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Determinants of suboptimal complementary feeding practices among children aged 6–24 months in Natuna: A Case-control study

Determinan praktik pemberian makanan pendamping ASI yang suboptimal pada anak usia 6–24 bulan di Natuna: Studi kasus-kontrol

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Abstract

Stunting affects more than 22% of children under five years of age globally, including approximately 6.3 million in Indonesia. The 2024 SSGI reported a decline in the national prevalence of stunting from 21.5% to 19.8% in 2023, surpassing the 20.1% target, with a further reduction goal of 14.2% by 2029. However, Natuna Regency reported a prevalence of 16.1% in 2023, exceeding the national target and highlighting the need for evidence-based intervention. This study aimed to investigate the association between maternal knowledge, attitudes, involvement, and self-confidence in complementary feeding practices among stunted children aged 6–24 months. This study employed a case–control design involving 122 mothers (60 cases and 62 controls). The study was conducted in the working areas of Puskesmas Serasan and Puskesmas Serasan Timur from September to November 2024. Data were collected using structured questionnaires and analyzed using chi-square tests and logistic regression. Most case group mothers had low knowledge (21.3%), unfavorable attitudes (48.4%), limited involvement (42.6%), and low self-confidence (50%). The results also showed significant associations between maternal factors and feeding practices ($p \leq 0.001$). Poor knowledge was the strongest predictor of stunting (OR = 24.0), followed by low self-confidence (OR = 8.8), negative attitude (OR = 7.29), and limited involvement (OR = 5.6). Strengthening maternal capacity is essential for improving feeding practices.

Keywords: Complementary feeding, stunting prevention, area (disadvantaged, frontier, and outermost regions), maternal behavior.

Abstrak

Stunting mempengaruhi lebih dari 22% anak di bawah lima tahun secara global, termasuk sekitar 6,3 juta di Indonesia. Laporan SSGI 2024 menunjukkan penurunan prevalensi stunting nasional dari 21,5% menjadi 19,8% pada 2023, melampaui target 20,1%, dengan target penurunan lebih lanjut menjadi 14,2% pada 2029. Namun, Kabupaten Natuna melaporkan prevalensi 16,1% pada tahun 2023, melebihi target nasional dan menyoroti kebutuhan akan intervensi berbasis bukti. Studi ini bertujuan untuk menyelidiki hubungan antara pengetahuan, sikap, keterlibatan, dan kepercayaan diri ibu dalam praktik pemberian makanan pendamping pada anak stunting berusia 6–24 bulan. Studi ini menggunakan desain kasus-kontrol yang melibatkan 122 ibu (60 kasus dan 62 kontrol). Studi ini dilakukan di wilayah kerja Puskesmas Serasan dan Puskesmas Serasan Timur dari September hingga November 2024. Data dikumpulkan menggunakan kuesioner terstruktur dan dianalisis menggunakan uji chi-square dan regresi logistik. Sebagian besar ibu

dalam kelompok kasus memiliki pengetahuan rendah (21,3%), sikap tidak mendukung (48,4%), keterlibatan terbatas (42,6%), dan kepercayaan diri rendah (50%). Hasil juga menunjukkan hubungan yang signifikan antara faktor ibu dan praktik pemberian makan ($p \leq 0,001$). Pengetahuan yang rendah merupakan prediktor terkuat untuk stunting (OR = 24,0), diikuti oleh kepercayaan diri yang rendah (OR = 8,8), sikap negatif (OR = 7,29), dan keterlibatan yang terbatas (OR = 5,6). Peningkatan kapasitas ibu sangat penting untuk meningkatkan praktik pemberian makan.

Kata Kunci: Pemberian makanan pendamping, pencegahan stunting, wilayah (wilayah terpencil, perbatasan, dan terluar), perilaku ibu.

