E-ISSN : 2963-4946
Vol. 1 No. 10 July 2023
Asian Journal of Social and Humanities
https://ajosh.org/

Factors Affecting the Growth of Low Birth Weight Babies

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KEYWORDS
Low Birth Weight, Catch-Up Growth, Post-Natal Growth Failure, Risk Factor.

ABSTRACT
Birth weight is one of the determinants of a child's physical growth and future brain development. However, babies with low birth weight (LBW) are at risk of death and other health problems. The purpose of this literature review is to systematically summarize research that analyzes the factors that influence the growth of low birth weight babies. The method used was a literature review using the PRISMA Protocol, with inclusion criteria, namely full text and original research, the research subjects were babies born with low birth weight (<2500g), articles in Indonesian and English, published in the last 5 years (2017-2022). The results showed that there are several factors that influence the growth of infants with a history of low birth weight such as gender (male), lower gestational age, postnatal health problems, nutritional intake, such as exclusive breastfeeding or enteral feeding, and maternal parenting practices such as Kangaroo Mother Care (KMC). Exclusive breastfeeding and maternal parenting practices (Kangaroo Mother Care) have an impact on increasing growth so it is good to apply especially for mothers who have low-birthweight babies to catch up with age-appropriate growth.

Introduction

Birth weight is one of the determinants of a child's physical growth and future brain development and is a valid sign of fetal growth in the womb. One of the most important health indicators is weight because babies with low birth weight (BBLR) have a risk of babies at risk of neonatal death and health problems (Khazaei *et al.* 2021). Babies born with a body weight of less than 2,500 g are low, even though the risk of death in BBLR babies is 25 to 30 times greater than babies with normal birth weight. Therefore, the lower the birth weight, the higher the risk of death. In addition, BBLR babies who can survive are at risk of short-term and long-term disability, 2 to 3 times more than babies with normal birth weight (Aregay *et al.* 2015).

As many as 16% of births are related to low birth weight babies or about 20 million babies born weighing less than 2,500 g. The percentage of births with low birth weight is higher in underdeveloped and developing countries and countries by 18.6% and 16.5% while in developed countries by 7%. Meanwhile, the prevalence of low-weight infants in

Asia is 20% (Derakhshi et al. 2014; Mumbare et al. 2012). In Indonesia, premature birth and low birth weight (BBLR) in Indonesia are still relatively high. Most premature births are always followed by Low Birth Weight Babies (BBLR). The prevalence of premature babies in Indonesia is still relatively high at 7-14%, even in some districts it reaches 16% while the national prevalence of low birth weight is 11.5%. This prevalence is greater than some developing countries which are 5 - 9% and 12 - 13% in the USA (Kemenkes RI 2022).

Babies with low birth weight (BBLR) have a high risk of postnatal growth retardation, and will subsequently have a long-term negative impact on health (Liao *et al.* 2019). Most babies born with low body weight have a long-term life process that is less than optimal. Babies born with low body weight have a risk of growing and developing more slowly compared to babies born with normal weight. In addition to growth and development disorders, individuals with a history of low birth weight have high risk factors for hypertension, heart disease and diabetes after 8 years of age (Kosim et al. 2012).

Some studies show that babies with low birth weight have a growth pattern that is less than optimal. Research conducted by Hsu *et al.* (2018) showed that very low birth weight infants with associated *failure to thrive* (FTT) were strongly associated with poor neurodevelopmental outcomes at three different time points (6, 12, and 24 months). Comorbidities associated with postnatal growth are necrotising enterocolitis, isolated gastrointestinal perforation, and severe retinopathy of prematurity, which are associated with an adjusted mean decrease in low birth weight Z-scores (Griffin *et al.* 2016). Growth delays or failure to regain birth weight may occur due to prevailing postnatal care practices and/or various factors, which may be medical, nutritional or environmental related (Subramanian *et al.* 2011). Therefore, this study aims to systematically summarize research that analyzes the factors that influence the growth of babies with low birth weight.

