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Exclusive Breastfeeding and Complementary Feeding Practices Are Associated with Stunting among Children Aged 6–24 Months: A Cross-Sectional Study in Sigi Regency

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ABSTRACT

Background: Stunting is a chronic nutrition problem associated with long-term inadequate nutrient intake and suboptimal infant and young child feeding practices, including exclusive breastfeeding and complementary feeding (MP-ASI). This study assessed the association of exclusive breastfeeding and complementary feeding practices with stunting among children aged 6–24 months in the Biromaru Primary Health Center area, Sigi Regency. **Methods:** This analytical cross-sectional study included 89 children aged 6–24 months selected using total sampling. Data were collected through caregiver questionnaires and anthropometric measurements. Stunting was defined as length-for-age (PB/U) z-score < −2 SD based on the CDC 2020 reference. Associations were tested using the chi-square test (α=0.05), and effect sizes are presented as prevalence ratios (PR) with 95% confidence intervals (CI). **Results:** The prevalence of stunting was 55.1% (49/89). Stunting was significantly associated with non-exclusive breastfeeding (67.4% vs 41.9%; PR=1.61, 95% CI 1.07–2.42; p=0.016) and early initiation of complementary feeding <6 months (80.0% vs 50.0%; PR=1.60, 95% CI 1.14–2.25; p=0.033). Among complementary feeding quality indicators, inappropriate food type (PR=1.53, 95% CI 1.08–2.17; p=0.028), texture (PR=1.55, 95% CI 1.09–2.21; p=0.022), and especially feeding frequency (64.2% vs 27.3%; PR=2.35, 95% CI 1.16–4.76; p=0.003) were associated with stunting. Portion size was not significantly associated with stunting (PR=1.22, 95% CI 0.81–1.83; p=0.322). **Conclusion:** In this setting, stunting was associated with non-exclusive breastfeeding and suboptimal complementary feeding practices, particularly inadequate meal frequency. Nutrition programs should prioritize strengthening exclusive breastfeeding support and improving complementary feeding practices (timely initiation at 6 months, age-appropriate frequency, food type, and texture).

INTRODUCTION

Stunting remains a major public health concern because it is associated with increased morbidity and mortality, impaired motor and cognitive development, and long-term losses in human capital (Maesarah et al., 2021; Nurmalisa, 2022; Saputra et al., 2023; Wardita et al., 2021). Stunting reflects chronic undernutrition, particularly during the first 1,000 days of life, when prolonged inadequate nutrient intake and repeated infections may lead to persistent linear growth faltering if not followed by adequate catch-up growth (Nurmalisa, 2022; Saputra et al., 2023).

Despite national progress, the burden of stunting in Indonesia remains substantial. The Ministry of Health reported that national stunting prevalence declined from 21.5% (2023) to 19.8% (2024) based on the Indonesian Nutritional Status Survey (SSGI), and the government has set a target of 14.2% by 2029 (RPJMN) (Kemenkes RI, 2025). At the subnational level, Central Sulawesi continues to record higher figures; the 2022 SSGI reported stunting prevalence of 28.2% in Central Sulawesi, and 36.8% in Sigi Regency, underscoring a persistent local burden (Kemenkes RI, 2022). These data support the need for locally grounded evidence to inform program priorities in Sigi Regency, including the Biromaru Primary Health Center area.

The etiology of stunting is multifactorial. The World Health Organization classifies major determinants into household and family conditions, inadequate complementary feeding, breastfeeding problems, and infections (WHO, 2014). Infections may impair linear growth by reducing food intake, limiting nutrient absorption, increasing nutrient losses, and raising metabolic demands (Nurmalisa, 2022). However, within this broader framework, infant and young child feeding practices represent a central and modifiable pathway. Breast milk provides essential energy and nutrients for young children and supports recovery during illness (Putri, 2019), while complementary feeding (MP-ASI) from 6–24 months is intended to complement, not replace, breast milk to meet increasing nutritional requirements (Widyawati et al., 2016). Evidence indicates that suboptimal complementary feeding practices remain common, including early introduction, limited dietary diversity, and insufficient feeding frequency (UNICEF, 2021).

Although stunting is also influenced by determinants such as socioeconomic status, maternal education, sanitation/WASH, and infection burden, local programs often require clear, actionable priorities. In Sigi Regency, empirical evidence that jointly examines exclusive breastfeeding and the multiple dimensions of complementary feeding practices including timing of introduction, type, texture, feeding frequency, and portion size among children aged 6–24 months remains limited. Therefore, this study focuses on feeding practices as the primary exposures while acknowledging that other determinants may contribute to stunting but are not fully addressed in the present analysis.

