The Relationship Between Infant Birth Weight, Gestational Age, and Hyperbilirubinemia Incidence in Neonates

Cornelius Steve[1], Dwi Hidayah[2], Irfan Dzakir Nugroho[2], Andhika Trisna Putra[2]

[1]Student of Medical Study Program, Faculty of Medicine,
Universitas Sebelas Maret, Surakarta, Indonesia
[2]Department of Pediatric, Dr. Moewardi Hospital, Surakarta,
Faculty of Medicine, Universitas Sebelas Maret, Surakarta, Indonesia

ABSTRACT

Background: Neonatal hyperbilirubinemia is an occurrence where a serum bilirubin value of 5-10mg/dL is obtained and is characterized by jaundice in newborns. This occurrence can be influenced by several factors, one of which is the birth weight of the baby <2,500 grams which is called Low Birth Weight (LBW). The incidence of LBW can be influenced by maternal age, infections that occurred before pregnancy, and one of them is gestational age LBW it self is one of the most critical health problems in various countries. Therefore, researchers are interested in finding the relationship between infant birth weight and gestational age with the incidence of neonatal jaundice.

Subjects and Method: This was a cross-sectional study conducted in Rumah Sakit Umum Daerah Dr. Moewardi on Surakarta. The subjects of this study were 89 neonates who were included in the criteria. The population of this study were neonates with hyperbilirubinemia. Sampling was carried out retrospectively using patient medical records from January to December 2021, using purposive sampling technique. The dependent variable was incidence of hyperbilirubinemia. The independent variables were low birth weight and gestational age. The data were then processed using SPSS version 26 and analyzed using the chi-square test.

Results: LBW and preterm increased the incidence of neonatal hyperbilirubinemia in neonates. Infants with LBW increased neonatal hyperbilirubinemia by 2.34 times compared to adequate birth weight, and this result was statistically significant (OR = 2.34; 95% CI = 1.58 to 3.47; p<0.001). Preterm infants increased neonatal hyperbilirubinemia by 2.55 times compared to term, and this result was statistically significant (OR = 2.55; 95% CI = 1.68 to 3.58; p <0.001).

Conclusion: There is an important correlation between infant birth weight and gestational age with the incidence of hyperbilirubinemia in neonates in the perinatology room at Rumah Sakit Umum Daerah Dr. Moewardi, Surakarta.

Keywords: low birth weight, neonate hyperbilirubinemia, gestational age.

Correspondence:
Dwi Hidayah, Department of Pediatrics, Faculty of Medicine, Universitas Sebelas Maret. JL. Ir. Soetami No. 36A, Surakarta 57126, Indonesia. E-mail: hidayahdwi2@gmail.com

BACKGROUND

Neonatal hyperbilirubinemia is an event in newborns where a serum bilirubin value of 5-10mg/dL is obtained which is characterized by jaundice. It usually occurs in the first perinatal week which is often called physiological jaundice neonatorum (Andesty et al., 2018). It can be influenced by several factors, including a history of asphyxia, hypoxia, infection, head trauma, hypoglycemia, and one of them is the birth weight of the baby <2,500 grams. Neonatal hyperbilirubinemia is a frequent cause of perinatal birth. Approximately 30-50% of newborn cases experience jaundice neonatorum (Setiati and Rahayu, 2017).

Low birth weight (LBW) is a health problem that requires attention in many countries. LBW often occurs in developing countries, especially countries with low socio-economic conditions (Hartiningrum and Fitriyah, 2019).

LBW is one of the causes of hyperbilirubinemia in neonates (jaundice neonatorum) from many other risk factors. A rise in bilirubin of 5-7 mg/dL or more in 24 hours may indicate that the neonate has clinical manifestations of jaundice. Jaundice can occur with increased blood hemolysis due to short erythrocyte age, blood incompatibility hemolysis, G-6-PD enzyme deficiency, and sepsis (Puspita, 2018).

