ASSOCIATION BETWEEN BIRTH WEIGHT, BIRTH LENGTH, AND STUNTING: AN ANALYSIS OF CASES AT LEMPAKE PUBLIC HEALTH CENTER, EAST BORNEO, INDONESIA

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ABSTRACT

Stunting remains a significant public health concern in Indonesia, as it affects early childhood growth and development, leading to long-term health and cognitive impairments. Birth length and birth weight are critical predictors of stunting, as inadequate growth parameters at birth may contribute to poor nutritional status and delayed development. Toddlers, particularly those in low-resource settings, are among the most vulnerable age groups to dietary deficiencies, making early identification of risk factors essential for prevention efforts. This study aimed to assess the association between birth weight, birth length, and the incidence of stunting among children at Lempake Community Health Center in Samarinda, Indonesia. A quantitative analytic observational study with a case-control design was conducted to evaluate the relationship between these perinatal factors and stunting risk. The findings revealed that stunting was more prevalent among male infants (51.1%) aged 0–11 months. A statistically significant association was observed between birth weight and stunting (p = 0.00), with an odds ratio of 0.414 (95% CI: 0.23–0.72), indicating that children born with a birth weight of <2500 grams had a higher likelihood of experiencing stunting. Similarly, birth length was significantly associated with stunting (p =0.02), with an odds ratio of 0.264 (95% CI: 0.13–0.50), suggesting that infants with a birth length of <48 cm were at an increased risk. These findings underscore the importance of monitoring birth weight and length as early indicators for stunting prevention strategies in Indonesia.

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Highlights:

1. Children born with a birth wight of less than 2500 grams had a significantly higher risk of stunting (p = 0.00; OR = 0.414, 95% CI: 0.23–0.72), while those with a birth length of less than 48 cm were also at an increased risk (p = 0.02; OR = 0.264, 95% CI: 0.13–0.50).

2. These findings emphasize the critical role of birth weight and birth length as early predictors of stunting, highlighting the need for targeted interventions to prevent childhood malnutrition and growth delays

INTRODUCTION

Toddlers are among the age groups most susceptible to nutritional deficiencies. One of the main concerns of dietary problems in toddlers is stunting, which remains a significant health issue in Indonesia. Addressing stunting globally is one of the objectives of the Sustainable Development Goals (SDGs). Even though it has steadily declined since 2000, we need faster progress, especially in Asia and Africa. Because 52% of children under 5 years old are affected by stunting, and 70% of all children affected by wasting live in Asia[1]. If current trends continue, an estimated 128.5 million children (19.5%) will be stunted in 2030. Indonesia is one of Asia's low- and middle-income countries (LMICs), with a stunting proportion of around 26.8%, higher than the global proportion[2]. Moreover, the prevalence of stunting in East Kalimantan Province in 2021 is 22.8%[3]. Stunting is defined as a condition of the nutritional status of toddlers with a length or height classified as less than their age. Birth length and weight have the potential as predictors of stunting. Predictors are crucial for prevention, early detection, and getting faster treatment. The pathogenesis underlying growth flattering or linear growth is poorly understood[4]. Measurements are carried out using child growth standards from WHO, namely with the interpretation of stunting if it is more than minus two median standard deviations. Many factors, such as socioeconomic conditions, maternal nutrition during pregnancy, infant pain, and inadequate nutritional intake in infants, can cause toddler stunting. These contributing factors typically persist over an extended period[5].

The causes of stunting include growth retardation in the womb, insufficient nutrient intake during infancy and childhood, frequent exposure to infectious diseases, low birth length, and weight, and inappropriate feeding practices and food consistency for the child's age.

Children born with low birth weight (LBW) are often the result of insufficient maternal nutrient intake during pregnancy, which inhibits growth and increases susceptibility to infectious diseases[6]. Moreover, socioeconomic disadvantage, poverty, and food insecurity were widespread problems in LMICs, including Indonesia. It caused higher maternal mortality, low weight gain, and inadequate fetal nutrition[7].