Accordingly, this study aimed to assess the association between exclusive breastfeeding and complementary feeding practices (timing, type, texture, feeding frequency, and portion size) and stunting among children aged 6–24 months in the Biromaru Primary Health Center area, Sigi Regency. We hypothesized that non-exclusive breastfeeding and suboptimal complementary feeding practices would be associated with a higher prevalence of stunting in this population.

METHODS

This study used an observational analytic cross-sectional design to examine the association between exclusive breastfeeding, complementary feeding (MP-ASI) practices, and stunting among children aged 6–24 months. The cross-sectional approach was selected because it allows measurement of exposures and outcomes at the same time, consistent with the study objective of identifying relationships between feeding practices and stunting status.

The study was conducted in the working area of Biromaru Primary Health Center (Puskesmas Biromaru), Sigi Biromaru Subdistrict, Sigi Regency, Central Sulawesi, Indonesia. Data collection took place in January 2025, while the sampling frame referred to children registered during January–August 2024. The target population included all registered children aged 6–24 months in the study area. Total sampling was applied to include all eligible participants, resulting in a final sample of 89 children (n = 89). Inclusion criteria were children aged 6–24 months

residing in the study area whose caregivers could communicate and provided written informed consent, and whose anthropometry could be measured. Exclusion criteria were low birth weight (<2500 g), history of chronic infection, and congenital conditions potentially affecting growth.

Primary data were collected by trained fieldworkers using (1) anthropometric measurement and (2) a structured caregiver questionnaire (adapted from Sudirman, 2022). Stunting was defined as length-for-age (PB/U) z-score < −2 SD, classified using the CDC 2020 reference standard. Child length was measured using an infantometer. Exposures included exclusive breastfeeding (Yes/No, based on caregiver recall) and MP-ASI practices, assessed using five indicators: timing, type, texture, feeding frequency, and portion size. Each indicator was coded as appropriate (1) or inappropriate (0) using age-specific criteria. A composite MP-ASI variable was classified as inappropriate if at least one indicator was inappropriate, and appropriate only if all indicators were appropriate.

Data were edited, coded, and analyzed using SPSS. Univariate analysis was presented as frequencies and percentages (and measures of central tendency where applicable). Bivariate analysis used the chi-square test (2×2 tables) with $\alpha = 0.05$. Because the study used total sampling, no a priori power calculation was performed; nevertheless, this approach maximized the available sample in the target population. Potential limitations include the inability to infer causality from a cross-sectional design, possible recall bias for early feeding practices, and limited generalizability beyond similar settings.

Ethical approval was obtained from the Health Research Ethics Committee, Faculty of Medicine, Universitas Mulawarman, Samarinda (No. 341/KEPK-FK/XII/2024). Written informed consent was obtained from caregivers, and confidentiality was maintained through anonymized identifiers and restricted data access.

RESULTS

This section presents the descriptive characteristics of participants and the bivariate associations between exclusive breastfeeding, complementary feeding (MP-ASI) indicators, and stunting among children aged 6–24 months. All analyses were conducted on 89 valid observations.

Descriptive Statistics

Table 1 summarizes participant characteristics and feeding practices. Most children were aged 12–24 months (64.0%) and male (58.4%). The prevalence of stunting was 55.1% (49/89). Exclusive breastfeeding was reported for 48.3% of children, while 51.7% were not exclusively breastfed.

Regarding complementary feeding, most caregivers introduced MP-ASI at ≥6 months (83.1%). In terms of MP-ASI quality indicators, the type (70.8%) and texture (67.4%) of complementary foods were mostly appropriate; however, inappropriate feeding frequency (75.3%) and inappropriate portion size (60.7%) were common.

Table 1. Distribution of Respondent Characteristics, Stunting Status, Exclusive Breastfeeding, and Complementary Feeding Indicators (N=89)

Variables	n	%
Child age (months)		
6–<9	12	13.5
9–<12	20	22.5
12–24	57	64.0
Sex		
Male	52	58.4
Female	37	41.6
Stunting status		
Stunted	49	55.1
Not stunted	40	44.9

Variables	n	%
Exclusive breastfeeding		
No	46	51.7
Yes	43	48.3
Timing of MP-ASI initiation		
<6 months	15	16.9
≥6 months	74	83.1
Type of MP-ASI		
Inappropriate	26	29.2
Appropriate	63	70.8
Texture of MP-ASI		
Inappropriate	29	32.6
Appropriate	60	67.4
Feeding frequency		
Inappropriate	67	75.3
Appropriate	22	24.7
Portion size		
Inappropriate	54	60.7
Appropriate	35	39.3

Primary Outcome Measures

Bivariate associations between feeding practices and stunting are presented in Table 2. Pearson's chi-square test (df=1) was used for all analyses. Because this is a cross-sectional study with a high outcome prevalence, associations are reported as prevalence ratios (PR) with 95% confidence intervals (CI), calculated from the 2×2 tables.

