

## GROWTH AND DEVELOPMENT ON INFANTS AGED 0-24 MONTHS WITH A HISTORY OF LOW BIRTH WEIGHT (LBW) IN DR. SOETOMO GENERAL HOSPITAL SURABAYA

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### ABSTRACT

**Introduction:** Low birth weight (LBW) is the baby's condition with a birth weight of <2500 grams. Babies with LBW tend to have the body not strong as normal babies, so growth or development disorders are often obtained. The condition ensues because the immaturity of some organs will affect the growth and development. Monitoring growth and development through the growth chart and the Denver II. Age 0-24 represents a critical period so that the time is right for the early detection of disorders. **Aims:** Determine growth according to W/A, H/A, W/H, and HC/A and development according to personal-social, fine motor, language, and gross motor. LBW infants aged 0-24 months Dr. Soetomo General Hospital Surabaya. **Methods:** Quantitative research using descriptive-analytic study and retrospective approach with a cross-sectional method. The sample was 81 babies who used a total population sampling technique with the medical record. Data processing used univariate and bivariate analysis chi-square. **Results:** The development dominated by delays measured using 4 domain (personal-social(59.3%), fine motor skills(61.7%), language(66.7%), and gross motor skills(85.2%)). Growth dominated by normal and above based on H/A(60.5%), W/H(55.6%), and H/A(50.6%); except W/A dominated below normal (55.6%). There was no relation between LBW with growth and development based on all domains, except personal-social domains. **Conclusion:** This study may prove that not all babies with LBW have growth disorder seen from all domains and the development dominate by delay on all domains. There is no relation between LBW with all domains of growth and development except personal-social.

**Keywords:** Denver II, development, low birth weight, growth, growth chart

### INTRODUCTION

Growth and development in infants aged 0-24 months reached a golden period with the intake of balanced nutrition, but the history of LBW which is a condition in birth weight <2500 grams, is considered for the high risk of impaired growth and development because of the low maturity of the organs which have an impact on the adaptation of the baby with the environment as well as fatal a baby in the future (Minarti and Mulyani, 2014). Growth is constantly

changing, quantitative, and irreversible, which is closely related to the size, number, dimensions of the levels of cells and organs that can be seen physically and can measure by the unit weight, length, age of the bones, and as the metabolic balance. While the development is the process of increasing the ability of the structure and function of the psychomotor development of the individual, which concerns the differentiation of cells, tissues, organs, and organ systems with specific functions and can be seen in aspects of functional abilities, such as cognitive,

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motor, social, emotional, language, and moral (Balasundaram and Avulakunta, 2021).

Babies with low birth weight can be caused due to the development and growth disorder while in the uterus, which is commonly known as intrauterine growth restriction (IUGR). Babies with a history of IUGR may be born 37 weeks before pregnancy or within 259 days from the first day of a woman's last menstrual period. This is commonly known as preterm birth or preterm birth (PTB). The cause of this condition is multifactorial contribute, especially maternal, fetal, and placental factors. Maternal factors for example, extra-uterine infection, chorioamnionitis, trauma, and family history such as hypertension can cause pre-eclampsia/eclampsia. Fetal factors could be IUGR, fetal infection, and anomalies. Placental factors such as placental abruption and placenta previa. The underlying etiology is various, but the result is the same that is inadequate uterine-placental perfusion resulting in reduced or absent fetal nutrition (Cutland et al., 2017).

Low birth weight is one indicator of the health or insurance of the community because the impact is not only perceived by babies but also by parents (Cutland et al., 2017). Low birth weight infants' risk of death in the first month of life is twenty times greater than infants born with normal birth weight (Mahayana et al., 2015). Low birth weight babies impact the increased risk of chronic diseases such as cardiovascular and diabetes also immaturity of several organ systems affecting intracranial bleeding, respiratory disorders, sepsis, blindness, and gastrointestinal disorders. Low birth weight infants lead cause of all deaths of children under five years old worldwide (Villar et al., 2012).

The birth of a baby with LBW in Indonesia in 2015 is quite high in the world: more than 497 thousand births and was rated

the second highest cause of neonatal death in Indonesia, equal to 32.4%. LBW ranked in Surabaya fifth highest in East Java as much as 855 birth. LBW includes the problem that can't be underestimated and needs special attention in many countries, particularly developing countries or countries with low socio-economic development (Ministry of Health, 2018; Central Bureau of Statistics of East Java, 2019; WHO, 2019).

