries Too Small to Be Seen? A Bottom-Up Overview on Neonatal Morbi-Mortality. *Trop Med Infect Dis* 2022;7. <https://doi.org/10.3390/tropicalmed7050064>.
- [8] Cusick SE, Georgieff MK. The Role of Nutrition in Brain Development: The Golden Opportunity of the “First 1000 Days.” *J Pediatr* 2016;175:16–21. <https://doi.org/10.1016/J.JPEDS.2016.05.013>.
- [9] Tan AP, Svrckova P, Cowan F, Chong WK, Mankad K. Intracranial hemorrhage in neonates: A review of etiologies, patterns and predicted clinical outcomes. *European Journal of Paediatric Neurology* 2018;22:690–717. <https://doi.org/10.1016/J.EJPN.2018.04.008>.
- [10] Hong HS, Lee JY. Intracranial hemorrhage in term neonates. *Child’s Nervous System* 2018;34:1135–43. <https://doi.org/10.1007/s00381-018-3788-8>
- [11] Datta D, Chisvin R, Tu A. Prevalence, type, and risk factors of intracranial hemorrhage in term neonates: a systematic review and meta-analysis. *Child’s Nervous System* 2025;41:32. <https://doi.org/10.1007/s00381-024-06688-y>.
- [12] Siffel C, Kistler KD, Sarda SP. Global incidence of intraventricular hemorrhage among extremely preterm infants: A systematic literature review. *J Perinat Med* 2021;49:1017–26. <https://doi.org/10.1515/jpm-2020-0331>.
- [13] American Academy of Pediatrics. Reference Range Values for Pediatric Care. American Academy of Pediatrics; 2019.
- [14] Hanifa R, Syarif I, Jurnal YD. Gambaran Perdarahan Intrakranial pada Perdarahan akibat Defisiensi Vitamin K (PDVK) di RSUP Dr. M. Djamil. vol. 6. 2017.
- [15] Gupta SN, Kechli AM, Kanamalla US. Intracranial Hemorrhage in Term Newborns: Management and Outcomes. *Pediatr Neurol* 2009;40:1–12. <https://doi.org/10.1016/j.pediatrneurol.2008.09.019>.
- [16] de Costa A, Moller AB, Blencowe H, Johansson EW, Hussain-Alkhateeb L, Ohuma EO, Okwaraji YB, Cresswell J, Requejo JH, Bahl R, Oladapo OT, Lawn JE, Moran AC. Study protocol for WHO and UNICEF estimates of global, regional, and national preterm birth rates for 2010 to 2019. *PLoS One* 2021;16. <https://doi.org/10.1371/journal.pone.0258751>.
- [17] Timbrell NE. The Role and Limitations of the Reference Interval Within Clinical Chemistry and Its Reliability for Disease Detection. *Br J Biomed Sci* 2024;81. <https://doi.org/10.3389/bjbs.2024.12339>.
- [18] Parodi A, Govaert P, Horsch S, Bravo MC, Ramenghi LA, Agut T, Alarcon A, Arena R, Bartocci M, Bravo M, Cabañas F, Carreras N, Claris O, Dudink J, Fumagalli M, Govaert P, Horsch S, Parodi A, Pellicer A, Ramenghi LA, Roehr CC, Steggerda S, Valverde E. Cranial ultrasound findings in preterm germinal matrix haemorrhage, sequelae and outcome. *Pediatr Res* 2020;87:13–24. <https://doi.org/10.1038/s41390-020-0780-2>.
- [19] Huseynov O, Huisman TA, Hassan AS, Huseynova RA. Intracranial Hemorrhage in Neonates: Causes, Diagnosis, and Management. *Newborn* 2024;3:111–23. <https://doi.org/10.5005/jp-journals-11002-0097>.