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Relationship Between Low Birth Weight and Neonatal Jaundice: Retrospective Case-Control Study at Wates Regional Hospital

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ABSTRACT

Introduction: Neonatal mortality is a critical indicator of public health and reflects the quality of maternal and neonatal healthcare services in a country. Low birth weight (LBW) and neonatal jaundice are among the leading causes of neonatal morbidity. This research aims to investigates the relationship between LBW and the incidence of neonatal jaundice in infants treated at the NICU of RSUD Wates, Kulon Progo, Yogyakarta. The findings will inform evidence-based policies and targeted interventions for Kulon Progo and surrounding areas.
Methods: This quantitative analytical study employed a retrospective case-control design. Data were collected from medical records of neonates admitted at the NICU of RSUD Wates from January to April 2023. A total of 200 neonates were selected using purposive sampling based on the study's criteria. Data analysis was performed using SPSS 25, with chi-square tests to examine the relationship between LBW and neonatal jaundice.
Results: The analysis revealed that 35% of infants were LBW, and 28% experienced neonatal jaundice. The chi-square test showed a significant association between LBW and neonatal jaundice, with a p-value of < 0.001. Infants with LBW were 4.15 times more likely to develop jaundice compared to those with normal birth weight.
Conclusion: This condition is a major contributor to the development of neonatal jaundice, with a 4.15 fold increased risk. These findings highlight the importance of early detection and management of LBW to reduce the incidence of neonatal jaundice and improve neonatal outcomes, particularly in regions with high LBW prevalence.

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INTRODUCTION

Neonatal mortality is a critical indicator for assessing public health status and reflects the quality of maternal and neonatal healthcare services within a country (1,2). In the global agenda of the Sustainable Development Goals (SDGs), it is targeted that neonatal mortality should be reduced to a maximum of 12 deaths per 1,000 live births by the year 2030 (3). This target underscores the importance of comprehensive interventions addressing the primary causes of neonatal deaths, including early detection of high-risk conditions such as Low Birth Weight (LBW) and neonatal jaundice (4–6). In Indonesia, the leading causes of neonatal mortality include low birth weight (34.5%) and asphyxia (27.8%), followed by congenital anomalies (12.8%) and infections (4.0%) (7).

The prevalence of LBW in the Special Region of Yogyakarta (DIY) in 2021 was recorded at 5.71%, which is lower than the national average of 8.8% (8). However, in Kulon Progo Regency, the prevalence reached 7.25%, the second highest in the region after Gunung Kidul Regency. As a Type B referral hospital and a comprehensive emergency obstetric and neonatal care facility in Kulon Progo, Wates Regional General Hospital (RSUD Wates) has recorded a year-on-year increase in cases of neonatal jaundice. Based on preliminary study data, neonatal jaundice accounted for 16.6% of NICU admissions in 2020, rising to 22% in 2021 and further increasing to 27.19% in 2022.

Government efforts to reduce the incidence of LBW have been implemented through the promotion of routine antenatal care visits, at least four times during pregnancy and the implementation of birth planning and complication prevention programs Ministry of Health in 2015 (9). Nonetheless, in practice, many pregnant women still fail to comply with recommended antenatal care, particularly in areas with limited access to health services (5,9). Therefore, public education and the reinforcement of healthcare workers' roles in providing information regarding the risks of LBW and neonatal jaundice are of critical importance (10).

Low birth weight is of particular concern, not only as a direct cause of neonatal death, but also due to its association with increased risk of complications such as hypothermia, respiratory distress, and neonatal jaundice (11,12). LBW infants often face challenges in adequate nutrient intake during early life, which can impair intestinal motility, delay meconium excretion, and increase the enterohepatic circulation of bilirubin (13). Additionally, protein deficiency frequently observed in LBW infants can further disrupt bilirubin transport in the body (14). Neonatal jaundice is marked by yellowing of the skin and sclera in newborns due to the buildup of unconjugated bilirubin (15). While this condition is physiological in most neonates, it may progress to a pathological state if bilirubin levels rise excessively or rapidly (15). Severe hyperbilirubinemia can lead to death, associated with acute bilirubin encephalopathy and long-term neurological complications, including seizures, hearing impairment, developmental delays, and even death due to kernicterus (16).