Introduction

Stunting is a condition characterized by impaired growth and development in children caused by chronic undernutrition and recurrent infections, resulting in height-for-age measurements that are below the WHO standards. This condition has long-term effects on physical and cognitive development and productivity and increases the risk of non-communicable diseases in adulthood (Hadi et al., 2021). Globally, stunting affects more than 22% of children under five, or approximately 149 million, including an estimated 6.3 million in Indonesia (Permatasari 2022). National survey data show a gradual decline in stunting prevalence, reaching 21.5% in 2023 (Ministry of Health of the Republic of Indonesia, 2023).

Concerning the Sustainable Development Goals (SDGs), the government of Indonesia has committed to reducing stunting by 40% among children under five years of age in Indonesia by 2030. Natuna District, situated in a disadvantaged, frontier, and outermost area, has exhibited a concerning increase in stunting prevalence over the past three years, from 11.77% in 2021 to 16.10% in 2023, despite the national target of reducing prevalence to 14%. This upward trend highlights the urgency of identifying specific contributing factors, including feeding practices, to inform targeted interventions (Natuna District Health Office, 2022).

The 2023 Indonesian Health Survey (SKI) found that complementary feeding (CF) practices in the Riau Islands Province remain suboptimal, with issues such as infrequent feeding (35.1%), low dietary diversity (46.8%), improper feeding patterns (63.1%), and poor intake of animal protein (14.6%). These problems are closely linked to maternal factors, such as limited knowledge, unsupportive attitudes, low confidence, and minimal involvement. Previous studies have confirmed these associations (Ministry of Health of Indonesia, 2023). Pangestuti et al. (2023) found that stunting is influenced by maternal height, food parenting practices, and early feeding patterns. Meanwhile, Yunitasari et al. (2022) reported that inappropriate CF is strongly linked to poor maternal education and limited access to health services, while Tadesse et al. (2023) emphasized the impact of inadequate dietary diversity and feeding frequency during the critical growth period of children.

According to the WHO (2024), complementary feeding should be introduced at the right time, be nutritionally adequate, and be prepared and served safely to prevent infection and support growth. Inappropriate practices, including the early introduction of solid foods or inadequate nutrient content, are associated with a higher stunting risk. Ensuring adequate nutrition during this critical period directly influences a child's physical development and overall health. These guidelines emphasize the importance of proper CF in promoting children's overall health and growth (Paramashanti et al., 2024).

Additionally, a varied diet plays a significant role in fulfilling the essential nutrient requirements. Ensuring food diversity, especially among children aged 6–59 months, is key to meeting their energy demands and providing the nutrient-rich nutritional intake essential for proper bodily and brain development (Isna Yuswella Babys, 2023). "Minimum meal frequency" refers to how often a child eats solid or semi-solid foods in addition to breast milk in one day; this is an indicator of whether young children are getting enough meals for growth (Wagris et al., 2019). Stunting means having a low height for age, which is a

sign of long-term malnutrition. A recent study reported a high prevalence of stunting (50.6%) among children with exceptionalities. Dairy and egg consumption were inversely associated with stunting risk, whereas the intake of meat, fruits, and vegetables showed no significant relationship. Therefore, milk and eggs are highly recommended, especially for children living in institutional care settings (Nachvak et al., 2020).

Socioeconomic status, reflected through education, income, employment, and place of residence, significantly affects children's nutritional statuses. Low maternal education and income often limit access to stunting-related information and the ability to provide adequate, nutritious, and diverse diet. Moreover, maternal knowledge, attitudes, self-confidence, and involvement are key determinants of the success of exclusive and complementary feeding (Ni'mah et al., 2023).

Despite extensive research on stunting and complementary feeding, their determinants in geographically isolated island regions, such as the Natuna District, have not been widely explored. As a disadvantaged, frontier, and outermost area, this district faces unique challenges, including limited access to health services, infrastructure gaps, and socio-economic constraints. These contextual barriers highlight the need for localized evidence. This study aims to fill this gap by examining maternal knowledge, attitudes, involvement, and self-confidence in relation to CF practices among stunted children aged 6–24 months in the Natuna District.

