Risk factors for wasting in toddlers in East Nusa Tenggara

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Abstract. Background: Wasting is a significant public health issue in East Nusa Tenggara (NTT), Indonesia, and it negatively impacts the nutritional status of toddlers. Objective: This study aims to analyze the factors associated with wasting among toddlers in NTT. Method: This observational study employed a cross-sectional design, conducted from July to August 2023 at the Panite and Kualin Health Centers in TTS, NTT Province, with a total of 150 respondents. Chi-square tests were used to analyze the relationship between variables, and logistic regression was applied to identify risk factors. The prevalence of wasting in 2022 was 10.7%. Research Results: The findings indicate that toddlers with wasting have a higher proportion of shorter birth lengths (<48cm) at 17.3%, are less frequently given early breastfeeding initiation (18%), are more prevalent in families with a moderate number of members (5-6 people) at 23.3%, have mothers with no education (2.7%) or only elementary education (20.7%), and have mothers with low knowledge about nutrition and health (score<60) at 18%, compared to non-wasting toddlers. Statistically significant differences were observed for birth length (p=0.040), early initiation of breastfeeding (p<0.001), the first drink given at birth (p=0.035), number of family members (p=0.041), mother's education (p=0.023), and mother's knowledge about nutrition and health (p=0.020) between wasting and non-wasting toddlers. The most influential factors contributing to wasting in toddlers are the duration of exclusive breastfeeding, per capita income, and postnatal environmental factors. The variables analyzed in this study explain 36.1% of the factors affecting wasting among toddlers in East Nusa Tenggara. These findings highlight the need for a comprehensive approach to addressing wasting in the region, emphasizing improved breastfeeding practices, increased family income, and enhancements in postnatal environmental conditions.

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1 Introduction

Wasting is a prevalent health issue among children under five years old in East Nusa Tenggara (NTT), Indonesia, characterized by a weight-for-height (WHZ) score more than three standard deviations below the median growth norms established by the World Health Organization (WHO) [1]. According to the 2022 Indonesian Nutrition Status Study (SSGI), the prevalence of wasting in NTT is 10.1%, significantly higher than the national average of 7.7%. This high prevalence is associated with increased risk of mortality, morbidity, and long-term disability [2]. Wasting compromises the immune system, reducing its ability to combat diseases and recurrent infections, which increases children's vulnerability to various illnesses. In severe cases, it can result in extreme weight loss, stunted growth, and long-term impacts on mental development and cognitive abilities [3]. Addressing wasting requires internal support, such as breastfeeding and adequate nutritious food intake, as well as external support from family and the surrounding environment.

WHZ represents the body weight relative to height, compared against reference standards from a healthy population. It is a widely used anthropometric measure for assessing nutritional status and the risk of non-communicable diseases [1]. The occurrence of wasting in toddlers is influenced by complex, interrelated factors. Exclusive breastfeeding and suboptimal early initiation of breastfeeding (EIB) are significant contributors to the risk of malnutrition, including wasting, particularly in regions with limited nutritional resources [4]. Breastfeeding, the primary food during the first months of life, supports growth and development in infancy. It fulfils basic needs for optimal growth, development, and health [5]. Additionally, breastfeeding is a cost-effective strategy to reduce infant and child morbidity and mortality [6]. A history of infectious diseases, such as diarrhoea and acute respiratory infection (ARI), significantly impacts children's nutritional status. Research □7□ indicates that children with poor nutritional status who frequently experience diarrhoea and ARI face a 1.6-fold increased risk of death from diarrhoea and a 1.7-fold increased risk from ARI. The combined mortality risk from both conditions has a relative risk of 2.0. Socio-economic factors, including family income levels and access to sanitation and clean water, significantly influence nutritional status. Children from low-income families or those in environments with inadequate sanitation are more susceptible to poor nutrition and wasting [8].

This study aims to identify risk factors associated with wasting in toddlers in East Nusa Tenggara. Factors such as early initiation of breastfeeding (EIB), duration of exclusive breastfeeding, per capita income, history of acute respiratory infections (ARI), history of diarrhoea, postnatal environmental conditions, and psychosocial stimulation significantly influence the incidence of wasting in toddlers. These findings highlight the need for comprehensive interventions to combat malnutrition in East Nusa Tenggara. Such efforts should address both child- specific factors and broader family-level determinants, with a particular focus on maternal education and breastfeeding practices.