In Indonesia, especially in RSUD Dr. Soetomo Surabaya, no research regarding the growth and development of infants aged 0-24 months with a history of LBW based on the domain of weight according to age (W/A), height according to age (H/A), weight according to height (W/H), and head circumference according to age (HC/A) for the growth as well as on the development based on the domain of personal social, fine motor, language, and gross motor. In addition, this study is also to determine the relationship between LBW with the overall domain of growth and development.

## METHODS

This study is a quantitative research using descriptive-analytic design and retrospective approach with cross-sectional methods to determine growth and development of babies aged 0-24 months with a history of low birth weight in Dr. Soetomo General Hospital Surabaya. The sample of 81 patients from a total population of 91 patients in Growth and Development Division of Dr. Soetomo General Hospital Surabaya period January-December 2019 by the inclusion criteria is patients with growth and development disorders. The data were conducted from December 2020 to January 2021 in the Growth and Development Division of Dr. Soetomo General Hospital Surabaya. Retrieval of data using total sampling technique with secondary data derived from the instrument growth chart

and Denver II in the patient's medical record. The variables of this study consist of the independent variables of infants aged 0-24 months with a history of LBW and the dependent variable is the growth and development of the baby. Data analysis was performed using univariate and bivariate analysis chi-square in SPSS. This study received an Ethical Exemption from the Health Research Ethics Committee of Dr. Soetomo General Hospital Surabaya 0187/LOE/301.4.2/XI/2020.

## RESULT

The number of patients diagnosed with LBW aged 0-24 months in Growth and Development Division RSUD Dr. Soetomo Surabaya in the period January-December 2019 who meet the inclusion criteria is total of 81 patients. The characteristics of the subject of 81 patients in the Growth and Development Division Dr. Soetomo presented in Table 1 is dominated by babies with LBW (<2500 grams) a total of 68 patients (84%) and 13 patients (16%) is VLBW (1000-1500 grams), and not obtained in patients with ELBW (<1000 grams). Babies with LBW dominated males as much as 44 patients (54.3%) and female 37 patients (45.7%).

The growth and development of the patient based on the domain and its relationship with LBW were tested using chi-square test statistics. On the data of patients, the majority had impaired growth based on the W/A with normal and below normal (underweight and severely underweight) 45 patients (55.6%) as well as patients with a bodyweight of normal and above normal (possible risk of overweight) a total of 36 patients (44.4%). Based on the H/A normal and above normal dominated with a total of 49 patients (60.5%) as well as data on patient height below normal (stunted

and severely stunted) a total of 32 patients (39.5%). Based on the W/H, patient's normal and above normal (possible risk of overweight, overweight, and obese) dominated as many as 45 patients (55.6%) as well as data on patient nutritional below normal (wasted and severely wasted) a total of 36 patients (44.4%). Based on the HC/A, this was dominated by the size of normal as much as 41 patients (50.6%) and the microcephaly as many as 40 patients (49.4%). The development based on the personal-social domain is dominated by the delay of as many as 48 patients (59.3%), while the normal total was 33 patients (40.7%). Based on the domain of fine motor, this was dominated with patient delay as many as 50 patients (61.7%), while the normal total was 31 patients (38.3%). The language domain is dominated by patient delay as many as 54 patients (66.7%), while normal had 27 patients (33.3%). Based on the domains of gross motor this was dominated with patient delay as many as 69 patients (of 85.2%) while normal was as many as 12 patients (14.8%).

Data on the relation of low birth weight with growth based on the W/A obtained  $p=0.457$ ; based on the H/A obtained  $p=0.186$ , based on the W/H obtained 0.892, based on the HC/A obtained  $p=0.143$ , in the entire domain of the growth of the obtained  $p>0.05$ , which means there is no relationship. Data on the relationship of low birth weight with the development based on the domain of personal social obtained  $p=0.023$ ; based on the domain of fine motor obtained  $p=0.070$ ; based on the language domain of the obtained  $p=0.341$ ; and based on the domains of gross motor obtained  $p=0.095$ . In the entire domain of development except personal social it obtained  $p>0.05$ ; there is no relationship and in the domain of personal social achieved  $p<0.05$ , which means there is a relationship.