Methods

This study employed a quantitative method with a case-control design. This study was conducted in two working areas of Puskesmas Serasan and Serasan Timur in Natuna District, a region with stunting locus status. This study was part of the *Natuna Complementary Feeding Practice (NaCoF) Mixed Method Study,* a multiphase investigation that integrates both quantitative and qualitative approaches to understand the maternal determinants of complementary feeding. The current study represents the quantitative phase of NaCoF, focusing on the association between maternal knowledge, involvement, attitudes, and self-confidence, and identifying the most influential factors associated with complementary feeding practices among mothers of stunted and non-stunted children aged 6–24 months. The research was conducted between August and December 2024, followed by a qualitative exploration phase to gain contextual understanding.

The study population comprised mothers of children aged 6–24 months. The selection of research participants used a consecutive sampling method, in which eligible subjects were included until the required sample size was obtained. The independent variables were maternal knowledge, attitudes, and involvement, and the dependent variable was complementary feeding practices. This study involved a total of 122 participants, comprising 60 in the case group and 62 in the control group. The data collection process is shown in Figure 1.

Data were analyzed using the SPSS software. The process involved univariate analysis to outline the participants' characteristics, bivariate analysis utilizing chi-square tests to explore associations between independent and dependent variables, and multivariate analysis through logistic regression to determine the most influential factors with a p-value less than 0.25. Knowledge, attitude, involvement, self-confidence, and CF practice had p-values of less than 0.25. A stepwise multivariate analysis was then performed, where variables were considered to have a significant relationship with a p-value of ≤0.05 and a significance level of 95%. Quantitative data processing involved several stages: editing, coding, tabulation, data entry, and cleaning. Prior to distributing the questionnaire, the researcher checked its validity and reliability. Ethical clearance was obtained from the Research Ethics Committee of Alma Ata University (No: KE/AA/VII/10112000/EC/2024). The study maintained respondent confidentiality and obtained written consent from the participants.

