



Determinants of malnutrition in children aged 6-36 months

Faktor-faktor yang menentukan malnutrisi pada anak usia 6-36 bulan

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Abstract

Stunting in children increases their risk of mortality, cognitive impairment, motor development, and poor body function. This study aimed to examine the relationship between low birth weight, low birth length, sex, age, and weight growth status and the prevalence of stunting, underweight, and wasting in children aged 6–36 months in West Lombok Regency, Indonesia. Methods: A cross-sectional study was conducted between November 2023 and May 2024 with 544 children. Secondary data were obtained from two community health centers in the study area. Data analysis was performed using the Spearman correlation test and chi-square test. Results: Birth weight and length were significantly associated with nutritional status in children. Higher birth weight was positively correlated with a better weight-for-age Z-score (WAZ; $p = 0,001$), height-for-age Z-score (HAZ; $p = 0,009$), and weight-for-height Z-score (WHZ; $p = 0,0001$), indicating a strong influence on overall growth and nutritional outcomes. Similarly, a greater birth length was significantly associated with WAZ ($p = 0,0001$), HAZ ($p = 0,002$), and WHZ ($p = 0,006$). Age was also correlated with HAZ ($p = 0,005$) and incidence of stunting ($p = 0,0001$), suggesting an age-related cumulative effect on linear growth. Moreover, children with low birth weight had a significantly higher risk of stunting ($p = 0,0007$), whereas those with low birth length were more likely to be underweight ($p = 0,050$). In conclusion, LBW and LBL are significant risk factors for stunting, wasting, and underweight in children aged 6–36 months in West Lombok Regency.

Keywords: Low birth weight, low birth length, child malnutrition determinants

Abstrak

Stunting pada anak meningkatkan risiko kematian, gangguan kognitif, perkembangan motorik, dan fungsi tubuh yang buruk. Penelitian ini bertujuan untuk menganalisis hubungan antara berat badan lahir rendah, panjang badan lahir rendah, jenis kelamin, usia, dan status kenaikan berat badan terhadap kejadian stunting, underweight, dan wasting pada anak usia 6–36 bulan di Kabupaten Lombok Barat, Indonesia. Metode: Penelitian ini menggunakan desain cross-sectional yang dilakukan pada bulan November 2023 – Mei 2024 dengan melibatkan 544 anak. Data sekunder diperoleh dari dua puskesmas di wilayah studi. Analisis data dengan uji korelasi Spearman dan chi-square. Hasil: Berat badan lahir dan panjang lahir memiliki hubungan yang signifikan dengan indikator status gizi anak. Berat lahir yang lebih tinggi berkorelasi positif dengan skor Z yang lebih baik untuk berat badan menurut tinggi badan (BB/U; $p = 0,001$), panjang badan menurut umur (TB/U; $p = 0,009$, dan berat badan menurut usia (BB/TB; $p = 0,0001$), yang menunjukkan pengaruh besar terhadap pertumbuhan dan status gizi secara keseluruhan. Panjang lahir juga menunjukkan hubungan yang signifikan dengan WAZ ($p = 0,0001$), HAZ ($p = 0,002$), dan WHZ ($p = 0,006$). Usia anak berkorelasi dengan HAZ ($p = 0,005$) dan kejadian stunted ($p = 0,0001$), yang mengindikasikan adanya efek kumulatif terhadap pertumbuhan linier seiring pertambahan usia. Anak dengan berat badan lahir rendah memiliki risiko stunting yang lebih tinggi secara signifikan ($p = 0,0007$), sedangkan panjang

badan lahir rendah berhubungan dengan underweight ($p = 0,050$). Kesimpulan: Berat badan lahir rendah (BBLR) dan panjang badan lahir rendah (PBLR), merupakan faktor risiko signifikan terhadap stunting, wasting, dan undeweight pada anak usia 6-36 bulan di Kabupaten Lombok Barat.

