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Correlation between Exclusive Breastfeeding, Complementary Feeding, Infectious Disease with Wasting among Toddlers: a Cross-Sectional Study

Hubungan ASI Eksklusif, Makanan Pendamping ASI, Penyakit Infeksi dengan Kejadian Wasting *pada Balita:* Cross-Sectional Study

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ABSTRACT

Background: Wasting, an acute nutritional deficiency, is assessed using weight-for-height with a z-score of <-2SD from growth standards. The prevalence of wasting in Puskesmas Kendit is 14.31%, with Kukusan Village at 29%.
Objectives: This study examined the correlation between exclusive breastfeeding, Complementary Feeding (CF), infectious diseases, and wasting in young children.
Methods: Conducted with a cross-sectional design, the study sampled 51 toddlers through simple random sampling and analyzed the data using Spearman's correlation.
Results: Findings revealed no significant correlation between exclusive breastfeeding and wasting (p-value=0.105). However, there was a significant correlation between CF and wasting (p-value=0.026). Nutrient intake, including energy (p-value<0.001), protein (p-value<0.001), fat (p-value=0.002), and carbohydrates (p-value=0.025), was significantly correlated with wasting, as was the presence of infectious diseases (p-value=0.001).
Conclusions: While exclusive breastfeeding tends to reduce wasting, appropriate CF and adequate intake of energy, protein, fat, and carbohydrates are associated with a lower prevalence of wasting. Recommended actions include improving exclusive breastfeeding practices, enhancing the quality of CF, and increasing preventive measures for infectious diseases.

INTRODUCTION

Malnutrition is a major global issue impacting children in developing countries[1]. Nutritional status reflects the balance between nutrient intake and expenditure, as nutrients are essential for physical growth, development, activity, productivity, and overall health.[2]. Poor quality or insufficient quantity of food can lead to wasting. Infants undergo a critical period from conception to age two, known as the "golden window," where a lack of essential macro and micronutrients can cause irreversible brain function impairments, even if nutritional supplementation is provided later[3,4].

Wasting is a health issue classified under the three burdens of malnutrition: undernutrition, overnutrition, and micronutrient deficiencies[5]. It represents an acute form of malnutrition, defined by a weight-for-height measurement below -2SD on a child growth chart[6,7]. Wasting is further categorized into two levels: wasted, with a z-score between -3SD and -2SD, and severely wasted, with a z-score below -3SD.[8].

The Infant and Young Child Feeding (IYCF) strategy is a global initiative promoting optimal feeding practices for infants and young children. It recommends key practices such as early initiation of breastfeeding, exclusive breastfeeding from birth to six months, introducing CF at six months, and continuing breastfeeding until at least two years of age[9,10]. United Nations Children's Fund (UNICEF) identifies major contributors to wasting in children, including inadequate food intake, infectious diseases, or a combination of both[9-11]. Additional contributing factors include urban-rural disparities, low parental education, poor feeding practices, and economic status. Malnutrition, a significant global health threat, is the leading cause of 3.1 million child deaths worldwide. It results in growth and developmental issues due to nutritional deficiencies, increases the risk of acute and chronic diseases, disrupts

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cognitive function and academic performance, and lowers productivity in adulthood[1].

According to the World Health Organization (WHO), 45.4 million children under five years old (6.7%) globally were affected by wasting in 2020, with 70% of cases occurring in Asia[12]. In Indonesia, 10.2% of children under five were reported as experiencing wasting according to the 2018 Basic Health Research data[13]. Indonesia's Nutrition Status Surveillance reports the prevalence of wasting at 7.4% (2019), 7.1% (2021), and 7.7% (2022), with East Java Province showing a prevalence of 7.2%.

Several studies on wasting highlight this critical nutritional issue, particularly in developing countries. The Sustainable Development Goals include waste specific targets to reduce wasting, aiming to lower the proportion of wasted children to less than 5% by 2025 and below3% by 2030[14-16]. Situbondo Regency ranks 10th out of 38 cities in Indonesia, with a wasting prevalence of 8.6%[17]. February 2023 data from the Electronic Community-Based Nutrition Recording and Reporting system shows a 7.83% prevalence in Situbondo Regency, with the highest rate recorded at Puskesmas Kendit at 14.31%, well above the regional average.