The short-term impacts of stunting include increased incidence of morbidity and mortality, suboptimal cognitive, motor, and verbal development in children, and higher health costs. The long-term effects of stunting include a body posture not appropriate for age, increased risk of obesity and other diseases, decreased reproductive health, reduced learning capacity and suboptimal school performance, and lower productivity and work capacity[8].

Babies with a history of low birth weight can be affected in their development, as can be seen from anthropometry. Birth weight is usually strongly associated with infant and child morbidity and subsequent growth and development. Birth length is a significant risk factor for stunting in toddlers and is one

of the determinants of the delay in growth and development[5] .

The main objective of this article is to analyze the odds ratio of birth weight and birth length regarding stunting outcomes in children at the Lempake Community Health Center in Samarinda, Indonesia.

MATERIALS AND METHODS

This research is a quantitative analytic observational design with a case-control approach. The population consisted of children aged 0 to 60 months who were recorded in the working area of the Lempake Community Health Center and visited between January 2022 and April 2023, excluding those who did not meet the inclusion criteria, such as incomplete medical records or toddlers with chronic diseases (e.g., tuberculosis, congenital heart disease. The sample for this research was selected using simple random sampling, resulting in 280 children divided into two groups. 1) case group, group that consist of children who stunted, and 2) control group, children who were not stunted. The study included independent variables of gender, age, birth length, and birth weight. The dependent variable was the stunting cases. The data were analysed using the chi-square test. The Spearman Rank was used for the variables of children's age, while the Pearson correlation was utilized to examine the relationship between birth length, birth weight, and stunting status. Furthermore, logistic regression analysis was performed to identify the most substantial factors associated with stunting, with a significance cutoff set at $p<0.05$.

The research protocol has been approved by the Medical Research Ethics Committee of Fakultas Kedokteran Universitas Mulawarman (Approval number: 184/KEPK-FK/VII/2023, Date: July 27th, 2023)

RESULTS

Characteristic

Table 1. Sample Distribution Characteristics

	Stunting condition			
	Stunted		Not Stunted	
	N	%	N	%
Gender				
Male	42	29.4%	101	70.6%
Female	29	21.2%	108	78.8%
Age (month)				
0 – 11	12	13.8%	75	86,2%
12 – 23	13	23.6%	42	76.4%
24 – 35	25	50%	25	50%
36 – 47	19	38%	31	62%
48 – 60	2	5.3%	36	94.7%
Total	**71**	**25.4%**	**209**	**74.6%**

Table 1 showed that 143 (51.1%) were male, and 137 (48.9%) were female. Forty-two male toddlers (29.4%) and 29 female toddlers (21.2%) were stunted. Most respondents (n=143, 51.1%) were male, and most (n=87, 31.1%) were aged 0-11 months at the time of measurement. Interestingly, at the age group 24–35 months, the percentages of toddlers stunted and not stunted are equal.

Table 2 showed that the majority of respondents (n=223, 83.2%) had a birth weight >2500 grams, while 16.8% (n=47) had a birth weight ≤2500 grams. Using the chi-square test revealed a significant association between birth weight and stunting (p=0.00), with an odds ratio of 4.130 (95% CI 2.144-7.9532); thus, children with a birth weight ≤2500 grams have a higher risk of stunted 4.130-fold higher.

Birth Weight Toward Stunting

Table 2. Correlation between birth weight and stunting

Birth weight	Stunting Condition				Total	p-value	Odds Ratio (95% CI)
	Not stunting		Stunting				
	N	%	N	%			
≤ 2500	24	8.57 %	23	8.21 %	47	0.000	0.414
≥ 2500	186	66.42 %	47	16.78 %	223		(0.23 – 0.72)
Total	**210**	**75.00 %**	**70**	**25.00 %**	**280**		