Kata Kunci: Berat badan lahir rendah, panjang lahir rendah, faktor-faktor malnutrisi pada anak

Introduction

A good nutritional status is one of the main determinants of optimal child health. Imbalanced nutritional intake, especially in early life, can have serious long-term impacts, including increased risk of morbidity and mortality, impaired cognitive development, and delayed motor development (Hartono, 2017; Papotot et al., 2021). Toddlerhood is seen as a critical period that greatly determines the direction of child growth and development; therefore, meeting nutritional needs appropriately from an early age is an aspect that cannot be ignored in efforts to improve the quality of life and productivity of future generations.

Global reports note that the prevalence of stunting in children under five remains a serious challenge, with the figure reaching 22,3% globally in 2022 (WHO, 2024). In Indonesia itself, the trend of decreasing stunting from 37,2% in 2013 to 24,4% in 2021 shows progress, but this achievement is still above the maximum threshold recommended by WHO, which is 20%, and has not met the national target of 14% in 2024 (Kementerian Kesehatan RI, 2021). In West Nusa Tenggara (NTB) Province, the prevalence of stunting has been reduced to 24,6% in 2023 but is still above the national average (Kementerian Kesehatan RI, 2023). At the district level, data shows that the prevalence of underweight at 17,59%, stunting at 22,71%, and wasting at 5,18% still requires special attention, considering that these figures exceed the limits set by WHO and have the potential for multidimensional impacts on children's quality of life in the future (Dinas Kesehatan Kabupaten Lombok Barat, 2022). The nutritional status assessment indicators used include height for age (HAZ), weight for age (WAZ), and weight for height (WHZ), where a Z score below -2 SD indicates stunting, underweight, or wasting conditions (Kementerian Kesehatan RI, 2020).

The high rates of stunting, underweight, and wasting in the West Lombok Regency indicate the need for a deeper understanding of the risk factors contributing to nutritional problems in toddlers. Several factors are known to be closely related to the incidence of malnutrition, including low birth weight (LBW), birth length, sex, age, and child growth status. Research shows that babies with LBW have a 6.16 times greater risk of stunting compared to babies born with normal weight (Supriyanto et al., 2018). In addition, shorter birth length is also an early indicator of postnatal growth disorders (Rahmadi, 2016). Gender factors are also influenced by the nutritional needs and growth patterns of boys and girls, which are physiologically different (Rahmadi, 2016). Monitoring data from the EPPGBM (Electronic Community-Based Nutrition Recording and Reporting) application in 2023 showed that the prevalence of stunting in the Narmada Health Center (17,84%) and Meninting Health Center (14,16%) areas was still below the national target (Kementerian Kesehatan RI, 2023). This study aimed to analyze the relationship between birth weight, birth length, sex, age, and weight growth status and the incidence of stunting, underweight, and wasting in children aged 6–36 months in the working area of the West Lombok Regency Health Center. The findings of this study are expected to provide a scientific basis for the preparation of targeted nutritional intervention programs and strengthen evidence-based public health policies at the local level.

Methods

Study Design and Setting

This was an analytical observational study that used a cross-sectional approach. The data used were secondary data from toddler weighing results obtained through the Electronic Application for Community-Based Nutrition Recording and Reporting (EPPGBM) from the

Nutrition Division of the Narmada Health Center and Meninting Health Center, West Lombok Regency, Indonesia. The study was conducted between November 2023 and May 2024.

Population and Sample

The population in this study included all toddlers aged 6–36 months who experienced stunting based on weighing results in August 2023 in the working areas of the Narmada and Meninting Health Centers. The initial study population consisted of 549 children. After applying the inclusion and exclusion criteria, and verifying the completeness of the data, the final sample size was 544 children.

Inclusion and Exclusion Criteria

This study included toddlers aged 6–36 months who were recorded as experiencing stunting in August 2023 EPPGBM data. Exclusion criteria included incomplete data (such as no birth weight, birth length, or sex), children with a history of congenital diseases (such as congenital heart defects and genetic syndromes), and other medical conditions that could significantly affect growth.

Data Collection and Ethical Considerations

Data collection was conducted through an official request from the two health centers, accompanied by a research proposal. After obtaining approval, the researcher made a payment for Non-Tax State revenue (PNBP) for data access and signed an informed consent form regarding the use of secondary data. This study was approved by the Health Research Ethics Committee of the Faculty of Public Health, Diponegoro University (No. 576/EA/KEPK-FKM/2023). Permission to use secondary data was also obtained from the Head of Nutrition center at each health center.