The World Health Organization (WHO) defines LBW as a baby whose birth weight is less than or equal to 2500 grams. LBW is classified by WHO into 3 groups, namely LBW (1500-2499 grams), Very Low Birth Weight (VLBW) (1000-1499 grams), and Extreme Low Birth Weight (ELBW) (<1000 grams). The Infant Mortality Rate (IMR), according to WHO, is 60-80% due to LBW. LBW infants have a greater risk of morbidity and mortality when compared to infants born with adequate body weight.

LBW that occurs in developing countries has a percentage of 16.5%, which means it is twice as large when compared to developed countries which only obtained 7%. One of the developing countries is Indonesia, which ranks third as a country with a high prevalence of LBW with a percentage of 11.1% (Putri et al., 2019).

The International Federation of Obstetrics and Gynecology defines pregnancy as the process of fertilization or the union of spermatozoa (sperm cells) with ovum (egg cells) followed by the process of nidation or implantation. Calculation of the fertility phase until the baby is born, lasts 40 weeks or 9 months and 7 days, calculated from the first day of the last menstrual period (FDLM) or 10 lunar months or 9 months according to the international calendar. A 40-week pregnancy is a normal pregnancy without interruption. Pregnancy usually takes place in three trimesters. The first trimester lasts for 13 weeks, then the second trimester for 14 weeks (14th week to 27th week), and in the third trimester for 13 weeks (28th week to 40th week) (Evayanti, 2015; Wijayanti and Suwito, 2019).

Gestational age can be calculated from the first day of the last menstrual period. To find out the calculation is by the date of the last menstrual period minus 3 months, plus 1 week or calculated from FDLM to the estimated day of birth (EDB). For gestational age has a time limit, the maximum is 40 weeks or about between 9 months + 1 week (Santi and Riana, 2016; Herman and Joewono, 2020).

Neonatal hyperbilirubinemia can occur due to high levels of erythrocytes (so that the process of remodeling is often carried out or increased heme catabolism), short erythrocyte life span, and the physiological process of the liver is not good enough or immaturity of liver function in

conjugating and excreting bilirubin. The liver organ in newborn babies that functions to process erythrocytes (red blood cells) cannot work optimally. Bilirubin is the main result of the breakdown of red blood cells by the reticuloendothelial system (Cholifah et al., 2017; Rohsiswatmo and Amandito, 2018; Guerra Ruiz et al., 2021).

Indirect bilirubin is bilirubin that is insoluble in water, so it requires albumin protein for transportation. This bilirubin has not undergone a conjugation reaction with glucoronic acid in the liver. This bilirubin is insoluble in water and is not found in urine. Normal bilirubin levels that occur in the blood for index bilirubin are 0.3-1.1 mg/dL. If the bilirubin level exceeds the normal value, it can cause yellow staining on the baby's body, and if the bilirubin level increases and accumulates in the baby's body, it can stain the skin and other body tissues (such as sclera, nails, mucosa, brain). An index bilirubin level of more than 5 mg/dL will begin to show on the skin and sclera (Sari and Rizal, 2018; Guerra Ruiz et al., 2021).

Bilirubin levels in low weight newborns are usually found to be around 5-7mg/dL. However, after 7 days, usually the symptoms of jaundice will gradually disappear. LBW is also one of the many risk factors that can affect the state of neonates with hyperbilirubinemia (Sari and Rizal, 2018; Hansen et al., 2020).