Research methods

The research method used is *literature review* using articles from international and national journals with national reputation Sinta 1-4 using keywords: "*low birth weight*", "catch-up growth", *"post-natal growth failure*" "risk factor". The articles have been selected using PRISMA. The article inclusion criteria used are *full text* and original *research*, research subjects are babies born with low body weight (<2500g), articles in Indonesian and English, published in the last 5 years (2017-2022). A total of 6 articles were obtained that fit the inclusion and exclusion criteria. The stages of PRISMA can be seen in Figure 1.

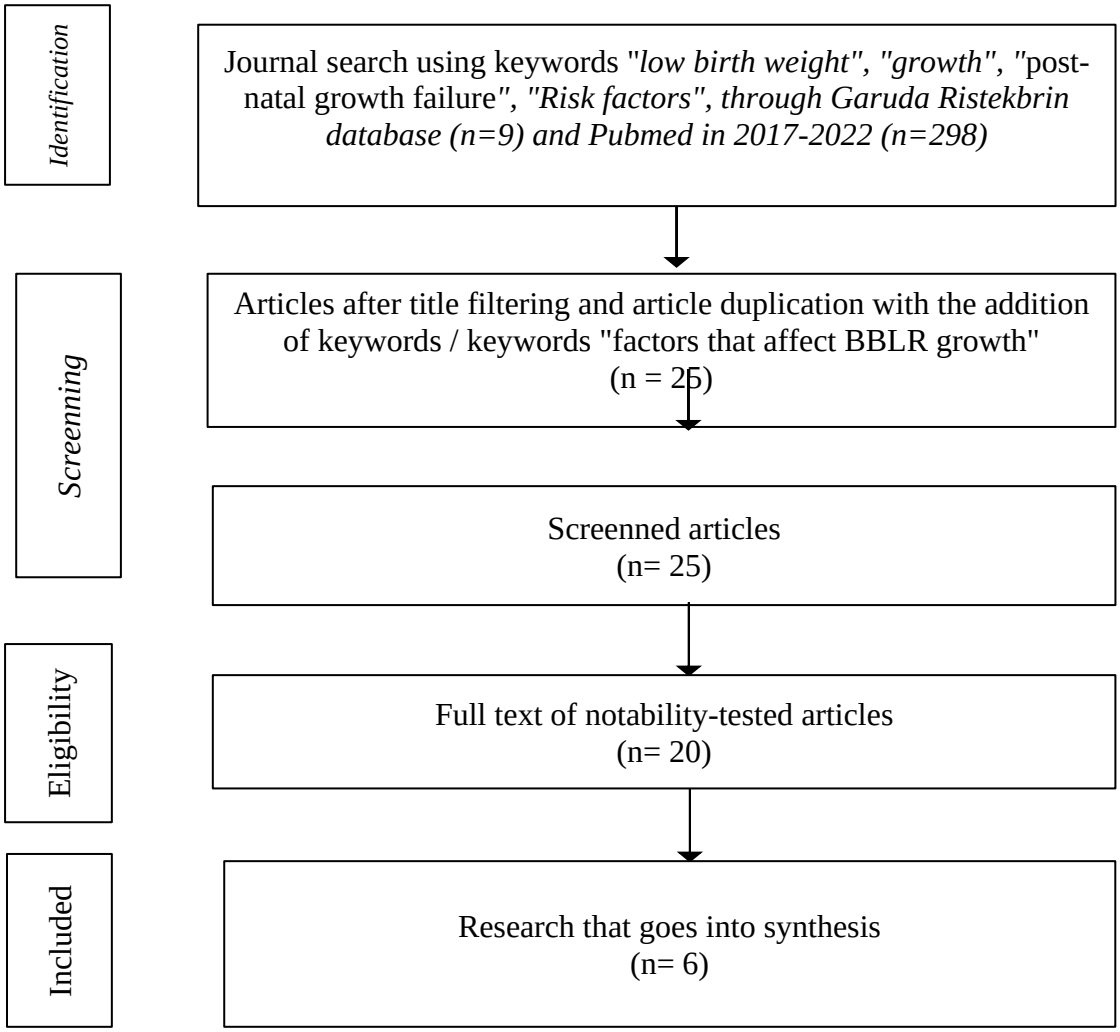

Figure 1. PRISMA Protocol (*Preffered Reporting Items for Systematic Review and Meta Analyses*) Factors Influencing the Growth of Low Birth Weight Babies