Definition of Variables

Nutritional status was classified based on the WHO Child Anthropometric Standards (2006) and Regulation of the Minister of Health of the Republic of Indonesia Number 2 of 2020. Stunting was defined as a height-for-age Z-score (HAZ) less than -2 standard deviation (SD). Underweight was defined as a weight-for-age Z-score (WAZ) of less than -2 SD, whereas wasting was defined as a weight-for-height Z-score (WHZ) of less than -2 SD. Low birth weight (LBW) is defined as a baby with a birth weight of

less than 2500 g according to the WHO criteria. Low birth length was defined as birth length below the 10th percentile according to gestational age, based on the WHO growth chart.

Statistical Analysis

Data analysis was performed descriptively and inferentially. Descriptive statistics included the frequency distribution, percentage, minimum, maximum, mean, and standard deviation values. The Spearman correlation test was used to determine the relationship between birth weight and Z scores of HAZ, WAZ, and WHZ. Chi-square test was used to analyze the relationship between birth weight, birth length, age, prematurity, sex, and nutritional status (stunting, underweight, and wasting). In the chi-square analysis, the nutritional status categories of 'stunted and severely stunted', 'underweight and severely underweight', and 'wasted and severely wasted' were combined into one group to facilitate analysis. Birth weight and birth length categories were also divided into two groups (<2500 grams and ≥2500 grams; <10th percentile and ≥10th percentile). Statistical significance was set at $P < 0,05$. All analyses were performed using the IBM SPSS Statistics software version 25 (IBM Corporation, Armonk, NY, USA).

Result and Discussion

The proportion of male children aged 6–36 months (55,1%) surpassed that of the female children (44,9%), as shown in Table 1. In the West Lombok Regency Health Centre's jurisdiction (Narmada Health Centre and Meninting Health Centre), the prevalence of nutritional deficiencies among stunted children was as follows: underweight and severely underweight, 74,2%; stunted with a short classification, 67,6%; very short (severely stunted), 32,4%; and wasted and severely wasted, 18,9%.

Table 1 indicates that 14% of stunted children aged 6–36 months had a history of low birth weight (LBW), whereas 10,3% had a record of low birth length (LBL). This information is presented in the context of children between the ages of six and 36 months. Of the overall sample, 544 stunted children aged 6-36 months had weight gain data from the preceding month's measurements. The majority

(56,1%) did not experience weight gain (T), whereas 43,8% experienced weight gain (N). Furthermore, 0,2% of stunted children aged 6-36 months weighed this month, although they did not have weight data from the preceding month.

Table 1. Characteristics of stunting children aged 6-36 months (n= 544)

Variables	n	%
Child Gender		
Male	300	55,1
Female	244	44,9
Age		
6-24 months	362	66,
25-36 months	182	33,5
Nutritional Status by WAZ		
Overweight	1	0,2
Normal	139	25,6
Underweight	294	54
Severely Underweight	110	20,2
Nutritional Status by HAZ		
Stunted	368	67,6
Severely Stunted	176	32,4
Nutritional Status by WHZ		
Obese	2	0,4
Overweight	7	1,3
Normal	432	79,4
Wasted	97	17,8
Severely Wasted	6	1,1
History of LBW		

Yes	76	14
No	468	86
History of LBL		
Yes	56	10,3
No	488	89,7
Weight Gain Status in August 2023 Weighing Month (n= 544)		
N (Number of Toddlers Gaining Weight this Month)	238	43,8
O (Number of Toddlers Weighed This Month but Not Weighed Last Month)	1	0,2
T (Number of Toddlers Who Did Not Gain Weight this Month)	305	56,1

WAZ= weight-adjusted Z-score, HAZ= height-adjusted Z-score, WHZ = weight for height Z-score, LBW = Low Birth Weight, LBL = Low Birth Length, Data is presented as numbers (percentages)

The number of stunted youngsters aged 6-36 months from a total of 544 who possessed weight growth data from the preceding month's measurements: Approximately 56,1% did not have weight growth, but 43,8% did suffer weight gain. Meanwhile, 0,2% of the stunted children were weighed this month but did not have weight data from the previous month. This shows that more than half of the stunted children experience growth stagnation, which can increase the risk of long-term nutritional and health complications.