Adequate gestational age (at term pregnancy) can give birth to babies who experience hyperbilirubinemia due to the function of the liver organs in infants who are not functioning optimally (immaturation and low concentration of uridine glucuronosyl transferase diphosphoglucuronate) and erythrocyte levels that tend to be high in the baby's body. If this occurs in premature infants, the risk is twice as high compared to at term infants. If on day 7 bilirubin levels have decreased then, the condition of liver function has worked optimally and reduces the risk of complications of pathological hyperbilirubinemia (Hansen et al., 2020; Khotimah and Subagio, 2021)

SUBJECTS AND METHOD

1. Study Design
This study was an analytic observational study with a cross-sectional approach. The population in this study were all infants admitted to the perinatology room of Rumah Sakit Umum Daerah Dr. Moewardi (RSUD Dr. Moewardi) aged 0-28 days in January-December 2021. The subjects of this study were infants with physiological hyperbilirubinemia aged 0-28 days with LBW and LBW. Exclusion criteria were infants with hemolytic disorders and congenital abnormalities in infants and congenital abnormalities of infants from mothers. The population of this study were neonates who had hyperbilirubinemia.

2. Population and Sample
The determination of sample size was utilizing the correlative analytical sample size formula and obtained the minimum required sample of 47 people. Sampling was carried out retrospectively using patient medical records during January-December 2021, using purposive sampling technique. The samples in this study were infants aged 0-28 days with hyperbilirubinemia who were admitted to the perinatology room of Dr. Moewardi Hospital who met the inclusion and exclusion criteria during January to December 2021. Sampling obtained 89 medical records that fit the inclusion and exclusion criteria. The data were then processed using SPSS software version 26 and analyzed using chi-square test to see the relationship between LBW and gestational

age with the incidence of hyperbilirubinemia in neonates.

3. Study Variables

The independent variables of this study were Infant birth weight and gestational age, while the incidence of hyperbilirubinemia was the dependent variable.

4. Operational Definition of Variables

Hyperbilirubinemia was the condition of infants aged 0-28 days admitted to the perinatology room with jaundice as indicated by the doctor's diagnosis listed in the infant's medical record at Rumah Sakit Umum Daerah Dr. Moewardi.

Infant birth weight was birth weight of infants written in infant medical record data at Rumah Sakit Umum Daerah Dr. Moewardi.

Gestational age was gestational age of the mother at the time of delivery of the baby recorded in the baby's medical record data at Rumah Sakit Umum Daerah Dr. Moewardi. The condition of infants aged 0-28 days admitted to the perinatology room with jaundice indicated by the doctor's diagnosis, the infant birth weight and gestational age recorded in the infant's medical record data at Dr. Moewardi Hospital.

5. Study Instruments

The hyperbilirubin infant was measured by the Laborat using a blood bilirubin measurement kit at the examination after the baby is >2 days old. Data for infant weight measurement using baby scales from the medical records. Data for gestational age of mother was measured by specialist pediatricians and specialist gynecologists.

6. Data analysis

The researcher analyzed whether there was a correlation between two variables. Consisting of independent variables, namely infant birth weight and gestational age, with the dependent variable being the incidence of neonatal jaundice. The data correlation will be analyzed using the chi-square test on the Statistical Product and Service Solution (SPSS) version 16 computer application.

7. Research Ethics

Research ethical issues including informed consent, anonymity, and confidentiality, were addressed carefully during the study process. The research ethical clearance approval letter was obtained from the Research Ethics Committee at Dr. Moewardi Hospital, Surakarta, Indonesia with number: 820 / VI / HREC / 2022.

RESULTS

1. Characteristics samples

In this study, 89 samples were obtained. Table 1 shows that most babies with sufficient birth weight (SBC) are 58 cases (65.2%), while the rest with LBW are 31 cases (34.8%). Most babies are born with term gestational age, there are 56 cases (62.9%), while the rest with preterm gestational age, there are 33 cases (37.1%). Babies born with hyperbilirubin are 45 cases (50.6%), while babies born without hyperbilirubin are 44 cases (49.4%).

2. Analysis Bivariate

Table 2 show that LBW (OR= 2.34; 95% CI= 1.58 to 3.47) and preterm gestational age (OR= 2.55; 95% CI= 1.68 to 3.58) increased risk of hyperbilirubinemia.