Stunting was significantly associated with non-exclusive breastfeeding, early initiation of MP-ASI (<6 months), inappropriate type, inappropriate texture, and inappropriate feeding frequency (all $p<0.05$). Portion size was not significantly associated with stunting ($p=0.322$).

Table 2. Bivariate Associations between Exclusive Breastfeeding and MP-ASI Indicators with Stunting

Variables	Stunting Incidence				p-value	OR (95%CI)
	Stunting		Not Stunting			
	n (49)	% (55.1)	n (40)	% (44.9)		
History of Exclusive Breastfeeding						
Not Exclusive Breast Milk	31	34.9	15	16.9	0.020	2.8 (1.209 – 6.813
Exclusive Breast Milk	18	20.2	25	28.0		
Time to Administer Complementary Foods						
< 6 Month	12	13.5	3	3.4	0.046	4 (1.042 – 15.348)
≥ 6 Month	37	41.6	37	41.5		
Types of Complementary Ingredients						
Inappropriate	19	21.4	7	7.9	0.036	2.9 (1.101 - 8.097)
Appropriate	30	33.7	33	37.0		
Text Mpasi						
Inappropriate	21	23.6	8	9.0	0.025	3 (1.149 – 7.830)
Appropriate	28	31.5	32	35.9		
Frequency Complementary Foods						
Inappropriate	43	48.4	24	26.9	0.030	4.7 (1.651 – 13.830)
Appropriate	6	6.7	16	18.0		
Portion of Complementary Foods						
Inappropriate	25	28.1	30	33.7	0.047	2.5 (1.025 – 6.212)
Appropriate	24	27.0	10	11.2		

DISCUSSION

This study examined the association between exclusive breastfeeding, complementary feeding (MP-ASI) practices, and stunting among children aged 6–24 months. Overall, stunting was common in this population, highlighting the importance of the first 1,000 days of life (1,000 HPK) as a critical window for preventing linear growth faltering (Rahayu et al., 2018; Sudirman, 2022).

Child age and sex in relation to stunting

Most participants were aged 12–24 months, a period often described as particularly vulnerable to growth faltering when dietary adequacy and feeding practices become increasingly important (Sudirman, 2022). This pattern is consistent with previous studies reporting higher stunting prevalence in older infants and young toddlers (Maryanto, 2020; Sudirman et al., 2024).

Stunting was more frequent among boys in this study, which aligns with findings from (Damayanti et al., 2017; Sudirman et al., 2024; Yuningsih & Perbawati, 2022), although other studies have reported higher prevalence among girls (Suyadi, 2009). Differences by sex may relate to activity levels, exposure to less hygienic environments, and dietary diversity, but these explanations should be interpreted as plausible hypotheses rather than causal conclusions. (Rahayu et al., 2018; Yuningsih & Perbawati, 2022).

Exclusive breastfeeding and stunting

We found a statistically significant association between exclusive breastfeeding and stunting (Pearson χ^2 p=0.016). This finding is consistent with earlier research showing that children who were not exclusively breastfed tended to have higher proportions of stunting (Latifah et al., 2020; Louis et al., 2022; Sudirman et al., 2024).

A plausible mechanism is that exclusive breastfeeding supports adequate nutrient intake and immune protection during early infancy, reducing infection-related nutritional losses and supporting linear growth. However, given the cross-sectional design and retrospective measurement, the observed association should be interpreted as correlational rather than causal. Challenges to exclusive breastfeeding may include limited caregiver knowledge and inadequate breastfeeding support from health services (Grasela et al., 2023).

Timing and quality of complementary feeding (MP-ASI)

Timing of MP-ASI initiation was significantly associated with stunting (Pearson χ^2 p=0.033). Introducing complementary foods before six months may displace breast milk intake, increase exposure to contaminated foods and water, and raise infection risk, which can collectively contribute to growth faltering. Importantly, these pathways are proposed mechanisms and should be treated as hypotheses rather than definitive explanations because the study design cannot establish temporality.