**Table 1.** General Characteristics of Patients

Variable	Frequency (n)	Percent (%)
<b>Classification</b>		
LBW	68	84.0
VLBW	13	16.0
ELBW	0	0
<b>Gender</b>		
Male	44	54.3
Female	37	45.7

**Table 2.** The Result of Bivariate Analysis

Variable	Low Birth Wight		p-Value
	Frequency (n)	Percent (%)	
<b>Growth</b>			
<b>W/A</b>			
Above normal (possible risk of overweight) and normal	36	44.4	.457
Below normal (underweight/ severely underweight)	45	55.6	
<b>H/A</b>			
Above normal and normal	49	60.5	.186
Below normal (stunted/ severely stunted)	32	39.5	
<b>W/H</b>			
Above normal (obese/ overweight/ possible risk of overweight) and normal	45	55.6	.892
Below normal (wasted/ severely wasted)	36	44.4	
<b>HC/A</b>			
Microcephaly	40	49.4	.143
Normal	41	50.6	
<b>Development</b>			
<b>Personal Social</b>			
Normal	33	40.7	.023
Delay	48	59.3	
<b>Fine Motor</b>			
Normal	31	38.3	.070
Delay	50	61.7	
<b>Language</b>			
Normal	27	33.3	0.341
Delay	54	66.7	
<b>Gross Motor</b>			
Normal	12	14.8	.095
Delay	69	85.2	

## DISCUSSION

The research results presented in Table 1 show babies with low birth weight dominate (birth weight <2500 grams) as much as 84%. The results of other findings gave the same results, namely the prevalence of the babies with low birth weight in UPT Puskesmas Babat obtained the majority results in the weight category of less than 2500 grams, which is 54.5% (Izzah, 2018).

In this study, infants with BBLR can experience accelerated growth up to the age of two years, but not all give the same results because growth disorders are not only determined by low birth weight but also influenced by constitutional heredity (varies by race, genetics, gender, and birth defects), hormonal factors (insulin, thyroid, sex hormones and steroids), also environmental factors during in the uterus and postpartum (nutrition, injury, socioeconomic, climate, physical activity, and disease) (Nutrisiani, 2010).

The corresponding Table 2 data results found that the growth of LBW infants based on W/A dominated below-normal weight at 55.6%. There was no significant association between LBW and growth based on W/A ( $p = 0.457$ ). The same results obtained in the Seberang Ulu I subdistrict found babies with low birth weight were dominated by below normal by 72,2% (Sari et al., 2020). However, a different study at Rwanda Hospitals found that most LBW infants were normal, 61.9%, and found no meaningful association between low birth weight and growth based on W/A ( $p=0.323$ ) (Kirk et al., 2017).

IUGR (Intra Uterine Growth Retardation) is one of the causes of low birth weight and has a very significant relationship. The baby has a high risk of deficiency or nutritional deficit at birth, resulting in growth disorders and death during the first year of life (Zoleko-Manego

et al., 2021). This condition occurs because of the optimal function of the digestive organs and the activation of digestive enzymes such as lactase sucrase that is not balanced. In addition, the ability of gastric emptying time and the function of sucking and swallowing have not been managed perfectly. Because of that, infants with low birth weight often present necrotizing enterocolitis (NEC) and diarrhea (Nasar, 2016). Underperforming body performance system in low-birth weight babies can be overcome by the intervention of post-birth, early detection, and proper growth management to catch up with delays. Nutrition and a healthy lifestyle are indispensable in preventing infectious diseases that result in growing barriers (Zoleko-Manego et al., 2021). Disorders of growth of body weight are also influenced by biological factors of the baby, the health of the baby, mother, and household, household environment, as well as local health services (Ntenda, 2019).

The results of the growth data in Table 2 are dominated by the normal and above normal, 60.5% and there is no correlation between LBW with H/A. This is in line with the survey data of the national Riskesdas 2013, which represent the 33 provinces in Indonesia with the results of the domination of LBW babies with the normal height of 50.7% (Badriyah, 2019). However, the results are different on the research in the Village of Umbulrejo, Gunung Kidul, Yogyakarta, which is dominated by stunted babies as much as 71.9% and the presence of a significant relationship between LBW with the incidence of H/A in toddlers ( $p=0.056$ ) (Murti et al., 2020).

Birth weight in infants is a strong indicator of body size later in life (Barker, 2004). In his research, Aramico et al. (2016) found that infants with Intra Uterine Growth Retardation (IUGR) find it difficult to pursue growth to normal form during

childhood. Therefore, babies with a history of low birth weight have the chance to have a below normal height such as stunting. Babies with stunting often have developmental restrictions, especially cognitive and motor functions, in the future. In addition, stunting also affects social aspects of daily life (Casale et al., 2014). Failure to grow in infants with a history of low birth weight can occur because there is no perfect catch-up growth. The explanation is not in accordance with the research results at Dr. Soetomo General Hospital Surabaya, which is that infants with low birth weight are dominated by babies with normal and above normal height. The pathogenesis underlying height disorders in low birth weight infants has not obtained further explanation. However, some other factors potentially affect the baby's height in the next period, such as the care after birth of nutrients in breast milk, complementary feeding, and recurrent infections. Environmental or social factors are such as health, education, political stability, population density, social support, income, and the behavior of hygiene. Prenatal factors are such as socio

economic conditions, nutrition, and diseases of the mother and the baby during pregnancy (Aramico et al., 2016)