Table 2. Sample mean according to research variables

Variables (n= 544)	Min-Max	Mean (SD)	95% CI
Birth Weight	1200 - 4800	2912,23 (395,138)	2878,95 - 2945,50
Birth Length	40 - 58	49,135 (1,6949)	48,993 - 49,278
Age	6 - 36	21,79 (7,794)	21,13 - 22,45
WAZ	-5,02 - 0,07	-2,4029 (0,73730)	-2,4650 - -2,3408
HAZ	-5,31 - -2,01	-2,8512 (0,59466)	-2,9013 - -2,8011
WHZ	-4,58 - 10,00	-1,2045 (1,11221)	-1,2981 - -1,1108

WAZ= weight-adjusted Z-score, HAZ= height-adjusted Z-score, WHZ = Weight for Height
Data is presented as minimum, maximum, mean \pm SD and Confidence Interval (CI 95%)

Table 2 presents the average birth weight, birth length, age, and z-score indices of WAZ, HAZ, and WHZ in the sample of stunted children aged 6-36 months. The average birth weight in the sample was 2912,23 grams (95% CI = 2878,95-2945,50), with an average birth length of 49,135 cm (95% CI = 48,993-49,278). The average age of the children was 21,79 months (95% CI = 21,13-22,45). The WAZ z-score index showed an average value of -2,4029 [95% CI = (-2,4650) to

(-2,3408)], HAZ z-score index was -2,8512 [95% CI = (-2,9013) to (-2,8011)], and WHZ Z-score index was -1,2045 [95% CI = (-1,2981) to (-1,1108)].

Table 3 shows that birth weight had a significant relationship with the WAZ, HAZ, and WHZ z-score indices. The Spearman correlation showed a positive correlation with a weak relationship strength on the HAZ z-score index (R = 0,231) and a very weak correlation on the

HAZ z-score index ($R = 0,111$) and WHZ ($R = 0,161$). This suggests that increased birth weight correlates with elevated WAZ, HAZ, and WHZ z-scores in stunted children aged 6–36 months. Birth weight accounted for only 0,1% of the variation in the WAZ z-score index, 0,9% in HAZ, and 0,1% in WHZ, indicating its limited contribution to explaining the variation in the z-score index among stunted children, despite the statistical significance of this relationship ($P < 0,001$). Although the correlation value was low, statistical significance showed that increasing birth weight was consistently associated with improving the nutritional status of children aged 6–36 months.

Table 3. Correlation of birth weight, birth length, and age with WAZ, HAZ and WHZ index

Variables	WAZ	HAZ	WHZ
Birth Weight (gr)	< 0,001 *	0,009 *	< 0,001 *
Birth Length (cm)	< 0,001 *	0,002 *	0,006 *
Age (months)	0,104	0,005 *	0,748

Data were analyzed using Spearman's correlation test.

WAZ= weight-adjusted Z-score, HAZ= height-adjusted Z-score, WHZ = weight for height Z-score

*Statistically significant at p value <0,05

This indicates that birth weight is an important early determinant, but is not the only determinant of children's nutritional status. This finding is in line with previous research by (Setiawan et al., 2018), which stated that children with low BBL have a 13,7 times higher risk of stunting compared to children born with normal weight. Similar results were also found by (Saadong et al., 2021), which showed that children with low BBL are 5,7 times more at risk of stunting. In addition, this study confirms that environmental and socioeconomic factors play an important role in mediating the impact of BBL on nutritional status. For example, a study by (Nadhiroh et al., 2024) found that repeated infections, such as diarrhea and ARI, greatly affect the growth of children with low BBL due to impaired nutrient absorption and increased energy needs. This factor strengthens the hypothesis that the effects of low BBL on nutrition are cumulative when combined with unfavorable environmental conditions.