Previous studies have shown that LBW infants are 4.46 times more likely to develop jaundice compared to those with normal birth weigh (17). Research conducted at Wangaya Regional Hospital and in Makassar also found a significant association between LBW and hyperbilirubinemia (18,19). Similar findings were reported by Latifah et al., who identified a statistically significant correlation between LBW and the incidence of neonatal jaundice (20). Previous studies predominantly employed a cross-sectional design, which limited the ability to compare cases and controls. Therefore, a case-control study is necessary to provide deeper insights and strengthen the implications for knowledge and clinical practice.

Given the high incidence of neonatal jaundice and LBW prevalence at RSUD Wates, along with substantial evidence of their association, further research is necessary to examine this relationship within the local context. This study aims to determine the relationship between LBW and the occurrence of neonatal jaundice in infants admitted to NICU at Wates Regional General Hospital, Kulon Progo Regency. The findings are expected to provide accurate data that will serve as a foundation for evidence-based clinical policymaking and the implementation of more targeted preventive interventions in Kulon Progo and surrounding areas.

METHOD

Research Type

This study employed a quantitative analytic approach using a case-control design with a retrospective method (21). This design was chosen to identify the association between low birth weight (LBW) and the incidence of neonatal jaundice, which served as the dependent variable. The retrospective case-control approach was suitable for

this study due to its resource efficiency and ethical feasibility, allowing researchers to analyze existing data without exposing neonates to potential risks or unnecessary intervention (22).

Population and Sample/Informants

The population in thsi study comprised all neonates admitted to the NICU at RSUD Wates during the specified timeframe, totaling 238 infants. Sampling was conducted using a purposive sampling technique, with subjects selected based on predefined inclusion and exclusion criteria. The inclusion criteria comprised neonates with complete medical records and birth weight under 4000 grams for cases, and complete data without jaundice for controls. Exclusion criteria included neonates with congenital anomalies, cephalohematoma, maternal diabetes, and birth weight of 4000 grams or more. A total of 200 neonates were included and analyzed in this study.

Research Location

The research was conducted in the NICU of the Perinatology Department at Wates Regional General Hospital (RSUD Wates), located in Kulon Progo Regency, Yogyakarta, Indonesia. Data collection took place between June and July 2023, with data sourced from neonatal medical records for the period of January to April 2023.

Instrumentation or Tools

The primary instrument utilized in this study was a data collection sheet, specifically designed to extract relevant information from secondary data or medical records in the form of NICU at RSUD Wates. The instrument captured various clinical variables, including maternal characteristics like maternal age, gestational age, parity, and neonatal characteristics like infant sex, birth weight, and the incidence of neonatal jaundice. The independent variable is Low Birth Weight (LBW) and the dependent variable is Neonatal Jaundice.

Data Collection Procedures

Data collection involved a thorough examination of existing medical records. A systematic review approach was employed to ensure accuracy and comprehensiveness in gathering relevant data.

Data Analysis

Data processing involved several stages, editing, coding, and data entry using Microsoft Excel, followed by statistical analysis using SPSS version 25. Data analysis involved two phases univariate analysis to describe respondent characteristics and variable distribution, and bivariate analysis using the chi-square test to examine the association between low birth weight (LBW) and neonatal jaundice, with statistical significance set at $p < 0.05$.

Ethical Approval

This study received ethical approval from the Ethics Committee of Wates Regional General Hospital, under reference number: KEPK/153/RS/VII/2023.

RESULTS

This study was conducted by sampling neonates admitted to NICU of the Perinatology Department at Wates Regional General Hospital (RSUD Wates) between January and April 2023. Analysis of maternal characteristics in Table 1 revealed that the majority of respondents were mothers aged between 20 and 35 years, totaling 155 individuals (77.5%). In terms of parity, most respondents were multiparous mothers (59%, n = 118). Additionally, most deliveries occurred at term (≥37 weeks gestation), with a total of 146 births (73%).

Table 1. Characteristics of Mothers in the NICU Perinatology Ward from January to April 2023

Maternal Category	Frequency (n)	Percentage (%)
Age		
20–35 years	155	77.5%
>35 years	45	22.5%
Parity		
Primiparous	82	41%

Maternal Category	Frequency (n)	Percentage (%)
Multiparous	118	59%
Gestational Age		
Preterm	54	27%
Term	146	73%

(Source: Secondary Data, 2023)

Table 2 presents neonatal characteristics. Male neonates were more prevalent, accounting for 115 infants (57.5%), while female neonates accounted for 85 (42.5%). Newborns were grouped based on birth weight those with normal birth weight ≥2500 grams and those with low birth weight <2500 grams. The majority of neonates (130, or 65%) were in the normal birth weight group, while 70 infants (35%) were classified as having low birth weight. Regarding neonatal jaundice, 56 neonates (28%) developed jaundice, while the remaining 144 (72%) did not.