Given this context, the researchers aim to explore the correlation between exclusive breastfeeding, CF, and infectious diseases with wasting in under five children in Kukusan Village, within the Puskesmas Kendit area of Situbondo Regency. These findings are especially relevant to the local health landscape, where malnutrition and infectious diseases are common among young children. By examining these factors, the researchers seek to provide valuable insights that could inform local health policies and improve child health outcomes in the community.

METHODS

Design, Time, and Place

This study employs an analytical design with a cross-sectional approach, collecting data at a single point in time. Preparation, data collection, and analysis were conducted from September 2023 to March 2024. The study received ethical approval from the Research Ethics Commission under reference number EA/2209.3/KEPK-Poltekkes_Sby/IV/2024.

Sampling

The study population consists of all toddlers aged 6-59 months residing in Kukusan Village, totaling 104 individuals. A sample of 51 toddlers was selected using simple random sampling, a method that gives each member of the population an equal probability of being chosen. This unbiased selection process avoids favoring or selecting based on specific characteristics, ensuring the sample represents the entire population of toddlers aged 6-59 months in Kukusan Village. Consequently, the findings are broadly applicable and statistically meaningful to the larger population.

Data Collection Method

Several systematic steps were used in data collection to ensure accuracy and relevance to the research objectives. First, primary respondents, identified as mothers of toddlers aged 6-59 months in Kukusan Village, were selected. Mothers were chosen as respondents due to their knowledge of their toddlers' characteristics, breastfeeding and CF practices, and history of infectious diseases. Inclusion criteria required mothers to be willing to participate, serve as their children's primary caregivers, and communicate effectively. Exclusion criteria included mothers of toddlers with chronic illnesses or disabilities that could affect nutritional status. Second, direct interviews were conducted with these mothers to gather information on toddler and maternal characteristics, breastfeeding and CF practices, and the history of infectious diseases (e.g., diarrhea, acute respiratory infection) over the past month. Third, a 2 × 24-hour food recall was conducted in which mothers recalled all food consumed by their toddlers over two separate 24-hour periods, providing insight into their dietary patterns. Fourth, anthropometric measurements were taken to assess toddlers' nutritional status using calibrated weighing scales, baby scales, and stadiometers for accurate height measurements for infants under 2 years old was measured lying down, and those over 2 years old, it was measured in a standing position.

Data Analysis

The data analysis in this study consists of several stages to explore relationships among the collected variables. Univariate analysis is used to describe respondent data, including toddler and maternal characteristics, breastfeeding practices, type and frequency of CF, history of infectious diseases, and nutritional status (weight and length/height). The frequency or percentage distribution of each variable is recorded and analyzed to provide an overall view of the sample characteristics. Bivariate analysis is then applied to determine relationships between pairs of studied variables. Spearman's correlation test is used to examine these relationships.

This approach aims to investigate the relationships between exclusive breastfeeding, CF practices, infectious diseases, and wasting among toddlers in Kukusan Village, Puskesmas Kendit, Situbondo Regency. By analyzing these factors, the researcher hopes to gain insights that can inform potential public health actions. The ultimate goal is to implement optimized interventions to improve nutrition and health management among children in this population.

RESULTS AND DISCUSSIONS

In this study conducted in Kukusan Village, Puskesmas Kendit, Situbondo Regency, researchers will examine various characteristics of both toddlers and their mothers. Key factors for toddlers include age, gender, immunization status, and birth weight. For mothers, characteristics such as age, education level, and occupation, all of which may influence child health outcomes.

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Table 1. Characteristics of Toddlers and Mothers in Kukusan Village, Puskesmas Kendit, Situbondo Regency

Characteristics of Toddlers and Mothers	Frequency (n)	Percentage (%)
Toddlers Age		
6-24 Months	19	37.3
25-59 Months	32	62.7
Toddlers Gender		
Female	25	49
Male	26	51
Immunization Status		
Incomplete	8	15.7
Complete	43	84.3
Birth Weight		
Low Birth Weight	4	7.8
Normal	47	92.2
Mother's Age		
<20 Years	2	3.9
20-35 Years	44	86.2
>35 Years	5	9.8
Mother's Education		
Elementary School	11	21.6
Junior High School	13	25.5
Senior High School	19	37.3
Diploma, Degree	8	15.6
Mother's Occupation		
Housewife	44	86.2
Private Employee	1	2
Others (Farmers, Drivers, Housekeeper Helpers)	6	11.8