Diet is also an important determinant of the transition in children's nutritional status. According to Menurut (Molani Gol et al., 2022), in a systematic review, it was shown that low food diversification is closely related to the

incidence of stunting and underweight in early childhood. Children with low BBL who do not receive balanced nutritional intake during early growth are more susceptible to growth disorders. Meanwhile, socioeconomic conditions also strengthen the relationship between low BBL and malnutrition. A study by (Ochi & Saidi, 2024) showed that economic inequality has a direct impact on limited access to food and health services, which in turn increases children's vulnerability to stunting. Another study by (Islam et al., 2024) emphasized that children from poor households who experience low BBL have a two-fold higher risk of stunting compared to children from higher-income households.

These findings collectively confirm that low BBL is an important risk factor for stunting, underweight, and wasting, but its impact is magnified by other factors, such as infection, poor diet, and socioeconomic status. Therefore, community-based interventions targeting pregnant women and infants, especially in terms of prenatal nutrition, infant and young child feeding (IYCF) practices, and increasing access to health services, need to be strengthened to reduce the risk of future malnutrition and stunting in children.

The correlation between birth length and z-score indices of WAZ, HAZ, and WHZ was positive but with very weak connection strength (r WAZ = 0,189; r HAZ = 0,133; r WHZ = 0,117). In stunted children aged 6–36 months, increased birth length was correlated with elevated z-score indices of WAZ, HAZ, and WHZ ($P < 0,001$). Birth length accounted for approximately 0,1% of the variance in the z-score index of WAZ, 0,2% in HAZ, and 0,6% in WHZ, suggesting that this factor had little impact on the z-score indices of WAZ, HAZ, and WHZ, despite the statistically significant link. The findings of this study align with the research conducted by (Sutrio & Lupiana, 2019), indicating a correlation between birth length and stunting in children, attributable to factors influencing fetal growth, including gestational duration and fetal growth rate.

The findings of this study demonstrated a favorable correlation between birth weight and the z-score indices of weight-for-age (WAZ), height-for-age (HAZ), and Weight for Height (WHZ). Data analysis indicated that children aged 6–36 months who were stunted and had a

history of low birth weight (<2500 grams) had an elevated risk of stunting, underweight, and wasting. This discovery corresponds with earlier research demonstrating that children with low birth weight had a 20% increased likelihood of experiencing stunting (Kumar et al., 2021).

The results of this study are in line with research by (Setiawan et al., 2018), that birth weight has a significant relationship with the incidence of stunting in toddlers aged 24-59 months in the Andalas Health Center Work Area, Padang Timur District, Padang City in 2018 and it was found that toddlers born with low birth weight are at risk of 13,7 (95% CI 1,4 - 132,8) times experiencing stunting when compared to toddlers born with normal weight (Setiawan et al., 2018). This study is also in line with research conducted by (Saadong et al., 2021), that children aged 24-59 months in the Mangasa Health Center work area with low birth weight have a risk of 5,7 (95% CI: 1,72 - 18,94) times greater than stunting when compared to children born with normal weight. This study is in line with the results of research conducted by Saadong et al. (2021) and Setiawan et al. (2018), which showed that different periods and research locations did not cause the LBW variable to become unrelated to stunting in children. This shows that LBW has a considerable influence on stunting in toddlers. LBW is a fundamental risk factor for stunting in toddlers because stunting itself is a manifestation of chronic nutritional conditions in children, which are characterized by short stature. Then LBW is caused by deficiencies or lack of nutrition experienced by the mother of the baby during pregnancy (Hartiningrum & Fitriyah, 2019).

These findings cannot be separated from the influence of contextual factors that contribute to children's nutritional status. Several contextual factors, such as food consumption patterns, frequency of respiratory tract infections or diarrhea, quality of environmental sanitation, and family socioeconomic status, are important variables that have been shown to influence children's nutritional status both directly and indirectly. Studies have shown that diabetes, acute respiratory infections, and diarrhea are strongly associated with increased incidence of stunting, especially in areas with poor

sanitation and low socioeconomic status (Fagbamigbe et al., 2021; Purnama et al., 2024). For example, LBW children who grow up in environments with good access to nutrition and optimal parenting tend to have a lower risk of stunting compared to children who grow up in less supportive socioeconomic conditions (Tesema et al., 2022; Ullah et al., 2019).