Table 1. Characteristics samples

Independent Variable	Frequency (n)	Percentage (%)
Infant Birth Weight		
Low Birth Weight	31	34.8
Adequate Birth Weight	58	65.2
Gestational Age		

Independent Variable	Frequency (n)	Percentage (%)
Preterm	33	37.1
Atrem	56	62.9
Bilirubin level		
Hyperbilirubin	45	50.6
Non Hyperbilirubin	44	49.4

Table 2. Analysis of the relationship between infant birth weight and gestational age of the incidence of neonatal hyperbilirubinemia

Independent Variable	Bilirubin				OR	Lower limit	Upper limit	p
	Hyperbilirubin		No Hyperbilirubin					
Infant Birth Weight	N	%	N	%				
Low Birth Weight	25	80.6	6	19.4	2.34	1.58	3.47	<0.001
Adequate Birth Weight	20	34.5	38	65.5				
Gestational Age								
Preterm	27	81.8	6	19.4	2.55	1.68	3.58	<0.001
Aterm	18	32.1	38	65.5				

DISCUSSION

This study utilized samples with several amounts obtained from infants admitted to the perinatology room of Dr. Moewardi Hospital who experienced neonatal jaundice - as many as 45 cases (50.6%), then infants who had LBW (<2500 grams) as many as 31 cases (34.8%) and infants born to mothers with premature or preterm gestational age (<37 weeks) as many as 33 cases (37.1%). Hyperbilirubinemia is a high level of bilirubin that is deposited or accumulated in the blood. People who have a history of hyperbilirubinemia will generally look icterus or jaundiced, which is yellow staining of the sclera, skin and nails (Sari and Rizal, 2018). Hyperbilirubinemia in neonates can occur due to many factors, both maternal, perinatal or neonatal factors. The analysis conducted in this study was related to neonatal factors, namely the birth weight of the baby and maternal factors, including gestational age or gestation period (Herman and Joewono, 2020). The following is a discussion related to the factors that cause

hyperbilirubinemia in neonates in this study.

1. **Relationship between Low Birth Weight and Neonatal Hyperbilirubinemia**

This study shows results stating that babies who have sufficient birth weight which is more than or equal to 2500 grams as many as 58 cases (65.2%), then for babies who experience LBW, which is less than 2500 grams as many as 31 cases (34.8%). The prevalence of LBW babies who experienced hyperbilirubin was 80.6%, while the prevalence of babies with sufficient birth weight who experienced hyperbilirubin conditions was 34.5%.

In the study, the PR was found to be 2.34 (95% CI= 1.58 to 3.47), which means that LBW babies have a 2.34 times greater risk of hyperbilirubinemia compared to babies with adequate birth weight. Chi Square test obtained a value of p<0.001, which means that there is a significant relationship between birth weight and the

incidence of hyperbilirubinemia in neonates. Newborns with a small body size (having a birth weight of less than 2500 grams) have a high incidence of hyperbilirubinemia in the first week of life. This can occur because the hepatic organs in these infants do not function optimally due to the lack of physiological maturity of the hepatic organs. So that the indirect bilirubin conjugation system becomes recruited which occurs in LBW babies who either have sufficient gestation period or babies with premature gestation period has not occurred completely (Setiati and Rahayu, 2017; Hajar et al., 2019; Yusuf et al., 2021).

This study is in accordance with research conducted by Husnul Khotimah and Sri Utami Subagio who conducted research in 2021 at Rumah Sakit Umum Drajat Prawiranegara. There is a significant relationship obtained a p value of 0.002 (P <0.05) which means that statistically there is a significant relationship between the baby's birth weight and the incidence of hyperbilirubin. From the statistical results, an OR of 6.500 was obtained, which means that LBW has a 6.5 times greater chance of experiencing hyperbilirubinemia when compared to babies who have sufficient birth weight (Khotimah and Subagio, 2021). Research conducted by Arisandi and Sodikin in 2020 at Rumah Sakit Daerah Banyumas also found a significant relationship between the baby's birth weight and the incidence of hyperbilirubinemia with a value of p = 0.019 (<0.05). The condition of babies with LBW can result in liver immaturity (imperfect liver maturation) which causes hyperbilirubinemia due to the bilirubin conjugation system that has not functioned optimally (Arisandi and Sodikin, 2020).