Table 2. Characteristics of Neonates in the NICU Perinatology Ward from January to April 2023

Neonatal Category	Frequency (n)	Percentage (%)
Birth Weight		
Male	115	57.5%
Female	85	42.5%
Birth Weight		
Low Birth Weight (LBW)	70	35%
Normal Birth Weight (NBW)	130	65%
Jaundice Incidence		
Yes	56	28%
No	144	72%

(Source: Secondary Data, 2023)

Bivariate analysis was conducted using the Chi-square test with a 95% confidence interval to assess the association between birth weight and the incidence of neonatal jaundice. The results demonstrated a statistically significant difference between groups. Among the 70 infants with low birth weight, 33 (47.1%) developed jaundice. In contrast, only 23 out of 130 infants with normal birth weight (17.7%) experienced jaundice. This marked difference in proportions indicates a strong association between low birth weight and the increased incidence of neonatal jaundice. The Chi-square test confirmed statistical significance with a p-value < 0.001, indicating a robust relationship between LBW and jaundice.

Table 3. Bivariate Analysis of the Association Between Low Birth Weight and Neonatal Jaundice in the NICU Perinatology Ward from January to April 2023

Birth Weight	Jaundice		p-value	OR	95% CI
	Yes	No			
Low Birth Weight (LBW)	33 (47.1%)	37 (52.9%)	<0.001**	4.15	2.16 – 7.95
Normal Birth Weight (NBW)	23 (17.7%)	107 (82.3%)			

(Source: Primary Data, 2023)

To quantify the magnitude of risk associated with LBW in the development of jaundice, the Odds Ratio (OR) was calculated. The findings indicate that neonates with LBW were 4.15 times more likely to develop jaundice compared to those with normal birth weight OR = 4.15. This finding is consistent with previous research, which indicates that LBW is a significant risk factor for neonatal jaundice, with an odds ratio of 4.46 (17). Physiologically, infants with LBW commonly present with immature organ functions, including liver immaturity. This underdevelopment impairs the conjugation process of bilirubin, causing to increased elevated levels of bilirubin accumulation in the blood, thus triggering jaundice.

DISCUSSION

The majority of mothers in this study 155 individuals (77.5%) were aged between 20 and 35 years. This age range is considered ideal for pregnancy, as reproductive organs are fully mature and women are generally regarded as psychologically prepared for pregnancy and childbirth (23). Previous studies have found that mothers delivering low birth weight (LBW) infants are more frequently within the 20–30 age group, accounting for 80.5% (24). This finding aligns with a study conducted in the Special Region of Yogyakarta, which also reported a higher incidence of LBW births among mothers aged 20 – 35 (25). However, maternal age does not always directly correlate with the occurrence of LBW, suggesting that additional factors may also influence LBW outcomes (26).

Among the 200 neonates included in this study, 130 (65%) were born with normal birth weight (NBW), while 70 (35%) were classified as LBW. This indicates that the majority of NICU patients at RSUD Wates were born with sufficient birth weight. Similar results were reported at Dr. Soebandi Hospital in Jember, where 54.3% of neonates were LBW and 45.7% were NBW (27). Another study found that 57% of infants were not LBW, while 42.2% were (28). Although most infants in this study were not LBW, it remains a critical concern in neonatal care. LBW infants are at higher risk for health complications such as feeding difficulties, gastrointestinal disturbances, and delayed meconium passage (13). These issues may contribute to increased enterohepatic circulation and protein deficiency, which impairs bilirubin transport (29). LBW is also recognized as a significant risk factor for neonatal jaundice. Previous research has indicated that LBW infants are 4.46 times more likely to develop jaundice compared to those with NBW (17).