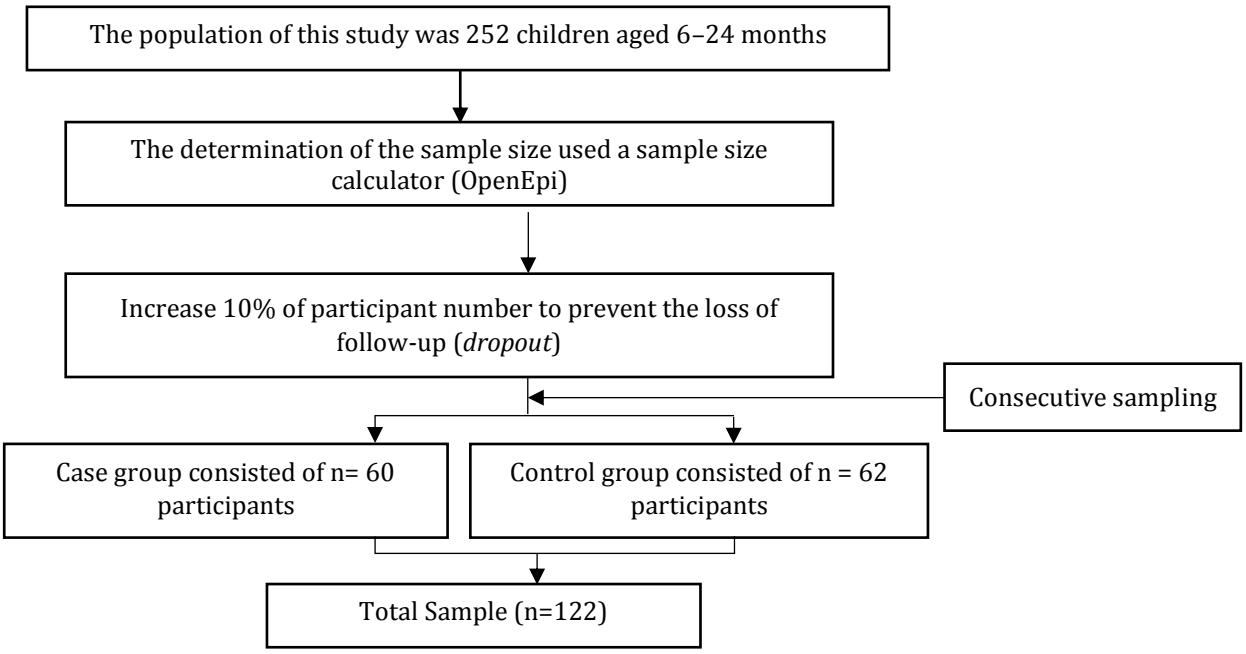

Figure 1. Flowchart of participant recruitment process

Result and Discussion

The characteristics of the respondents included demographic and socioeconomic variables such as the respondent's domicile, age, family economic status, education level, employment status, child's age, and child's gender. The analysis of these variables aimed to identify differences in proportions between the stunted and non-stunted groups and to recognize possible factors associated with the incidence of stunting. Consistent with evidence from Eastern Indonesia, exclusive breastfeeding has been proven to significantly reduces the risk of stunting, especially in low-income households, underscoring the importance of maternal feeding practices within broader socioeconomic constraints (Hadi et al., 2021).

As shown in Table 1, this study involved 122 respondents, consisting of a stunting group (60 children, 49.2%) and a non-stunting group (62 children, 50.8%). The majority of respondents were from Serasan Timur (64.8%), with a higher proportion of stunting cases in Serasan (32%) than in Serasan Timur (17.2%). Most respondents were in the early adulthood age category (26–35 years), with stunting prevalent among this group, which had a higher proportion of late adolescents (13.9%) and early adults (23.0%) than the non-stunting group. Low economic status dominated (88.5%), with a higher prevalence in the stunted group (48.4%), while high economic status was more common in the non-stunted group (10.7%). Regarding education level, a large proportion of respondents (53.3%) had a high school education, with the non-stunting group showing a higher education level, such as a bachelor's degree (9.0% compared to 1.6% in the stunted group). Most respondents were unemployed (82.8%), with a higher proportion in the stunted group (45.1%) than in the non-stunted group (37.7%).

The children were predominantly aged between 12 and 24 months (71.3%). The proportion of boys was higher in the non-stunted group (28.7%) than in the stunted group (18.0%). The analysis demonstrated a significant correlation between stunting prevalence and factors such as place of residence, economic status, and parental education. These results indicate the critical need for socioeconomic interventions, particularly in high-prevalence regions such as Serasan.

Table 1. Characteristics of respondents

Characteristics of Respondents	Category	Stunting (n=60)	Not Stunting (n=62)	Total (%)
Respondent's Domicile	Serasan	39 (32)	4 (3.3)	43 (35.2)
	Serasan Timur	21 (17.2)	58 (47.4)	79 (64.8)

Respondent's Age	Young Adulthood (Ages 26–35)	28 (23.0)	24 (19.7)	52 (42.6)
	Middle Adulthood (Ages 36–45)	14 (11.5)	19 (15.6)	33 (27.0)
	Pre-Elderly (Ages 46–55)	1 (0.8)	2 (1.6)	3 (2.5)
Family Economic Status	High	1 (0.8)	13 (10.7)	14 (11.5)
	Low	59 (48.4)	49 (40.2)	108 (88.5)
Education	Elementary school/equivalent	7 (5.7)	12 (9.8)	19 (15.6)
	Junior high school/equivalent	13 (10.7)	9 (7.4)	22 (18.0)
	Senior high school/equivalent	38 (31.1)	27 (22.1)	65 (53.3)
	Diploma III	0 (0.0)	3 (2.5)	3 (2.5)
	Bachelor's degree	2 (1.6)	11 (9.0)	13 (10.7)
Employment Status	Employed	55 (45.1)	46 (37.7)	101 (82.8)
	Unemployed	5 (4.1)	16 (13.1)	21 (17.2)
Child Age	6-8 Months	8 (6.6)	6 (4.9)	14 (11.5)
	9-11 Months	9 (7.4)	12 (9.8)	21 (17.2)
	12-24 Months	43 (35.2)	44 (36.1)	87 (71.3)
Child's Gender	Boys	22 (18.0)	35 (28.7)	57 (46.7)
	Girls	38 (31.1)	27 (22.1)	65 (53.3)