*immunization status incomplete if any vaccine recommended for their age is not received and complete if all vaccines received according to age

Table 1 presents the demographic characteristics of toddlers and mothers of toddlers in the study on wasting incidence in Kukusan Village, Puskesmas Kendit, Situbondo Regency. The majority of toddlers are aged 25-59 months (62.7%), a vulnerable age group for wasting. The gender distribution is nearly equal, with 51% male and 49% female toddlers. Regarding immunization status, most toddlers have received complete immunization (84.3%), while 15.7% have incomplete immunization. Most toddlers were born with normal birth weight (92.2%), while a small proportion were born with low birth weight (7.8%). The majority of mothers are within the 20-35-year age range (86.2%), generally considered an ideal age for pregnancy and child care. In terms of education, most mothers have completed high school (37.3%), with some attaining a diploma or bachelor's degree (15.6%), reflecting a level of education that supports understanding of child health and nutrition. Additionally, most mothers are homemakers (86.2%), a factor that can influence access to health information and family spending on child nutrition.

Table 2. Cross-Tabulation and Spearman Correlation Test Result for Exclusive Breastfeeding, CF, Infectious Disease and Wasting Incidence in Toddlers in Kukusan Village, Puskesmas Kendit, Situbondo Regency

Variables	Nutritional Status				Total (N)	r	p-value
	Wasting		Non Wasting				
	Frequency (n)	Percentage (%)	Frequency (n)	Percentage (%)			
Exclusive Breastfeeding							
Not Exclusive	9	52.9	8	47.1	17	0.229	0.105
Exclusive	10	29.4	24	70.6	34		
Complementary Feeding							
Inappropriate	12	54.5	10	45.5	22	0.311	0.026
Appropriate	7	24.1	22	75.9	29		
Infectious Disease							
Sick	11	68.7	5	31.3	16	0.440	0.001
Not Sick	8	22.9	27	77.1	35		

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Relationship between Exclusive Breastfeeding and Wasting Incidence in Toddlers

Table 2 shows that toddlers who received exclusive breastfeeding had a lower percentage of wasting (29.4%) compared to those who did not receive exclusive breastfeeding (52.9%), suggesting that exclusive breastfeeding may be associated with a reduced risk of wasting in toddlers. However, despite the proportional differences, the Spearman correlation indicated that there is no statistically significant relationship between exclusive breastfeeding and wasting (r=0.229; p-value=0.105).

This finding may be influenced by the age distribution of toddlers in the study, with 62.7% in the 25-59-month range. At this stage, children's physical activity increases, resulting in higher nutritional needs compared to infants under six months. By 25-59 months, breastfeeding has typically ceased, and their nutrition relies solely on complementary foods and beverages.

This study aligns with findings by Muliyati et al. (2021), which also showed no correlation between exclusive breastfeeding and wasting (p-value=0.958) months of age, toddlers require CF, and continued breastfeeding until age two is recommended. Addition indicate no significant correlation between continued breastfeeding and weight-for-height or weight-for-length ratios, as factors like nutrient intake and infectious diseases also impact nutritional status[21].

Research by Youwe et al. (2020) found that there was no significant correlation between exclusive breastfeeding and nutritional status in toddlers (p-value=0.658). This suggests that while exclusive breastfeeding plays an important role, CF practices and infectious disease prevention are also critical factors influencing child nutrition[22].

Relationship between CF and Wasting Incidence in Toddlers

Table 3 shows that toddlers who received appropriate CF had a lower percentage of wasting (24.1%) compared to those with inappropriate complementary feeding (54.5%). The Spearman correlation indicates a significant relationship between the quality of CF and wasting incidence (r=0.514; p-value<0.001). These results indicated that appropriate CF may be associated with a lower prevalence of wasting in toddlers compared to inappropriate CF. The next table examines on the relationship between macronutrient intake and nutritional status (wasting and non wasting):

Table 3. Cross-Tabulation and Spearman Correlation Test Results between Macronutrient Intake and Wasting Incidence in Toddlers in Kukusan Village, Puskesmas Kendit, Situbondo Regency