Another corresponding study is research conducted by Morika, et al in 2020 at the Rumah Sakit Umum Daerah Padang Panjang. Their study stated that there was a relationship between birth weight in infants and the incidence of hyperbilirubinemia with a value of p = 0.003 (p < 0.05) (Morika et al., 2020). Babies born with a body weight that is less than normal (2500-3800 kg) can result in abnormalities that can occur in the neonate. Infants who have LBW have a weak immune system so that they are prone to infection which can cause organ damage so that the organ is impaired both anatomically and physiologically (Mathindas et al., 2013; Hajar et al., 2019).

There are several other studies which results are not in accordance with this study, including the research by Rahayu in 2020 at Dr. R Soedarsono Hospital, Pasuruhan. The study stated that there was no relation between infant birth weight and the incidence of hyperbilirubinemia with a value of p = 0.614 (p> 0.05) (Rahayu, 2020). The study conducted by Mojtahedi, et al in 2018 at Ziyaeian Hospital and Khomeini Hospital, Iran also are not in accordance with this study. The results obtained were that there was no association between infant birth weight and the incidence of hyperbilirubinemia (Mojtahedi et al., 2018). Infant birth weight is influenced by the incidence that occurs in the hospital. If the incidence is low and there are not many respondents, it can affect the results of the study. The prevalence ratio in the study can also be influenced if the number of babies born in a hospital is normal and does not experience hyperbilirubinemia. However, babies born with normal weight still have a risk due to the shorter life cycle of red blood cells (Mojtahedi et al., 2018; Dysart, 2022).

2. **Relationship between Gestational Age and Neonatal Hyperbilirubinemia**

This study presents results stating that babies born with full-term gestational age (at-term) were 62.9% or 56 cases and for babies born with preterm gestational age

(preterm) were found to be 33 cases (37.1%). The prevalence of infants with preterm gestational age who experienced hyperbilirubin was 81.8%, while infants with at-term gestational age who experienced hyperbilirubin was 32.1%. The PR was 2.55 (95%CI=1.68-3.58), which means that infants with preterm gestational age have a 2.55 times greater risk of hyperbilirubin than those with at term gestational age. Chi Square test obtained the value of p<0.001 (p<0.05) which means that there is a significant relationship between gestational age and the incidence of hyperbilirubinemia in neonates.

Infants who experience preterm and at-term gestational age can experience liver immaturity so that it can cause hyperbilirubinemia conditions. Liver immaturity causes imperfection of conjugation reaction due to lack of uridine diphosphoglucuronyl transferase (UDPGT) enzyme. As a result of this deficiency, the process of converting undirected bilirubin into rec bilirubin is less than perfect. The decrease in the clearance process (indirect into direct bilirubin) occurs due to low levels of ligandin in hepatocytes. The high level of bilirubin that is deposited or accumulated in the blood causes jaundice, which is yellow staining of the sclera, skin and nails (Hansen, 2017; Guerra Ruiz et al., 2021; Dysart, 2022).

This study is in accordance with research conducted by Melinda et al. (2021) at Rumah Sakit Umum Daerah Wangaya, Denpasar. In this study, there was an influence between gestational age and the incidence of hyperbilirubinemia with p < 0.001 (Melinda et al., 2021). According to Husnul Khotimah and Sri Utami Subagio who conducted research in 2021 at Drajat Prawiranegara Hospital, there is a significant relationship between gestational age and the incidence of hyperbilirubin. Statistically, the P value was 0.006 (P <0.05). This

P value means that statistically there is a relationship between gestational age and the incidence of hyperbilirubinemia with an OR value showing the results of 5.4 which means it has a 5.4 times greater chance that can cause babies with preterm gestational age to experience hyperbilirubinemia compared to babies with at-term gestational age (Khotimah and Subagio, 2021).