2 Materials and methods

This observational study employed a cross-sectional design and was conducted in the Panite and Kualin Public Health Center areas, South Central Timor Regency (TTS), East Nusa Tenggara Province (NTT), from July to August 2023. TTS Regency, reporting 686 cases of toddler wasting—the highest in the region—was selected as the research site [9]. Therefore, TTS Regency was selected as the research location. The study population included toddlers aged 12-59 months in the Panite Public Health Center area (35 integrated care posts) and Kualin Public Health Center area (31 integrated care posts) in TTS Regency, NTT Province. The sample size was calculated using the formula from [10], with

a 95% confidence level and a 7.0% prevalence of wasting. Using the sample size formula, the calculation determined a minimum of 110 toddlers, with 150 toddlers included to account for potential dropouts. The inclusion criteria required mothers of toddlers aged 12-59 months who were not currently ill, had no disabilities, and were willing to adhere to all research procedures. Data collection was carried out by enumerators with assistance from integrated care post cadres. Primary data were obtained through anthropometric measurements of the respondents and interviews with their mothers, while secondary data were sourced from the TTS District Health Office, child profiles from the Public Health Center, and relevant literature.

The variables in this study include the characteristics of toddlers and their families. Anthropometric measurements were conducted at the village hall and the nearest integrated health post (posyandu). The samples were allowed 10–15 minutes of rest before the measurements were taken. Body weight was measured using digital floor scales (Omron), while height was measured with a microtoice, capable of measuring up to 200 cm with an accuracy of 0.1 cm. For children aged 12–23 months, length was measured using a length board, and upper arm circumference was measured with a LILA tape. Toddler attributes include gender, age, birth weight, birth length, birth order, history of early initiation of breastfeeding, the first drink given to newborns, and a history of acute respiratory infections (ARI) and diarrhoea, all obtained through interviews with the respondents' parents. Family characteristics include the number of family members, parental education, parental occupations, and the mother's knowledge of nutrition and health, which were gathered through interviews using a questionnaire.

Nutritional status, according to the Indonesian Minister of Health (2020) and based on WHO guidelines (2011) for Weight-for-Height (WHZ), are classified into six categories: Severely wasted: <-3 SD; Wasted: -3 SD to <-2 SD; Normal: -2 SD to +1 SD; Possible risk of overweight: > +1 SD to +2 SD; Overweight: > +2 SD to +3 SD; Obese: > +3 SD. For upper arm circumference, toddlers are classified into three categories: Malnutrition: <11.5 cm; Underweight: 11.5–12.4 cm; and Normal: ≥12.5 cm. The relationship between variables was analyzed using Chi-square, and logistic regression was employed to identify the risk factors for wasting. Ethical approval for this research was granted by the Kupang Health Polytechnic, Ministry of Health, No. LB.02.03/1/0147/2023.

3 Results and discussion

This study included 150 subjects aged 12–59 months. Weight-for-Height Z-scores (WHZ) was determined by the ratio of body weight (kg) to height squared (m2). Table 1 presents the distribution of nutritional status: 28% of subjects were classified as having severe acute malnutrition (SAM), 18.7% as having moderate acute malnutrition (MAM), and 53.3% had normal nutritional status. The gender distribution was not significantly different, with 46% male and 54% female subjects. The data show significant differences in birth length, early breastfeeding initiation, and the first drink given to the newborn. A significant difference in birth length was observed ($p = 0.040$), with children born with a length < 48 cm being 32.6% more likely to experience wasting compared to those with a birth length > 48 cm. This finding aligns with [11], which states that children with a short birth length are at increased risk of growth disorders in subsequent age periods and may not achieve optimal growth.

Early initiation of breastfeeding (EIB) showed a significant correlation with wasting ($p< 0.001$). Children who received EIB were less likely to experience wasting. EIB helps fulfil the infant's nutritional needs and prevent infection. The first liquid produced by mothers after childbirth, colostrum, is easily digested and contains sufficient nutrients to support optimal growth and development in infants [12]. Colostrum contains a relatively low concentration of lactose, highlighting its primary immunological function. It also provides antibodies that

protect the infant from various infections. Infections can lead to diarrhoea and vomiting, resulting in fluid and nutrient loss, thereby increasing the risk of wasting [13]. The first drink given to infants significantly affects the risk of wasting, with breast milk serving as a protective factor (p = 0.035). Infants exclusively breastfed from birth have a lower risk of wasting due to the rich immunological components in colostrum, such as secretory IgA and lactoferrin, which enhance nutrient absorption [12] [14]. Early initiation of breastfeeding (EIB) is crucial for providing colostrum and fostering a strong mother-infant bond, which supports exclusive breastfeeding and reduces the risk of wasting [15].