The contribution of birth weight to the results of this study explaining the variation in Z scores is also very limited, that is, only 0,1% in WAZ, 0,9% in HAZ, and 0,1% in WHZ. Therefore, further research with a multivariate approach is highly recommended to include other variables such as maternal nutritional status during pregnancy, gestational age, breastfeeding status, and family education and income to provide a more comprehensive understanding (Jasrotia et al., 2024; Shibeshi & Asfaw, 2024).

In addition, the WAZ and HAZ z-score indices exhibited a positive correlation with age, indicating a limited relationship strength ($R_{WAZ} = 0,070$ and $R_{HAZ} = 0,122$). This suggests that the WAZ and HAZ z-score indices decrease as the stunted child ages, specifically from six to 36 months. Nevertheless, the age variable accounted for only 10,4% of the variation in the WAZ z-score index and 0,5% in the HAZ z-score index. Therefore, its role in elucidating the z-score index variable was comparatively diminutive despite the statistical significance of the relationship ($P < 0,001$). At the same time, the correlation between age and WHZ z-score index was not statistically significant ($P = 0,748$). The results of this study differ from those of another study, which stated that there was a negative relationship between age and the WAZ and HAZ z-score indices. The relationship between age and the WAZ and HAZ z-score indices showed a negative correlation with the relationship's low strength/closeness ($R_{WAZ} = -0,074$ and $R_{HAZ} = -0,118$). The age variable can only explain 0,5% of the variation in the WAZ z-score index variable and 1,4% in the HAZ z-score index variable, or it is less able to explain the WAZ and HAZ z-score index variables in toddlers, although this relationship is statistically significant (Al Rahmad, 2023; Abimayu & Rahmawati, 2023).

Table 4. Mean difference test

Variables			P value	OR (95% CI)
Stunted	Stunted	Severely stunted		
LBW				
Yes	45 (59,2%)	31 (40,8%)	0,118	0,652 (0,396-1,072)
No	323 (69%)	145 (31%)		
Age				
6-24 months	228 (63%)	134 (37%)	0,0001 *	0,510 (0,340-0,766)
25-36 months	140 (76,9%)	42 (23,1%)		
LBL				
Yes	33 (37,9%)	23 (41,1%)	0,186	0,655 (0,372-1,154)
No	335 (68,6%)	153 (31,4%)		
Gender				
Male	201 (67%)	99 (33%)	0,791	0,936 (0,652-1,344)
Female	167 (68,4%)	77 (31,6%)		
Underweight	Yes	No		
LBW				
Yes	9 (11,8%)	67 (88,2%)	0,007 *	0,365 (0,177-0,753)
No	126 (26,9%)	342 (73,1%)		
Age				
6-24 months	80 (22,1%)	282 (77,9%)	0,050 *	0,655 (0,438-0,979)
25-36 months	55 (30,2%)	127 (69,8%)		
LBL				
Yes	7 (12,5%)	49 (87,5%)	0,037 *	0,402 (0,177-0,910)
No	135 (24,8%)	360 (73,8%)		
Gender				
Male	68 (22,7%)	232 (77,3%)	0,235	0,774 (0,524-1,144)
Female	135 (24,8%)	177 (72,5%)		
Wasted	Yes	No		
LBW				
Yes	61 (80,3%)	15 (19,7%)	0,972	0,942 (0,511-1,734)
No	380 (81,2%)	88 (18,8%)		
Age				
6-24 months	289 (79,8%)	73 (20,2%)	0,358	0,781 (0,489-1,248)
25-36 months	152 (83,5%)	30 (16,5%)		
LBL				
Yes	44 (78,6%)	12 (21,4%)	0,747	0,840 (0,427-1,655)
No	397 (81,4%)	91 (92,4%)		
Gender				
Male	236 (78,7%)	64 (21,3%)	0,140	0,702 (0,452-1,089)
Female	205 (84%)	39 (16%)		

LBW = low birth weight, LBL = low birth length

Data are presented as numbers (percentages), and differences were compared using the chi-squared test,