Results and Discussion

1. Multiple Linear Analysis

Based on data analysis that has been carried out with systematic *literature review* research with prism method, research findings are obtained in Table 1.

Table 1 Research findings related to factors affecting the growth and development of low birth weight babies

Researchers (year) and Title	Purpose	Design &; location	Research Results
Soon Min Lee, Namhyo Kim, Ran Namgung, Minsoo Park,	• Analyze factors that predict growth failure through a comparison of	•*Cohort Study* • 55 *Korean Neonatal Network centres*	• Overall, the incidence of PGF was 45.5%,: 68.9% in SGA group and

Kookin Park, Jihyun Jeon (2018); Prediction of Postnatal Growth Failure among Very Low Birth Weight Infants	PGF and non-PGF infants. • Analyze independent risk factors affecting postnatal growth in the SGA (Small Gestational Age*) and AGA (*Appropiate Gestational Age*) groups*		36.2% in AGA group • Respiratory distress (OR: 1,012, 95% CI: 1,008–1,050, days to reach 100 ml/kg enteral food (OR: 1,030, 95% CI: 1,015–1,045) is a significant factor for growth failure in the adequate birth group (AGA). • Days to reach 100 ml/kg of enteral food (OR: 1.028, 95% CI 1.006–1.050) were a significant factor for growth failure in the SGA group.
Joohee Lim, So Jin Yoon, Jeong Eun Shin, Jung Ho Han, Soon Min Lee, Ho Seon Eun, Min Soo Park, Kook In Park (2021); Growth failure of very low birth weight infants during the first 3 years: A Korean neonatal network	• Analyze risk factors for growth failure in the first 3 years in babies with very low birth weight	•*Secondary data analysis* (Korean Neonatal Network (KNN) database)	• While gestational hypertension (p <0.01; OR (95% CI): 0.529 (0.343–0.816)) and rehabilitation (p<0.01; OR (95% CI): 2,076 (1,315–3,276) is a risk factor for growth failure among SGA infants • BBLR infants with male sex (p<0.01; OR (95% CI): 1,531 (1,156–2,026), growth failure at birth (p<0.01; OR (95% CI): 2,437 (1,798–3,302)), periventricular condition leukomalacia (p<0.01; OR (95% CI): 1,847 (1,180–2,893), retinopathy

			of prematurity (p<0.01; OR (95% CI): 1,425 (1,025–1,980), VP shunt (p<0.01; 95%CI: 6,359 (2,874–14,074), and rehabilitation (p<0.05, OR (95% CI): 1,462 (1,088–1,963) are risk factors for growth failure among AGA infants
Bireshwar Sinha, Tarun Shankar Choudhary, Nitika Nitika, Mohan Kumar, Sarmila Mazumder, Sunita Taneja, dan Nita Bhandar (2022); Linear Growth Trajectories, Catch-up Growth, and Its Predictors Among North Indian Small-for-Gestational Age Low Birthweight Infants: A Secondary Data Analysis	• Analyze factors associated with poor catch up in SGA-BBLR infants at 6 months of age	*Secondary data analysis* (Data *kangaroo mother care* (ciKMC))	• Among SGA-BBLR infants, 55% showed *catch up growth* by 6 months of age. • Lower wealth quintiles, high birth order, home births, boys, full-term delivery, non-exclusive breastfeeding, and pneumonia were associated with a higher risk of poor growth chase among SGA-BBLR infants.
Teodoro Durá-Travéa, Isabel San Martín-García, Fidel Gallinas-Victoriano, María Jesús Chueca-Guindulain, Sara Berrade-Zubiri (2020); Catch-up growth and	• Analyze the characteristics of catch up growth and some of the factors associated with babies born with very low body weight.	•*Retrospective study* Official child health program in the Navarre region of Spain	• Abnormal height and preterm birth before 28 weeks' gestation were associated with inadequate height growth at ages 2, 4, and 10. Abnormal weight and height were associated with inadequate chase growth only