Birth Length Toward Stunting

Table 3. Correlation between birth length and stunting

Birth length	Stunting Condition				Total	p-value	Odds Ratio (95% CI)
	Not stunted		Stunted				
	n	%	n	%			
≤ 48	52	62.7%	31	37.3%	83	0.04	2.340
> 48	157	79.7%	40	20.3%	197		(1.331-4.114)
Total	**209**	**74.6%**	**71**	**25.4 %**	**280**		

Table 3 shows the majority of respondents (n=197, 70.4%) had a birth length >48 cm, while 29.6% (n=83) had a birth length ≤48 cm. This aligns with a study in Musi Rawas Regency, where 64.3% of respondents reported a birth length >48 cm. 75% of children with a birth length under 48 cm (n=21) experienced stunted growth. Using the chi-square test revealed a significant association between birth length and stunted (p=0.04), with an odds ratio of 2.340 (95% CI 1.331-4.114); thus, children with a birth length ≤48 cm have a higher risk of stunted 2.340-fold higher compared to those with a birth length >48 cm.

DISCUSSION

Stunting was more prevalent in males than females[9–14]. This finding is higher stunting prevalence in males; the discrepancy may be attributed to differing nutritional needs between sexes, with males requiring more energy, protein, and a lower satiety level[15] noted that boys tend to experience lower satiety levels than girls, potentially influencing nutrient intake and increasing their susceptibility to obesity. This is likely due to differences in body composition and energy and nutrient requirements between sexes.

In this study, most respondents had a birth weight >2500 grams, which was not stunted. Children with a birth weight under 2500 grams have a higher risk of stunting, 4.130-fold higher. This result aligns with other studies where most respondents had a regular birth weight history and a significant correlation between birth weight and stunting in children aged 24-59 months[16,17]. However, LBW is identified as a risk factor for stunting, as it can impair infant growth. If coupled with inadequate nutrition, frequent infections, and poor healthcare, LBW can lead to stunting as

most non-stunted children have a birth weight below 2500 grams[18].

LBW infants may experience gastrointestinal problems due to immature digestive tracts. They may also face breastfeeding difficulties due to small size, weakness, small stomach capacity, and inability to suckle effectively, leading to growth delays. LBW infants with compromised digestive systems can lead to nutrient malabsorption and electrolyte imbalances. Their small size, weakness, and difficulty breastfeeding further hinder growth. If this persists alongside inadequate nutrition (e.g., lack of exclusive breastfeeding), these children are prone to infections and stunting. Birth weight is strongly linked to fetal, neonatal, and post-neonatal mortality, as well as infant and child morbidity and long-term growth and development. The impact of LBW can even extend across generations, with LBW children experiencing smaller anthropometric measurements throughout development due to intrauterine growth restriction. This can lead to slower growth and development compared to children with normal birth weight, potentially hindering their ability to reach their full growth potential. These health issues can persist into adolescence, resulting in short stature[16,17,19].

Our statistical analysis contradicts other findings that found no association between birth weight and stunting in children aged 1-2 years. This discrepancy may be due to the higher impact of birth weight on stunting in the first 6 months, which then decreases to 24 months. Normal growth is likely if catch-up growth occurs within the first 6 months[20]. Furthermore, a descriptive case study found that only 9.3% of stunted children (n=97) had abnormal birth weight. This suggests that stunting is multifactorial and influenced by imbalanced nutrition, a history of infection, and low birth weight. Adequate food and the absence of disease in LBW infants may prevent stunting[20,21].

Our study reveals that most respondents had a birth length >48 cm, while 29.6% (n=83) had a birth length ≤48 cm. This aligns with a study in Musi Rawas Regency, where 64.3% of respondents reported a birth length >48cm; 75% of children with a birth length under 48 cm (n=21) experienced stunted growth. Our study revealed a significant association between birth length and stunting. Children with birth length ≤48 cm have a higher risk 2.340-fold higher This aligns with previous studies[17,18,21,22].