* Statistically significant at p value <0,05

The results of this study indicate that low birth weight (LBW) is significantly associated with the incidence of underweight in children aged 6-36 months, as recorded in Table 4, which shows that 22,3% of children aged 6-36 months with a history of LBW are underweight, whereas only 13,4% of children aged 6-36 months who do not have a history of LBW experience the same condition (p =

0,007). This finding is in line with research (Siddiqa et al., 2024), which shows that children with LBW are more susceptible to malnutrition problems, especially in the form of being underweight, due to growth limitations that occur early in life. This condition worsens their nutritional status and puts them at risk for impaired physical and cognitive development later in life.

Meanwhile, the relationship between LBW and stunting in this study was not significant ($p = 0,118$), although the prevalence rate in children aged 6-36 months with LBW was still quite high (20,4%) compared to that in the group without LBW (16,2%). This suggests that although LBW contributes to malnutrition, stunting is influenced by other factors such as maternal nutrition during pregnancy, access to nutritious food, and environmental sanitation conditions. According to (Shrestha et al., 2020) also reported that children with a history of LBW, although more often underweight, are not always at high risk of stunting, especially if they receive good nutrition and optimal parenting support after birth.

The age of the child also showed a significant relationship with nutritional status. Toddlers aged 25–36 months had better Z scores in the WAZ and HAZ ($p < 0,05$), with a prevalence of stunting in this group of 18,7%, much lower than that in the age group of 6–24 months, with a prevalence of stunting of 32,1%. This difference reflects the importance of providing sufficient exclusive breastfeeding and complementary foods during early childhood, as well as a better transition to nutritious family food at 25–36 months. Research by (Li et al., 2022) emphasized that children under two years of age are particularly vulnerable to malnutrition because this period is a critical phase in the formation of their eating patterns and growth. Interventions at this age, such as adequate nutrition and complete immunization, greatly contribute to reducing the prevalence of stunting and underweight.

Sex also plays a role in nutritional status, with a higher prevalence of wasting in boys ($p = 0,140$). Although not significant at $\alpha = 0,05$, these data suggest that boys are more susceptible to wasting than girls. Research by (Khura et al., 2023) suggests that biological and physiological differences, such as higher metabolism in boys, may explain this tendency. In addition, lower immunity in boys may exacerbate the impact of gastrointestinal infections, increasing the risk of wasting.

Birth length (BL) also affects the nutritional status of children. The findings showed that children with a low birth length had a higher prevalence of underweight, with 19,6% of children with a birth length of less than 47 cm being underweight, compared to 14,3% of

children with a birth length of more than 47 cm ($p = 0,037$). The results of the study by (Rahman et al., 2021) Stated that birth length plays an important role in identifying the risk of long-term malnutrition, as it indicates growth factors that occur during the prenatal period. Children with short birth lengths often experience limitations in postnatal growth, which affects their nutritional status. Overall, this analysis underscores the importance of coordinated evidence-based interventions to address child nutrition issues. LBW, age, sex, and birth length are interacting factors that influence a child's nutritional status. Therefore, effective nutrition intervention programs must consider multifaceted risk factors including prenatal conditions, diet, access to health services, and good sanitation.

The findings of this study indicated a favorable correlation between birth length and the z-score indices of WAZ, HAZ, and WHZ. Stunted children aged 6–36 months with a history of low birth length (LBL) had a higher incidence of stunting than those without a history of LBL and those who were underweight and emaciated. This aligns with the findings of (Andini et al., 2020), which indicated that infants with shorter birth lengths had a 75,5-fold increased risk of stunting compared to those with normal birth lengths. Additional research indicate that birth length correlates with the prevalence of stunting in toddlers (Hidayati, 2021; Mentari & Hermansyah, 2019; Sawitri et al., 2021).