Data are presented as frequencies and percentages (%).

The study revealed key factors associated with stunting in the Serasan and Serasan Timur sub-districts. Although the sample was evenly grouped between children with and without stunting, Serasan showed a higher stunting prevalence, indicating disparities in healthcare or resource access. Most stunting cases involve mothers in late adolescence or early adulthood, a group often limited in experience, knowledge, and healthcare access, factors that affect child nutrition. This is in line with Titaley et al. (2019), who found that geographic location, healthcare availability, diet, and sanitation significantly influenced stunting rates.

Early adulthood was the most common maternal age group and showed higher stunting rates, highlighting the need for targeted nutritional education. Rahman et al. (2016) found that young mothers, especially those with low education and poor economic access, are more likely to have stunted children. Most families had a low socioeconomic status (88.5%), with a higher stunting rate (48.4%) than wealthier households (0.8%). Income-generating interventions through economic empowerment programs have been proven to be effective in reducing stunting rates. Azriani et al. (2024) showed that families with better income levels tend to have improved access to nutritious food, healthcare services, and nutrition knowledge, thereby significantly lowering the risk of stunting.

Education plays a crucial role, with stunting being more common among mothers with elementary or junior high school education levels. Although most mothers had a high school education (53.3%), stunting was more common among those with lower education levels. Headey et al. (2016) emphasized maternal education as a key factor influencing child nutrition, as educated mothers tend to have better knowledge of child care and nutrition. Mothers with higher education levels tend to have non-stunted children, indicating that higher education contributes to improved access to nutritional knowledge, parenting skills, and healthcare.

Most mothers were unemployed (82.8%), and this group had a high prevalence of stunting (45.1%); this aligns with recent national analyses in Indonesia, which reported that children of unemployed mothers have a greater likelihood of experiencing stunting than those whose mothers are employed (adjusted PR ≈1.15), considering limited household resources in meeting children's nutritional needs (Kusuma et al., 2023). The majority of children aged 12–24 months (71.3%) had a high prevalence of stunting (35.2%). This

finding is consistent with evidence identifying the period between 6 and 23/24 months as a "critical window" during which nutrient requirements and the risk of growth faltering increase, making adequate complementary feeding practices crucial (UNICEF, 2020).

The transition from exclusive to complementary feeding is critical for preventing stunting, especially in early childhood (Imdad et al., 2016). While this study observed a higher proportion of stunted growth among girls (31.1%) than boys (18%), this finding contrasts with the broader literature, which often reports higher vulnerability in boys. Given the limited sample and contextual variability, further investigation is required to draw conclusions related to sex-based differences in stunting (Thurstans et al., 2022). This may reflect local sociocultural and biological factors. Interventions should focus on improving healthcare access, economic conditions, and parental nutrition education, especially in high-prevalence areas such as Serasan, using a comprehensive socioeconomic approach.