Insufficient birth length indicates inadequate maternal nutrition during pregnancy, leading to suboptimal fetal growth. Increased intake of nutritious food is crucial for promoting growth in children with short birth lengths to achieve normal height as they age[14,19]. Short birth length occurs due to fetal growth plasticity in response to environmental changes during pregnancy, which can lead to irreversible stunting if instability occurs. Inadequate maternal nutrition during pregnancy can trigger fetal adaptation, resulting in growth delays and reduced cell development, including brain and organ cells[23].

It found that 75% of children with a birth length under 48 cm (n=21) experienced stunted growth, compared to 67.5% of those with standard birth length (n=27). They reported a significant correlation between birth length and stunting in children aged 24-59 months (p=0.001), with those born under 48 cm at 6.231 times higher risk[17].

Infants with adequate birth length often indicate good maternal nutrition

during pregnancy, sufficient fetal energy and protein intake, and the absence of intrauterine growth restriction. This protects them from breastfeeding difficulties associated with small size, allowing for proper growth and development[7,17].

Birth length is a crucial indicator of an infant's nutritional status during pregnancy. Low birth length reflects inadequate past nutrition, particularly energy and protein deficiencies[22]. It is associated with stunting, as infants with low birth length have smaller body proportions, potentially leading to reduced brain volume and impaired cognitive development. Low birth length can be caused by poor socioeconomic conditions, maternal illness, and malnutrition throughout pregnancy[21].

Short birth length reflects inadequate maternal nutrition during pregnancy, leading to suboptimal fetal growth. Continued undernutrition during childhood can further hinder growth. Increased intake of nutritious food is crucial for promoting growth in children with short birth lengths to achieve standard height as they age[17].

In this study, most respondents (n=210, 75%) were not stunted, while 25% (n=70) were stunted. This aligns with a survey in Surakarta, where 54.2% of respondents were not stunted[24]. Although the non-stunted group had a higher percentage, the stunting rate still exceeded the WHO-recommended threshold of 20%[25].

On the condition that we compared, the most significant contributing factor to stunting was LBW. Furthermore, using the regression logistic Wald value from this variable was 10.750, and the F value was 66.092. It was indicated that birth weight has contributed more to poor maternal nutritional status, infections, and inadequate exclusive breastfeeding. Effective treatment options are available to alleviate stunting, dietary shortages, and child fatalities. Assuming implemented on a large scale, they would reduce DALYs (all child deaths) by almost a fourth in the short run[26]. Both LBW infants and stunted children face challenges in catch-up growth. Stunting can impact posture, sensory-motor skills, and cognitive development. Proper nutrition, including exclusive breastfeeding and timely complementary feeding, promoting healthy behaviours, and regular growth monitoring, can address these issues[27]. A multi-sectoral approach is needed to address stunting. Based on these findings, we recommend that Lempake Community Health Center (Puskesmas) staff provide optimal services, such as growth monitoring and supplementary feeding during Integrated Health Service Posts (Posyandu) activities. Collaboration with health cadres to coordinate with parents is crucial to ensure proper childcare and nutrition for every child.

CONCLUSION

This study identified a significant association between birth weight and birth length and the incidence of stunting in children at Lempake Community Health Center. Furthermore, public health centers should disseminate information through posters, leaflets, counselling sessions, and other media to raise awareness about the importance of adequate nutrition for infants and young children. Also, to educate the community about the risk factors for stunting, emphasising the importance of monitoring child growth and development to reduce stunting prevalence. It is crucial to monitor child growth and development

actively and regularly, particularly in children with risk factors such as low birth weight and short birth length. Utilising growth monitoring services at Posyandu can help detect growth and development disorders early for prompt intervention and improved outcomes.

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CONFLICT OF INTEREST

All Authors have no conflict of interest in this research.

ETHICS CONSIDERATION

The research received ethical clearance from the Medical Research Ethics Committee of Fakultas Kedokteran Universitas Mulawarman (184/KEPK-FK/VII/2023) on July 27th, 2023.

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AUTHOR CONTRIBUTION

All authors have contributed to all processes in this research, including preparation, data gathering, analysis, drafting, and approval for publication of this manuscript.

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