Premature growth inhibition increases the likelihood of further growth issues resulting in unsatisfactory growth. Additionally, a link appears between sex and the incidence of wasting, with boys demonstrating a 1,5-fold increased risk relative to girls. Research by (Ashagidigbi et al., 2022) found that boys exhibit a higher susceptibility to nutritional difficulties than girls. This phenomenon may be ascribed to the disparate developmental rates of the sexes, with males demonstrating rapid growth; however, inadequate nutritional intake leaves them more susceptible to malnutrition. Moreover, males are physiologically more susceptible to morbidity, thus increasing the risk of malnutrition in less supporting environments (Aheto, 2020; Al Rahmad et al., 2020). Other research indicate that wasting in toddlers is frequently observed in men (Garenne et al.,

2019) The danger of wasting in this gender is attributable to alterations in the hormonal system (Roba et al., 2021).

The correlation between age and the WAZ and HAZ z-score indices was positive, exhibiting a modest degree of association ($R_{WAZ} = 0,070$ and $R_{HAZ} = 0,122$). This indicates that as the age of the stunted kid increases, that is, between 6 and 36 months, the WAZ and HAZ z-score indices decrease. The age variable accounted for only 10,4% of the variance in the WAZ z-score index and 0,5% in the HAZ z-score index. Notwithstanding its small contribution, this association remained statistically significant ($P < 0,001$). The relationship between age and WHZ z-score index was not statistically significant ($P = 0,748$).

This outcome contrasts with the research conducted by Anggi et al., who identified a negative correlation between age and the WAZ and HAZ z-score indices. This study aligns with the findings of (Abimayu & Rahmawati, 2023; Headey et al., 2019), which indicated a trend of declining z-score indices as Indian toddlers aged. Moreover, a statistically significant difference was observed in the prevalence of stunting and underweight nutritional issues between the age groups of 6–24 and 25–36 months, with children aged 6–24 months exhibiting a higher risk of stunting and underweight. This conclusion aligns with a systematic analysis by (Katoch, 2022), which indicated that 32,4% of the analyzed publications identified a correlation between age and the prevalence of dietary issues. An increase of one month in age was associated with a 0,45% elevated risk of stunting and underweight (Ashagidigbi et al., 2022; Miko & Rahmad, 2017). This may be attributed to alterations in nursing behaviors after six months, when children start to consume supplementary meals that may not fully satisfy their nutritional requirements (Sutopa & Bari, 2022). This study identified substantial disparities in the average z-score index for WAZ, HAZ, and WHZ among stunted children aged 6–36 months, which correlated with variations in weight status. Children who experienced weight growth in the preceding month exhibited a higher average z-score than those whose weight decreased. These findings indicate that stunted children aged 6–36 months who do not gain weight are at increased risk of stunting, underweight, and wasting.

This study has several limitations. Namely, the cross-sectional research design used does not allow for tracing the causal relationship between birth weight, birth length, age, and gender variables to the nutritional status of children, the use of secondary data from the EPPGBM (Electronic Community-Based Nutrition Recording and Reporting) application limits the researcher's control over data quality and causes other important variables to be unavailable, such as history of infectious diseases, breastfeeding status, maternal nutritional status, and family socio-economic conditions. Assessment of nutritional status is based on only one measurement point, without considering long-term growth patterns. Although most stunted children did not experience weight gain, this study did not formulate policy implications that can be directly applied to address the problem.

Conclusion

This study found a significant positive relationship between birth weight and birth length and WAZ, HAZ, and WHZ scores among children aged 6–36 months, indicating that higher birth measurements are associated with better nutritional status. Age also influenced growth outcomes, with children aged 25–36 months having better WAZ and HAZ scores than those aged 6–24 months. Stunted children with a history of low birth weight had a higher risk of being underweight, highlighting the compounded vulnerability of this group. Encouragingly, catch-up growth was observed in some stunted children, especially with timely nutritional intervention.

These recommendations should be prioritized for children aged 6–24 months with a history of low birth weight. Early interventions included exclusive breastfeeding for the first six months, followed by age-appropriate, balanced complementary feeding. Health workers must provide regular education and individualized counseling, especially for high-risk families. Preventing LBW through improved maternal nutrition and iron supplementation are crucial. Local governments should support maternal health through home visits, pregnancy classes, and monitoring programs. Children with stunting who show no weight gain should undergo further nutritional assessments and, if needed, be referred to higher-level care.

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