associated factors in very low birth weight infants			until age 10, while preterm birth between 28 to 32 weeks' gestation was associated with inadequate chase growth only at 2 and 4 years of age
Afsar Omidi, Sahar Rahmani, Roya Amini, dan Manoochehr Karami (2022); The efect of a planned lactation education program on the mother's breastfeeding practice and weight gain in low birth weight infants: a randomized clinical trial study	• Analyze the effect of planned lactation education programs on maternal breastfeeding practices and BBLR infant weight gain	• *randomized clinical trial pretest-posttest design* • *Hamadan University of Medical Sciences, Iran*	• After the education, the average weight score of BBLR babies increased significantly in the treatment group ($p<0.001$) • Maternal breast milk also increased significantly in the treatment group compared to the control group after the lactation training program ($p<0.001$).
Virginie de Halleux, Catherine Pieltain, Thibault Senterre, Frédéric Studzinski, Catheline Kessen, Vincent Rigo, dan Jacques Rigo (2019); Growth Benefits of Own Mother's Milk in Preterm Infants Fed Daily Individualized Fortified Human Milk	• Analyze the relationship between breast milk and growth during the early weeks of life and the effect of breast milk on the growth rate of BBLR babies	• *Prospective study* • NICU of the University of Liège, Belgium	1. Infants who received most breast milk on their own experienced significant weight gain (19.8 ± 2.0 vs 18.2 ± 2.2 g/kg/day; $p = 0.002$) and length (1.17 ± 0.26 vs 0.99 ± 0.36 cm/week; $p = 0.020$) compared to those given donor breast milk • Breastfeeding alone directly accounted for 22.7% of weight gain and length gain of 4.0%

Low birth weight (BBLR) significantly indicates infant survival and intrauterine growth. Differences in postnatal growth rates, especially in babies with low birth weight, are associated with sex, nutritional factors, chronic diseases, lung diseases or sepsis. Some research suggests that male sex, early respiratory distress, bronchopulmonary dysplasia and postnatal steroid exposure exposure are risk factors for postnatal growth disorders in infants with low body weight (Griffin *et al.* 2016). These results are also in line with research by Sinha *et al.* (2022) and Lim *et al.* (2021) which also shows boys and other health disorders such as pneumonia, *periventricular leukomalacia*, *retinopathy of prematurity* and VP shunt are risk factors for postnatal disorders in infants with low birthweight. The presence of health problems in BBLR infants can increase the length of time the baby is hospitalized while the duration of hospitalization for more than 7 days (AOR: 4.2; 95% CI: 2.3 - 7.6; p value <0.001) is independently associated with growth failure in infants with low birth weight (Namiro *et al.* 2012).

Although, the results of research conducted by Santri *et al.* (2014) did not show a significant association of sex factors to growth rates in infants with a history of low birthweight, but family economic status and parental education had a significant relationship to growth rates. This is because poverty is always associated with lack of food, poor environmental health, and ignorance of information about how to take good care of children, how to maintain children's health so that it can hinder efforts to increase growth in children.