Neonatal jaundice is a frequently observed condition in newborn infants, marked by a yellowish tint of the skin and the whites of the eyes, caused by elevated levels of bilirubin accumulation in the blood (30). In this study, 144 infants (72%) did not experience neonatal jaundice, while 56 (28%) did. Among the 70 LBW infants, 37 (52.9%) did not develop jaundice, indicating that although LBW increases the risk, not all LBW infants experience this condition. These results suggest that RSUD Wates has implemented effective antenatal care (ANC) programs, including the recommended minimum of four antenatal visits and the Complication Prevention and Birth Planning Program, in line with the Ministry of Health guidelines 2015. Similar findings were reported in a study where 75% of LBW infants did not develop jaundice (31). However, another study found that 24.7% of LBW infants developed neonatal jaundice, while 9.1% did not. Neonatal jaundice occurs due to the inability of the immature liver in newborns to efficiently process unconjugated bilirubin produced from the breakdown of red blood cells (32). In utero, the placenta handles bilirubin elimination however, after birth, this function transitions to the infant's liver, which requires time to mature (32). Consequently, increased bilirubin levels during this transitional phase often result in neonatal jaundice. Severe hyperbilirubinemia can lead to serious complications, including kernicterus and death if not promptly treated (33).

The bivariate analysis revealed a statistically significant association between LBW and neonatal jaundice at RSUD Wates NICU, with a p-value < 0.001 and an odds ratio (OR) of 4.15. This indicates that LBW infants are 4.15 times more likely to develop neonatal jaundice than NBW infants. A previous study also found a significant relationship between LBW and hyperbilirubinemia ($p = 0.020$), reinforcing the notion that LBW infants are at higher risk to developing jaundice in neonatal (34). Physiologic jaundice is a mild and transient condition typically seen in newborns, resolving on its own, whereas pathologic jaundice is a more severe form that may indicate an underlying medical condition requiring prompt attention (14). The key differences lie in onset, duration, and treatment implications, with physiologic jaundice being self-limiting and pathologic jaundice often necessitating medical intervention (35).

The primary cause of neonatal jaundice in LBW infants is hepatic immaturity, which impairs the conversion of unconjugated bilirubin into a form that can be excreted through the digestive system (35). Impaired bilirubin binding by albumin and limited hepatic conjugation capacity further increase the risk of jaundice in LBW infants (14). Additionally, prematurity further elevates the risk of hyperbilirubinemia, as the liver of preterm infants is not fully developed to handle the bilirubin load (34). LBW is thus a significant risk factor for hyperbilirubinemia, with a prevalence ratio of 2.13, indicating that are 2.13 times more likely to develop the condition compared to non-LBW infants. This study also highlights that prematurity in conjunction with LBW exacerbates the risk of neonatal jaundice, primarily due to disruptions in bilirubin conjugation processes (18).

This study presents several limitations, including its retrospective nature, which depends exclusively on secondary data from medical records and may affect the accuracy and completeness of certain variables. Moreover, as the research was conducted in a single healthcare facility, the findings may not be widely applicable to other regions or populations. This study also limited by the lack of stratified analyses for other variables, which is recommended for future research to provide deeper insights. Future studies are encouraged to adopt a prospective, multicenter cohort design with a larger sample size, while also accounting for additional potential confounding factors such as nutritional status, maternal health conditions, and neonatal interventions. This approach would offer a more in-depth understanding of the link between low birth weight and neonatal jaundice.

CONCLUSION

This study reveals a significant relationship between low birth weight (LBW) and the incidence of neonatal jaundice in infants treated at the NICU of RSUD Wates. Out of 200 samples, it was found that infants with LBW have a 4.15 times higher risk of developing jaundice compared to those with normal birth weight. Statistical analysis showed a p-value of < 0.001, indicating a highly significant relationship, these findings emphasize that LBW is a critical risk factor for neonatal jaundice. Therefore, this finding can inform policy decisions, suggesting that governments and health departments prioritize preventing and managing LBW during pregnancy to reduce neonatal morbidity, especially in regions with high LBW rate.

AUTHOR'S CONTRIBUTION STATEMENT

SH: Contributed to concept development, study design, data and statistical analysis, as well as manuscript preparation, writing, editing, and review. ESL: Contributed to concept development, study design, data and statistical analysis, and participated in manuscript preparation, writing, and revision.

CONFLICTS OF INTEREST

The authors affirm that there are no competing interests associated with the content of this article.

DECLARATION OF GENERATIVE AI AND AI-ASSISTED TECHNOLOGIES IN THE WRITING PROCESS

The authors acknowledge the use of ChatGPT, a generative AI tool developed by OpenAI, for the purpose of translating content from Indonesian to English during the manuscript preparation process. The final content has been reviewed and verified by the authors to ensure accuracy and integrity

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