Table 1. Association between subject and family characteristics with wasting nutritional status

Characteristics	Wasting		No wasting	P value
	Severe WHZ (<-3SD) n (%)	Moderate WHZ (-3SD to <-2SD) n (%)	Normal + over WHZ (-2SD to 2SD) & (>2SD) n (%)	
Sex				
Boys	21 (14)	15 (10)	33 (22)	0.440
Girls	21 (14)	13 (8.7)	47 (31.3)	
Age (months)				
≤23 months	24 (16)	12 (8)	27 (18)	0.170
24-36 months	10 (6.7)	8 (5.3)	30 (20)	
>36 months	8 (5.3)	8 (5.3)	23 (15.3)	
Birth weight (g)				
<2500 g	8 (5.3)	5 (3.3)	9 (6)	0.445
≥2500 g	34 (22.7)	23 (15.3)	71 (47.3)	
Birth length (cm)				
<48 cm	20 (13.3)	6 (4)	23 (15.3)	0.040*
≥48 cm	22 (14.7)	22 (14.7)	57 (38)	
Order of children				
<3	14 (9.3)	15 (10)	33 (22)	0.242
≥3	28 (18.7)	13 (8.7)	47 (31.3)	
Early initiation of breastfeeding (EIB)				
Yes	30 (20)	13 (8.7)	70 (46.7)	<0.001*
No	12 (8)	15 (10)	10 (6.7)	
The first drink given to newborn babies				
Breast milk	35 (23.3)	20 (13.3)	73 (48.7)	0.035*
Formula milk	7 (4.7)	8 (5.3)	7 (4.7)	
Upper respiratory tract infections				
Yes	3 (2)	6 (4)	13 (8.7)	0.214
No	39 (26)	22 (14.7)	67 (44.7)	
Diarrhea				
Yes	4 (2.7)	3 (2)	5 (3.3)	0.689
No	38 (25.3)	25 (16.7)	75 (50)	
Number of family members				
Small (≤4 people)	9 (6)	12 (8)	26 (17.3)	0.041*
Moderate (5-6 people)	27 (18)	8 (5.3)	33 (2.2)	
Big (>6 people)	6 (4)	8 (5.3)	21 (14)	
Father's education				
Not in school	2 (1.3)	2 (1.3)	5 (3.3)	0.023*
Primary education	19 (12.7)	12 (8)	31 (20.7)	
Secondary education	8 (5.3)	6 (4)	19 (12.7)	

Characteristics	Wasting		No wasting	P value
	Severe WHZ (<-3SD) n (%)	Moderate WHZ (-3SD to <-2SD) n (%)	Normal + over WHZ (-2SD to 2SD) & (>2SD) n (%)	
The final year of high school	7 (4.7)	8 (5.3)	18 (12)	
University	0 (0)	0 (0)	2 (1.3)	
Mother's education				
Not in school	0 (0)	4 (2.7)	1 (0.7)	0.023*
Primary education	22 (14.7)	9 (6)	30 (20)	
Secondary education	11 (7.3)	5 (3.3)	20 (13.3)	
The final year of high school	7 (4.7)	10 (6.7)	26 (17.3)	
University	2 (1.3)	0 (0)	3 (2)	
Mother's knowledge about nutrition and health				
Less (score <60)	21 (14)	6 (4)	18 (12)	0.020*
Moderate (score 60-80)	9 (6)	8 (5.3)	28 (18.7)	
Good (score >80)	12 (8)	14 (9.3)	34 (22.7)	

*Chi square test, $p<0.05$

Table 2. Risk factors of wasting

Variables	Wasting nutritional status		
	B	Beta	Sig
Birth weight	-0.347	-0.134	0.145
Order of children	-0.292	-0.173	0.061
IMD history (0=no;1=yes)	0.419	0.212	0.017*
Duration of exclusive breastfeeding (month)	-0.110	-0.308	0.000**
Mother's education level	0.085	0.096	0.291
Income per capita (rupiah)	$-3.141x10^{-6}$	-0.396	0.000**
Per capita expenditure (rupiah)	$-2.168x10^{-6}$	0.179	0.291
History of upper respiratory tract infection (0=no;1=yes)	0.545	0.229	0.009*
History of pulmonary tuberculosis (0=no;1=yes)	0.602	0.134	0.120
History of diarrhea (0=no;1=yes)	-0.726	-0.197	0.020*
Prenatal environmental factor (score index)	0.005	0.135	0.112
Postnatal environmental factor (score index)	0.018	0.395	0.000**
Mother's knowledge about nutrition and health	0.004	0.086	0.331
Psychosocial stimulation	-0.014	-0.194	0.045*
R	0.666		
Adj. R^2	0.361		
F	5.395		
sig. Model	0.000**		
df	149		
n	150		