Research conducted by Lee *et al.* (2018) and Durá-Travé *et al.* (2020) showed that postnatal growth disorders in BBLR infants were associated with lower gestational age, very low body weight and having lower Apgar scores at birth. Infants with postnatal growth disorders also experienced RDS, air leakage, and pulmonary hypertension that required longer ventilation support, longer ventilation support than the BBLR group without postnatal growth disorders. Research conducted by Lim *et al.* (2021) shows that maternal hypertension during pregnancy is also a risk factor for postnatal growth disorders in infants with low birthweight, especially with *Small Gestational Age* (SGA). Babies born with low body weight with smaller SGA had a 1.89 and 2.32 times greater risk of *stunting* and underweight at 6 months of age compared to infants under gestational age (AGA). Babies who did not regain birth weight for two weeks also had a 1.51 and 1.55 greater risk of *stunting* and underweight compared to babies who gained weight. Therefore, early intervention is necessary that includes optimal feeding support, growth monitoring is important to be given to enable proper weight gain and proactivity in the management of babies with low birth weight.

Nevertheless, early and aggressive intervention for adequate weight gain may further reduce the risk of growth retardation of children with a history of low birth weight (Liao *et al.* 2019). One of the nutritional interventions that can be given is full enteral feeding and this is a factor that inhibits postnatal growth disorders in AGA and SGA infants so it is recommended to provide aggressive nutrient intake used to prevent postnatal growth disorders in BBLR babies. *The ESPGHAN Committee* recommends supplementation of enteral nutrient intake with a reasonable energy intake range of 110-

135 kcal/kg/day (Agostoni *et al.* 2010). In addition, research conducted by Sinha *et al.* (2022) and Omidi *et al.* (2022) also shows that aggressive nutrient intake, one of which is exclusive breastfeeding, can also be an inhibiting factor of growth disorders. Babies with low birth weight (BBLR) have high nutritional needs so they must get nutritional intake, especially from breast milk (ASI) which can significantly affect their weight and length. In addition, exclusive breastfeeding up to six months of age or breastfeeding is recommended for babies with a history of birth weight with low birth weight because it can reduce the risk of lateonset sepsis, necrotizing entercolitis, reduce food intolerance so as to catch up *growth* (De Halleux *et al.* 2019). In addition, early initiation of breastfeeding within 48 hours after birth.

The existence of support for mothers, one of which is education related to breastfeeding and *Kangaroo Mother Care (*KMC) also affects the increase in body weight of babies with low birth weight (Kurniawati *et al.* 2019; Omidi *et al.* 2022). Education to mothers related to breastfeeding can increase the weight of babies with a history of birth with low body weight, namely 2297.5 grams to 2565.6 grams for 14-15 days after education, while in the control group the baby's weight is still relatively low after 14-15 days (Omidi *et al.* 2022). Significant differences were also seen from infant weight gain between the control group (1735.7 ± 297 gr) and the KMC intervention group (1923.4 ± 281 gr) ($\alpha<0.05$) (Kurniawati *et al.* 2019). These results are also in line with research conducted by Siswanti *et al.* (2022) which showed an increase in the body weight of infants receiving kangaroo care, the average weight of babies born low before kangaroo treatment was 1900 grams, while the body weight of infants after receiving kangaroo care increased by 2150 grams (*p-value* = 0.000).

Conclusion

The results of this study show that there are several risk factors for growth failure of children with a history of low birth weight such as gender (male), lower gestational age, and postnatal health problems such as pneumonia, periventricular leukomalacia, retinopathy of prematurity and VP shunt as well as maternal conditions during pregnancy, especially hypertension. However, there are also factors that can inhibit the growth failure of children with a history of low birth weight, including early and aggressive intervention, especially in nutritional intake, namely exclusive breastfeeding or enteral food and maternal parenting practices such as Kangaroo Mother Care (KMC).

The results of this literature review are expected to be a reference for health practitioners to give more attention and treatment to babies with low birth weight by providing early intervention to infants or mothers to increase their confidence in caring for babies with low birth weight so that they can catch up with growth. Suggestions for future research can develop related interventions both to mothers and families to increase self-confidence or the ability to care for babies with low birth weight as an optimal health effort so that children can achieve age-appropriate growth and development processes.

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