Nutrient Intake	Nutritional Status				Total (N)	Median ± Min-Maks	r	p-value
	Wasting		Non *Wasting*					
	Frequency (n)	Percentage (%)	Frequency (n)	Percentage (%)				
Energy						1029.65 kcal ± 500.45 kcal-1667.55 kcal	0.475	<0.001
Deficiency	14	63.6	8	36.4	22			
Adequate	5	17.2	24	82.8	29			
Protein						30.3 g ± 13.7 g-68.35 g	0.617	<0.001
Deficiency	12	85.7	2	14.3	14			
Adequate	7	18.9	30	81.1	37			
Fat						40.8 g ± 15.3 g-60.05 g	0.427	0.002
Deficiency	13	61.9	8	38.1	21			
Adequate	6	20	24	80	30			
Carbohydrates						136.35 g ± 53.1 g-219.65 g	0.314	0.025
Deficiency	16	48.5	17	51.5	33			
Adequate	3	16.7	15	83.3	18			

Table 3 shows that toddlers with energy deficits have a higher incidence of wasting (63.6%) compared to those with adequate energy intake (17.2%). The correlation between energy intake and wasting incidence is significant (r=0.475; p-value<0.001), indicating that sufficient energy intake is associated with a lower incidence of wasting. The average energy intake among wasting toddlers (1029.65 kcal) is lower than among wasting toddlers, highlighting the importance of adequate energy intake for preventing wasting.

Protein intake analysis reveals that toddlers with protein deficiencies exhibit a much higher percentage of wasting (85.7%) compared to those with adequate protein intake (18.9%). The significant correlation (r=0.617; p-value<0.001) underscores the importance of sufficient protein intake for optimal growth and development, as wasting toddlers consume an average of 30.3 g, lower than wasting toddlers.

Fat intake shows that toddlers with fat deficiencies also have higher rates of wasting (61.9%) compared to those with adequate fat intake (20.0%). A significant correlation exists between fat intake and wasting incidence (r=0.427; p-value=0.002), emphasizing the role of adequate fat intake in toddler health.

Carbohydrate intake analysis indicates a slightly higher wasting incidence in toddlers with carbohydrate deficiencies (48.5%) compared to those with adequate intake (16.7%), with a significant correlation (r=0.314; p-value=0.025). Although the relationship is less pronounced than with energy, protein, and fat intake,

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adequate carbohydrate intake remains beneficial for reducing wasting incidence.

Introducing CF before six months significantly impacts wasting incidence (ARR 2.9, 95% CI 1.3-6.3). Toddlers with fewer meal frequencies are at higher risk (ARR 1.9, 95% CI 1.5-2.5), while a varied diet is associated with wasting status (ARR 1.3, 95% CI 1.01-1.6)[23]. This study emphasizes the importance of both the timing and quality of CF in preventing toddler wasting.

Research by Torizellia et al. (2023) identified significant correlations between toddler nutritional status and carbohydrate intake (p-value=0.001), protein intake (p-value=0.016), and fat intake (p-value=0.014) related to wasting[24]. Additionally, Azrimaidaliza et al. (2020) found that protein intake is the dominant factor correlated with nutritional status based on weight-for-height (p-value=0.007). Insufficient carbohydrate intake is strongly associated with wasting nutritional status, as the study indicated that toddlers with carbohydrate deficiencies have a higher likelihood of experiencing wasting (p-value=0.015)[25].

Macronutrient intake in children with nutritional problems such as wasting is significantly lower than the Recommended Nutrient Intake established by the Indonesian Ministry of Health in 2019[26]. Energy supports growth processes, nutrient metabolism in the body, and physical activities. Energy from food is derived from macronutrients[26,27]. Protein intake influences bone matrix proteins, growth factors, and the roles of calcium and phosphorus in bone formation[27]. Fats are macronutrients that contribute to a higher calorie content; deficient fat intake can lead to insufficient calorie intake for bodily activities and metabolic processes. Carbohydrates are the primary energy providers, and a deficit in carbohydrate intake forces the body to use other macronutrients to produce energy, disrupting the balance of other nutrients and inhibiting growth[28].