**Significant at ≤0.01; * Significant 0.05

Data on family characteristics show that the number of family members, the mother's education, and her knowledge of child growth and development significantly affect children's nutritional status. The p-value for the number of family members ($p = 0.041$) indicates that a larger family size impacts food distribution, which is further influenced by family per capita income. As the number of household members increases, food distribution per person decreases. According to [16], low-income families are more likely to experience food shortages due to limited food availability.

Maternal education also has an effect ($p = 0.023$), indicating that highly educated individuals are more receptive to new information on child growth and development [17]. Research by [18] found a relationship between the education level of the child's primary

caregiver and the nutritional well-being of toddlers. Similarly, a study in Sub-Saharan Africa by [19] revealed that countries with lower education levels tend to have higher rates of malnutrition. The level of knowledge can be influenced by intellectual ability, which in turn affects a person's attitude and behavior, as it correlates with logical reasoning, experience, and clarity of understanding [20]. Maternal knowledge of growth and development plays a crucial role in determining children's nutritional status ($p = 0.020$). Furthermore, maternal knowledge of early childhood development is essential for selecting appropriate stimulation to support children's growth and development [21].

Table 2 presents the risk factors influencing the nutritional status of wasting. Multiple linear regression analysis was employed to identify factors affecting wasting in toddlers. The results indicate that the duration of exclusive breastfeeding, per capita income, and postnatal environmental factors have the greatest influence on toddler wasting. These variables account for 36.1% of the factors contributing to wasting in toddlers.

The research findings indicate that wasting nutritional status is more prevalent in children who did not undergo IMD (Initiation of Maternal Breastfeeding). Children with a history of IMD show significantly better nutritional status regarding wasting ($\beta = 0.419$, $p = 0.017$). These results align with previous studies suggesting that timely IMD enhances breast milk production and strengthens the mother-child bond, thereby promoting optimal growth and nutritional status [22]. The duration of exclusive breastfeeding has a significant impact on the condition of child wasting. Each additional month of exclusive breastfeeding can reduce the level of wasting by 0.110 points ($\beta = -0.110$, $p < 0.001$). These results underscore the importance of exclusive breastfeeding during the first 6 months of life, in accordance with WHO recommendations. Systematic reviews show that children who are exclusively breastfed have a lower risk of wasting ($\beta = -0.110$, $p<0.001$). These results highlight the importance of exclusive breastfeeding during the first six months of life, which is in line with WHO recommendations. Systematic reviews demonstrate that exclusively breastfed children have a lower risk of wasting [23].

Per capita income significantly influences the incidence of child wasting. For every increase of one million rupiah in per capita income, the risk of child wasting decreases by 3.141 points ($\beta=-3.141$, $p<0.001$). Poverty is closely linked to inadequate nutrition and infections, which contribute to malnutrition in children [24]. This is further supported by a meta-analysis [25], which confirms a strong correlation between economic status and children's nutritional status. The study also found that children with a history of acute respiratory infections (ARI) have significantly worse nutritional status regarding wasting ($\beta=0.545$, $p=0.009$). Respiratory infections can reduce appetite and disrupt nutrient absorption, hindering growth. This is consistent with research [26] showing that recurrent respiratory infections impair growth. Interestingly, a history of diarrhoea was negatively correlated with wasting ($\beta=-0.726$, $p=0.020$).

4 Conclusion

1. There remains a need to address the issue of wasting in NTT through counselling on the importance of exclusive breastfeeding and early initiation of breastfeeding for pregnant and breastfeeding mothers, as well as the establishment of breastfeeding support groups within the community.
2. Efforts to improve nutritional and health status can be optimized through growth monitoring at integrated service posts, enhanced immunization coverage, and the provision of nutritional supplementation for at- risk toddlers.
3. Strengthening the health system by enhancing the capacity of health workers and the nutrition surveillance system through active community involvement and cross-sector collaboration in monitoring and addressing toddler nutrition issues.

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