Another study that resulted consistently with this study is a study by Yuni Arisandi and Sodikin in 2020 at Rumah Sakit Daerah Banyumas. This study states that there is an influence between gestational age and the incidence of hyperbilirubinemia p< 0.001 (<0.05) (Arisandi and Sodikin, 2020). According to Cholifah, et al (2017) in their research conducted at the Muhammadiyah Gersik Hospital, there was a significant relationship between the factor of gestational age and the incidence of hyperbilirubinemia in neonates with a value of p = 0.001.

Gestational age is one of the factors that can cause babies to experience hyperbilirubinemia. The health quality of the newborn baby can be determined from the gestational age of the baby itself. Gestational monthly age that is not enough can affect the condition of the baby's immune system which is not ready to adapt and accept the environment outside the womb which can then provide the potential for various complications, one of which is jaundice neonatorum.

Gestational age can affect the survival of neonates, the lower the gestational age of neonates and the smaller the size of the baby born, the higher the mortality and morbidity of neonates. The body organs of premature neonates cannot function optimally like mature neonates. Therefore, babies who experience hyperbilirubinemia are usually the result of the function of the liver organ in babies which have not functioned optimally

(immaturation and low concentration of uridine glucuronosyl transferase diphosphoglucuronate) and the process of excretion and metabolism in neonates both urination and defecation is impaired so that there is a buildup of bilirubin in the body of neonates (Mathindas et al., 2013; Cholifah et al., 2017; Morika et al., 2020).

However, there is another study conducted by Estiwidani, et al in 2017 at Sadewa Hospital. In her research, 114 medical records of neonates were obtained which were then tested statistically and found that gestational age had no relationship with the incidence of hyperbilirubinemia (Estiwidani et al., 2017). Another study conducted by Bhat et al in 2019 at the World College of Medical Sciences (WCMS) Haryana, India from 300 newborns found that there was no relationship between gestational age, gender, and type of delivery with the incidence of neonatal hyperbilirubinemia (Bhat et al., 2019). This happened because the sample data obtained showed fewer representative results (Estiwidani et al., 2017).

Based on the results of the study of 89 neonate patients who were treated in the perinatology room at Dr. Moewardi Hospital, Surakarta, the incidence of hyperbilirubinemia of neonates with LBW was 80.6%, babies with normal birth weight were 34.5%, premature babies were 81.8% and at term babies were 32.1%. There is a relationship between the birth weight of the baby, namely LBW with the incidence of hyperbilirubinemia and also there is a relationship between gestational age, namely preterm gestational age, and the incidence of hyperbilirubinemia in neonates from January to December 2021. The prevalence ratio of infant birth weight to the incidence of hyperbilirubinemia was 2.34 and The prevalence ratio of gestational age to the incidence of neonatal hyperbilirubinemia was 2.55.

CONFLICT OF INTEREST
There are no conflicts of interest.

REFERENCES

Andesty D, Rachmawati and Taliah (2018). Hubungan kejadian bayi berat badan lahir rendah dengan hyperbilirubinemia (The relationship between the incidence of low-birth-weight babies and hyperbilirubinemia). Jurnal Media Kesehatan, 8(1):25–29. doi: 10.33088/jmk.v8i1.251.

Arisandi Y, Sodikin (2020). Factors associated with the occurence of hyperbilirubinemia in infants. Proceedings Series on Health & Medical Sciences. 1:78–81. doi: 10.30595/pshms.v1i.38

Bhat JA, Sheikh SA, Ara R (2019). Cord

blood bilirubin, albumin, and bilirubin/ albumin ratio for predicting subsequent neonatal hyperbilirubinemia. Paediatrica Indonesiana, 59(5):244–251. doi: 10.14238/pi.