Research data in Table 2 obtained that most of the nutrition of low birth weight infants is normal to above normal 55.6% and did not obtain the relation between LBW with the W/H. A previous study in Education Hospital Laussane Switzerland obtained a total of 56,3% had normal nutrition; moreover, there is a meaningful relationship between infants' birthweight with BMI (Jornayvaz et al., 2016) A research of 82 villages in the City of Vellore, India found most of the nutrition of babies with low birth weight entry in the categories was below normal, 34.7%, and did not find a meaningful relationship

between birth weight with a BMI of infants ( $p=0.468$ ) (Chakraborty et al., 2014)

Changes in the body's metabolism post-birth as a form of adaptation response to ominous environments that result in malnutrition in the intrauterine period impact the increased risk of metabolic diseases in the future. This situation is reinforced by parental mistakes in gaining growth improvements in infants with low birth weight to overcome growth disorders. Diet early in life affects the plasma concentration of leptin in the body in the future, which is closely related to obesity, insulin resistance, and type 2 diabetes (Barker, 2007; Jornayvaz et al., 2016). Low birth weight babies have less lean body mass, which interferes with the body's energy production and insulin performance in the body. Additionally, hormones related to appetite control, such as high levels of ghrelin, leptin resistance, and low level of adiponectin, will affect weight gain in the first month of life (Kyriakakou et al., 2008). Moreover, infants with higher socioeconomic family backgrounds have the potential to have access to high-energy foods with low physical activity, making them susceptible to weight gain later in life (Jornayvaz et al., 2016). Nutrition is influenced by birth weight and several other factors, such as parental education, shelter, and the environment, which can change parental parenting and affect the child's diet (Rahayu et al., 2015).

Table 2 shows the growth of head circumference in infants of low birth weight is predominantly normal as much as 50.6%, which is not much different to the amount of normal and no relationship was found in LBW with HC/A ( $p=0.143$ ). The same results in the study of Rwanda Hospital found as much as 90.5% of the head circumference of LBW babies was normal and there was no relationship between birth

weight with head circumference ( $p=0.863$ ) (Kirk et al., 2017).

Head circumference has the highest predictive value for birth weight. Head circumference is often used as a guideline in identifying or detecting neonates with low birth weight. Babies born with small size are likely to have smaller organs, especially the brain. In the fetus in the uterus, brain growth is very rapid. Poor nutritional conditions in pregnant women can cause fetal brain cells to decrease, especially in the cerebrum (Septira and Anggraini, 2016). The hypothalamus pituitary axis (HPA Axis) regulates normal responses to stress. Psychosocial stressors during pregnancy, maternal immune activation (MIA), and HPA modification can significantly impact fetal brain development (Khan and Leventhal, 2021). The manifestation of brain size shows the head circumference and is likely to affect cognitive levels in infants (Septira and Anggraini, 2016).

The cause of developmental delay or disorders is same as growth, most are idiopathic. The underlying pathophysiology is not known for sure but epidemiological studies have proposed several mechanisms that cause developmental delays to be differentiated into four groups. The prenatal group is due to family genes assumed to perform an important role in developmental delays, cerebral dysgenesis, vascular disorders such as bleeding or occultism, complications due to infection, medications, and toxins. The perinatal group are prematurity, perinatal asphyxia, and metabolic diseases such as bilirubin disorders. The postnatal group are infections, metabolic disorders, anoxia, trauma, and vascular. In other groups, social, mental health disorders in the mother, idiopathic, and other environmental stressors could cause developmental delays. Developmental delay can occur when failure reaches a stage compared with peers from

the same population. It is caused by disturbances in one domain, the combined domain, or global (mostly affecting the development area's domain). Therefore, early detection and intervention are necessary to avoid long-term disability (Khan and Leventhal, 2021).

Based on the research results in Table 2, the development of LBW infants based on the personal-social domain delays is as much as 59.3% and there is a relationship of low birth weight infants with a delay of personal social reliance. The same results found in Wonosobo Regency obtained a total of 73.1% of LBW infants under two years experience interference (Ashar et al., 2021).