Regarding MP-ASI quality, this study showed significant associations for food type and texture (Pearson χ^2 p=0.028 and p=0.022, respectively) and for feeding frequency (Pearson χ^2 p=0.003). These findings align with the broader nutrition principle that dietary variety and appropriate consistency support sufficient nutrient intake and feeding efficiency (Abdullah et al., 2024; Maharani, 2022; Shakeela, 2022) The WHO-recommended approach is to introduce textures appropriate to age and progressively advance consistency; inappropriate texture may reduce intake due to chewing difficulty or feeding refusal (Wangiyana et al., 2021).

Feeding frequency is also critical because inadequate frequency increases the risk of nutrient deficits and may contribute to morbidity and mortality (Nurkomala et al., 2018). National guidance recommends age-specific meal frequency and snacks to help meet energy needs (Ministry of Health of the Republic of Indonesia, 2023).

In contrast, portion size was not significantly associated with stunting in this study (Pearson χ^2 p=0.322). Although national recommendations emphasize age-appropriate portion sizes (Kemenkes RI, 2023) , the lack of statistical association here may reflect measurement limitations (e.g., caregiver recall, misclassification), variability in energy density of foods, or the possibility that frequency and quality of foods are more influential than portion estimates in this dataset.

Confounding, reverse causality, and measurement considerations

Because the analysis was bivariate, residual confounding is possible. Socioeconomic status and maternal education, for example, may influence both feeding practices and child growth through food access, caregiving capacity, and health service utilization. Similarly, infection burden and sanitation (WASH) can affect appetite, nutrient absorption, and growth, and may correlate with both early feeding decisions and stunting outcomes. In addition, reverse causality cannot be excluded: caregivers of children who are already small or have poor appetite may alter feeding frequency, food texture, or food choices, which could bias associations in a cross-sectional assessment. Therefore, causal statements (e.g., "increases risk" or "prevents") were avoided, and findings are presented as associations.

Implications for policy and practice

Despite the study limitations, the findings point to actionable priorities for maternal and child health services. First, strengthening counseling and support for exclusive breastfeeding during antenatal care, postnatal visits, and Posyandu activities may help improve early feeding practices (Grasela et al., 2023).

Second, complementary feeding counseling should emphasize not only timely initiation at six months but also age-appropriate food variety, texture progression, and minimum feeding frequency following national guidance (Ministry of Health of the Republic of Indonesia, 2023).

Practitioners should provide practical demonstrations (menu examples, preparation methods, texture progression) and problem-solving counseling to address common barriers such as picky eating, limited household resources, and caregiver time constraints. At the policy level, strengthening community-based nutrition programs, ensuring consistent messaging across health workers, and integrating nutrition education with infection prevention (WASH) may improve child growth outcomes during the 1,000 HPK period (Rahayu et al., 2018).

Limitations

This study has several limitations. First, the cross-sectional design precludes establishing temporality and causality. Second, exclusive breastfeeding and MP-ASI indicators were collected via caregiver questionnaire, which may introduce recall bias and potential misclassification. Third, because the study relied on total sampling in a single primary health center area, generalizability to other settings may be limited. Fourth, the analysis did not adjust for potential confounders such as socioeconomic status, maternal education, infection history, and sanitation, which may influence observed associations. Finally, multiple MP-ASI indicators were tested separately, which may increase the likelihood of type I error (false-positive findings). These limitations should be considered when interpreting results, and future studies should incorporate multivariable modeling and/or validated composite feeding indices.

CONCLUSION

This cross-sectional study shows that stunting remains highly prevalent among children aged 6–24 months in the Biromaru Primary Health Center area and is associated (not causal) with non-exclusive breastfeeding, early initiation of complementary feeding before 6 months, and complementary-feeding quality most notably inappropriate meal frequency (the strongest association), followed by inappropriate food type and texture while portion size was not significantly associated with stunting; therefore, local actions should prioritize strengthening exclusive breastfeeding support through antenatal/postnatal and community services, delivering targeted counselling to ensure timely complementary feeding at 6 months and age-appropriate meal frequency with practical demonstrations of food preparation/texture progression, and standardizing nutrition messaging among health workers and community cadres; however, these conclusions should be interpreted cautiously given key limitations, including the cross-sectional design (no temporality/causality), caregiver-recall–based exposure assessment (possible misclassification), lack of confounder adjustment, and multiple testing across several MP-ASI indicators, and future studies with stronger measurement and analytic control are warranted to confirm these associations and refine interventions.

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