Cholifah, Djauharoh, Machfudloh H (2017). Faktor-faktor yang berpengaruh terhadap hiperbilirubinemia di RS Muhammadiyah Gersik (Factors that influence hyperbilirubinemia at Muhammadiyah Hospital Gresik) Jurnal fakultas ilmu kesehatan muhammadiyah sidoarjo. 3:14–25. doi: 10.21070/mid.v3i1.1501.

Dysart KC (2022). Neonatal hyperbilirubinemia. MSD manual Professional Version, 1:1–9. doi: 10.1542/peds.103.1.6.

Estiwidani D, Kusmiyati Y, Waryana and Asmarani H (2017). The influence of parent's blood type towards jaundice on neonates in Sadewa Hospital 2016. International Journal of Scientific Research and Education. 5(3):6246–6253. ISSN 2321-7645.

Guerra Ruiz AR, Crespo J, López Martínez RM, Iruzubieta P, Casals Mercadal G, Lalana Garcés M, Lavin B, et al. (2021). Measurement and clinical usefulness of bilirubin in liver disease. Advances in Laboratory Medicine / Avances en Medicina de Laboratorio, 2(3):352–361. doi: 10.1515/almed-2021-0047.

Hajar NS, Antari I, Mizan DM (2019). Kejadian ikterus neonatorum pada berat bayi lahir rendah (The occurrence of neonatal jaundice in low-birth-weight babies). Jurnal Kesehatan Madani Medika. 10(1):35–39.

Hansen TW (2017). Neonatal Jaundice. Medscape, 1: 1–27. Available at: https://emedicine.medscape.com/article/974786-overview#a7?form=fpf

Hansen TWR, Wong RJ and Stevenson DK (2020). Molecular physiology and pathophysiology of bilirubin handling by the blood, liver, intestine, and brain in the newborn. Physiological Reviews, 100(3):1291–1346. doi: 10.1152/physrev.00004.2019.

Hartiningrum I, Fitriyah N (2019). Bayi Berat Lahir Rendah (BBLR) (Low Birth Weight (LBW) Babies). Jurnal Biometrika dan Kependudukan, 7(2): 97. doi: 10.20473/jbk.v7i2.2018.97--104

Herman S, Joewono HT (2020). Buku acuan persalinan kurang bulan (prematur) (Reference book for premature birth). 1st ed. 2020. Kendari: Yayasan Avicenna Kendari

Khotimah H, Subagio SU (2021). Analisis hubungan antara usia kehamilan, berat lahir bayi, jenis persalinan dan pemberian asi dengan kejadian hyperbilirubinemia (Analysis of relationship between gestational age, birth weight, type of childbirth and breastfeeding with occurrence of hy. 8(2): 115–121. e-ISSN 2597-8667.

Mathindas S, Wilar R, Wahani A (2013). Hiperbilirubinemia pada neonatus. Jurnal Biomedik. 5(1):S4-10. doi: 10.35790/jbm.5.1.2013.2599

Melinda F, Suryawan IWB and Agung A (2021). factors associated with the incidence of neonatal hyperbilirubinemia in perinatology ward of Wangaya General Hospital, Denpasar. Bali Medical Journal. 10(3):1105–1110. doi: 10.15562/bmj.v10i3.2690.

Mojtahedi SY, Izadi A, Seirafi G, Khedmat L and Tavakolizadeh R (2018). Risk factors associated with neonatal jaundice: a cross-sectional study from Iran. Open Access Macedonian Journal of Medical Sciences. 6(8):1387–1393. doi: 10.3889/oamjms.2018.319.

Morika HD, Sari IK, Sandra R, Amalia RF (2020). Relationship of types of labor

and birth weight with icteric events in neonates. The 1 St Syedza Saintika International conference on Nursing, Midwifery, Medical Laboratory technology, Public Health, And Health Information Management (SESICNIMPH). 1(1):211–220. e-ISSN: 2745-7818.