The domain of personal social reliance cannot stand alone and will always depend on other domains such as gross motor, fine motor, and language. Such as the example of the baby, who initially sits down and grabs a moving object, this activity is a task for the baby to try to interact, stabilize the body's physiological and social sensitivity which are all affected by the ability to communicate, language, and the social and cognitive development. So, when a baby with disorders of the personal social domain is found it can be ascertained that the baby has suffered a developmental disorder in the other domain (Holloway and Long, 2019). The cause of the delay of the personal social domain in infants is also influenced by the stimulus and the quality of interaction of the baby with the parents. In addition, the parents' confidence and freedom they give from an early age are also appropriately influential on the domain. Freedom and trust will help the baby in exploration efforts (Wayan et al., n.d.). Factors of pregnancy also affect the delay, such as knowledge of the mother while pregnant, the quality of nutrition and sanitation during pregnancy, and visits to health services are very

influential on the condition of the baby (Westgard and Alnasser, 2017).

The research results contained in Table 2 show the development of LBW infants based on the motor domain is dominated by the fine motor delay as much as 61.7% while the gross motor is 85.2% and also shows there is no relationship between LBW with motor development (fine motor  $p=0.070$  and gross motor  $p=0.095$ ). The results of the research are in line with the findings in Puskesmas Babat, that LBW infants have impaired fine motor as much of 72.7% and gross motor as much as 77.3% as well as the relationship between LBW with the development of both fine motor and gross motor (fine motor  $p=0.007$  and gross motor  $p=0.019$ ) (Izzah, 2018). The findings of different research in Wonosobo Regency majority of LBW infants were that 73.1% had normal motor development and did not reveal any significant relationship between LBW and the status of infant motor development ( $p=0.97$ ) (Ashar et al., 2021).

Based on the research results in Table 2, development of LBW infants based on the domain of language dominated the delay by 66.7% and no correlation was found between LBW with the language domain ( $p=0.341$ ). Other research findings in the RSB Rachmi Yogyakarta were as much as 87.5% of LBW infants have speech and language disorders and obtained a relationship between LBW with developmental disorders of speech and language ( $p=0.027$ ) (Sari, 2015). In addition, other studies in the area of Wonosobo give other results that were dominated by normal babies by 90.4%, and it was also found that there is no significant relationship between LBW with the language skills of the baby ( $p=0.17$ ) (Ashar et al., 2021).

In premature low birth weight infants, optimal maturation in the brain and nervous system does not occur, so that it can lead to

growth disorders such as functional impairment and motor disorders. Babies with low birth weight are often found to have the weight and size of the lower brain and the acquisition of a deficit of brain cells, particularly in the frontal and posterior seen from the size of the head circumference of a baby, tends to have little effect on neural development and the impact on motor and language development (Scharf et al., 2016). A baby with a neuromuscular disorder often presents with a gross motor delay but not all are accompanied with a fine motor delay (Lurio et al., 2015). Gross motor skills are responsible for movement and balance, such as run, walk, and jump. Gross motor is the first domain that the baby must master because with this the baby will be helped to interact with the environment to provide an opportunity to enrich the other domain of the development, in particular the domain of language. Therefore, a baby experiencing delays in the gross motor stage at higher risk of developmental delay at the four other domains. Fine motor factors are associated with the dexterity of such a view, response writing, typing, drawing, and manipulating objects and are closely related to the language domain because the coordination of the lips, tongue, and facial muscles affects the ability to speak (Ribeiro et al., 2017). Intervention treatment, duration of hospital stay, and medical complications of neonates, such as septicemia, intraventricular hemorrhage, chronic lung diseases, apnea, and bradycardia, can have a negative impact on brain development and contribute to highlight the deficits in neurobehavioral in the long term, which have a bad effect on speech development with delayed language (Ribeiro et al., 2011).

In this research on the growth and development of low birth weight infants aged 0-24 months in the Growth and Development Division of Dr. Soetomo General Hospital, Surabaya the results

obtained that low birth weight has more impact on development than infant growth with evidence of the dominance of disorders occurring in the domain of development. This is contrary to the theory of growth and development that growth and development are not separate and also the processes occur simultaneously and are related. However, the results of this study are in line with the theory that the rate of growth and development is different for each individual because the data are taken from several individuals at different ages but at the same time (Ingriani, Rinjani and Adila, 2019).

## CONCLUSIONS

Results obtained in this study showed that infants with low birth weight were more influential on the development than the baby's growth, with a demonstrated predominance of the disorder occurring in the development domain. In addition to that, no relationship was found between low birth weight infants with all domains growth and development except the domain of personal social obtained a relationship.

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