Relationship between Infections and Wasting Incidence in Toddlers

From Table 2, toddlers who suffered from infections had a higher percentage of wasting (68.7%) compared to those without infections (22.9%). The Spearman correlation showed a significant relationship between infections and wasting incidence (r=0.440; p-value=0.001). This indicates that preventing infections is crucial for lowering the prevalence of wasting, as infections are strongly correlated with an increased prevalence of wasting in toddlers.

The results of the analysis between infections and wasting revealed a p-value of 0.001 and a correlation coefficient (r) of 0.440, suggesting a significant relationship between infectious diseases and wasting in toddlers in Kukusan Village, Kendit Health Center, Situbondo Regency. This relationship is moderate and positively valued, where improvements in health status correspond to enhancements in nutritional status. Toddlers who are not ill tend to exhibit a lower frequency of appetite loss, which may contribute to their body weight remaining stable or increasing. Conversely, sick toddlers often experience decreased appetite, ultimately adversely affecting their nutritional status.

Research by Dwi et al. (2022) indicated a correlation between infectious diseases, such as pneumonia, and the nutritional status of toddlers (p-value=0.003). Repeated infectious diseases in toddlers over a long period can lead to metabolic disturbances that ultimately affect nutritional status[29]. Purba et al. (2020) also demonstrated a significant correlation between a history of illness and infection and nutritional status (p=0.032)[30].

Khairunnas et al. (2022) found statistically significant results indicating that a history of infectious diseases in the last three months affects wasting in toddlers (95% CI: 1.5-8.5)[31]. Similarly, research by Azrimaidaliza et al. (2022) indicated a history of infectious diseases in malnourished toddlers (POR=5.650, CI=1.212-26.153)[32]. Infectious diseases in toddlers often arise due to a low immune system. These diseases also impair a child's ability to optimally absorb nutrients. The relationship between infectious diseases and wasting is closely intertwined, meaning that infectious diseases can exacerbate nutritional status, while children with wasting are more susceptible to infections due to their weakened immune systems[33].

Inadequate nutrient intake and infectious diseases often occur simultaneously. Insufficient nutrient intake can increase the risk of infectious diseases, while infections can lead to malnutrition. The occurrence of infections is one of the causes that impact reduced food intake and changes in nutritional function, which should support growth but instead are used to maintain the body's immune system to combat infection[34].

CONCLUSIONS

This study provides an overview of the variables related to nutritional status (wasting and wasting) in toddlers, specifically focusing on breastfeeding practices, CF, infectious diseases, and nutrient intake (energy, protein, fats, carbohydrates). Although exclusive breastfeeding was not found to be statistically significant, toddlers who receive exclusive breastfeeding tend to have a lower prevalence of wasting compared to those who do not. Nevertheless, exclusive breastfeeding practices remain a potential factor in preventing wasting.

The study highlights a significant association between appropriate CF and a lower prevalence of wasting in toddlers. Toddlers who receive appropriate CF have a lower prevalence of wasting compared to those who receive poor-quality CF. Moreover, energy, protein, fat, and carbohydrate intake show significant associations with toddlers' nutritional status. Deficiencies in energy, protein, fat, and carbohydrates are significantly correlated with a higher prevalence of wasting. Therefore, adequate nutrient intake is crucial for preventing wasting in toddlers. Additionally, infectious diseases are a significant factor associated with wasting, as toddlers suffering from infections tend to have a higher prevalence of wasting compared to their healthy counterparts.

To reduce the incidence of wasting in toddlers, several strategic steps are recommended. First, increasing exclusive breastfeeding should continue to be encouraged through support for breastfeeding mothers. Second, improving the quality of CF is essential, with a

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focus on providing nutritious food options. Third, monitoring and early intervention regarding energy, protein, fat, and carbohydrate intake in toddlers are crucial. Fourth, enhanced preventive efforts are necessary to reduce the incidence of infectious diseases in toddlers through improved sanitation, hygiene, and access to health services. Collaboration between the government, healthcare workers, and the community is vital to ensure that all toddlers receive adequate nutrition and a healthy environment to support their optimal growth and development. Further research is needed to evaluate the long-term effectiveness of these interventions.

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AUTHOR CONTRIBUTIONS

AI: methodology, writing-original draft; RYP: conceptualization, investigation, methodology, supervision, writing-review and editing writing-original draft, writing-review and editing; ISE, TR: methodology; formal analysis, writing-original draft; IS, NM, DS: formal analysis, resources.

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