Puspita N (2018). The Effect of low birth-weight on the incidence of neonatal jaundice in Sidoarjo. Jurnal Berkala Epidemiologi. 6(2).:174-181. doi: 10.20473/jbe.v6i22018.174-181.

Putri AW, Pratitis A, Luthfiya L, Wahyuni S, Tarmali A (2019). Faktor ibu terhadap kejadian bayi berat lahir rendah (Maternal factors in the incidence of low-birth-weight babies). Higea Journal of Public Health Research and Development. 3(1):55–62. doi: 10.15-294/higeia.v3i1.28692.

Rahayu KD (2020). Hubungan antara berat badan lahir dengan kejadian ikterus pada bayi baru lahir di Rsud Dr. R Soedarsono Kota Pasuruan (The relationship between birth weight and the incidence of jaundice in newborns at Dr. R Soedarsono Regional Hospital, Pasuruan City) Jurnal Kesehatan. :550–552. e-ISSN: 2339-2045.

Rohsiswatmo R and Amandito R (2018). Hiperbilirubinemia pada neonatus >35 minggu di Indonesia; pemeriksaan dan tatalaksana terkini (Hiperbilirubinemia pada neonatus >35 minggu di Indonesia; pemeriksaan dan tatalaksana terkini). Sari Pediatri. 20(2):115. doi: 10.14238/sp20.2.2018.115-22.

Santi IH and Riana M (2016). Pola hidup sehat bagi wanita hamil menggunakan sistem pakar (Healthy lifestyle for pregnant women using expert system). Antivirus: Jurnal Ilmiah Teknik Informatika. 10(2):91–103. doi: 10.3545-7/antivirus.v10i2.166.

Sari RS, Rizal M (2018). Hubungan berat badan lahir rendah (BBLR) dengan kejadian hiperbilirubin di ruang perinatologi di RSUD Kabupaten Tangerang Tahun 2018 (The relationship between low birth weight (LBW) and the incidence of hyperbilirubinemia in the perinatology room at Tangerang District Hospital in 2018). Jurnal Kesehatan. 7(1):34–43. doi: 10.37048/kesehatan.v7i1.162.

Setiati AR and Rahayu S (2017). Faktor yang mempengaruhi kejadian BBLR (Berat Badan Lahir Rendah) di Ruang Perawatan Intensif Neonatus RSUD DR Moewardi Di Surakarta (Factors influencing the incidence of BBLR (Low Birth Weight) in the Neonatal Intensive Care Unit of DR Moewardi Regional Hospital in Surakarta). Jurnal Keperawatan Global. 2(1):9–20. doi: 10.37341/jkg.v2i1.27.

Wijayanti AR, Suwito CRL (2019). Gambaran pengetahuan ibu hamil trimester I tentang hiperemesis gravidarum (di wilayah Puskesmas Tiron Kecamatan Banyakan Kabupaten Kediri) (Description of knowledge of pregnant women in the first trimester about hyperemesis gravidarum (in the Tiron Health Center area, Banyakan District, Kediri Regency) Jurnal Kebidanan. 6(2):131–138. doi: 10.35890/jkdh.-v6i2.42.

Yanti Y Eva (2015). Hubungan pengetahuan ibu dan dukungan suami pada ibu hamil terhadap keteraturan kunjungan Antenatal Care (ANC) di Puskesmas Wates Lampung Tengah Tahun 2015 (The relationship between maternal knowledge and husband's support for pregnant women and the regularity of Antenatal Care (ANC) visits at

Wates Health Center, Central Lampung in 2015). JKM (Jurnal Kebidanan Malahayati). 1(2): 81–90.

Yusuf N, Aupia A, Sari RA (2021). Hubungan frekuensi pemberian ASI dengan kejadian ikterus neonatorum di Rumah Sakit Umum Daerah Provinsi NTB (The relationship between frequency of breastfeeding and the incidence of neonatal jaundice at the NTB Provincial General Hospital). Jurnal Medika Hutama. 02(02):764–771.