Table 2. Distribution of maternal knowledge, attitude, involvement, and self-confidence related to complementary feeding practices

Determinants	Category	Stunting (n=60)	Not Stunting (n=62)	Total (%)
Knowledge	High	34 (27.9)	62 (58.8)	96 (78.7)
	Low	26 (21.3)	0 (0)	26 (21.3)
Attitude	Good	20 (16.4)	43 (35.2)	63 (51.6)
	Poor	40 (32.8)	19 (15.6)	59 (48.4)
Involvement	Involved	20 (16.4)	50 (41.0)	70 (57.4)
	Not Involved	40 (32.8)	12 (9.8)	52 (42.6)
Self-Confidence	High	19 (31.7)	42 (67.7)	61 (50.0)
	Low	41 (68.3)	20 (32.3)	61 (50.0)
CF Practice	Appropriate	15 (25.0)	51 (82.3)	66 (54.1)
	Inappropriate	45 (75.0)	11 (17.7%)	56 (45.9)

Data are presented by percentage (%)

Table 2 shows that the majority of respondents (78.7%) had a high level of knowledge, with a higher proportion in the non-stunted group (58.8%) than in the stunted group (27.9%). In contrast, all respondents with insufficient knowledge (21.3%) were in the stunting group, emphasizing the relationship between knowledge and stunting occurrence. In terms of attitudes, 51.6% of respondents demonstrated a positive attitude, with a significant majority in the non-stunted group (35.2%), while the stunted group had a higher proportion of poor attitudes (32.8%). Parental involvement also contributed to CF practices, with 57.4% of respondents actively involved, more so in the non-stunting group (41.0%) than in the stunting group (16.4%). Conversely, 42.6% of respondents were not involved, with the majority coming from the stunted growth group (32.8%). Most respondents in the stunting group practiced inappropriate CF (75%), whereas the majority in the non-stunting group practiced appropriate CF (82.3%).

The stunting group demonstrated lower knowledge, poorer attitudes, less parental involvement, and inappropriate complementary feeding practices than the non-stunting group. This is in line with Nisa (2024), who reported a significant relationship between maternal nutritional knowledge and the incidence of stunting ($p = 0.013$). Mothers with low nutritional knowledge were more likely to be unable to meet key nutrition awareness indicators, such as exclusive breastfeeding, dietary diversity, and vitamin A supplementation, thereby increasing the stunting risk. A study in Aceh found that maternal knowledge, nutritional care, and stunting were significantly correlated (Ramadhan et al., 2024), considering that limited knowledge often coincides with inconsistent meal provision, poor growth monitoring, and inadequate dietary diversity. Therefore, interventions to prevent stunting should not only focus on improving maternal knowledge but also on building caregiving skills, ensuring consistent feeding practices, and strengthening parental engagement through community-based programs and regular growth monitoring in the future.

Table 3. The relationship between maternal knowledge, attitudes, and involvement in the provision of complementary foods to stunted children aged 6–24 months.

		The practice of providing complementary foods				
	Category	Appropriate n (%)	Inappropriate n (%)	Total n (%)	OR (CI 95%)	P-value
Knowledge	High	59 (48.4)	22 (18.0)	81 (66.4)	24.0	≤0.001
	Low	7 (5.7)	34 (27.9)	41 (33.6)	(5.4-107.9)	
Attitude	Good	50 (41.0)	22 (18.0)	72 (59.0)	7.2	≤0.001
	Poor	16 (13.1)	34 (27.9)	50 (41.0)	(3.2-16.2)	
Involvement	Involved	57 (46.7)	24 (19.7)	81 (66.4)	5.6	≤0.001
	Not Involved	9 (7.4)	32 (26.2)	41 (33.6)	(2.5-12.3)	
Self-Confidence	High	48 (72.7)	13 (23.2)	61 (50.0)	8,8	≤0,001
	Low	18 (72.7	43 (76.8)	61 (50.0)	(3.8-20.0)	

Data are presented as percentages (%).

Table 3 shows a statistically significant correlation (p<0.001) between maternal knowledge and complementary feeding practices in children aged 6–24 months with stunted growth. A total of 59 mothers (72.8%) with good knowledge had appropriate CF practices, while 22 (27.2%) had inappropriate practices. Mothers with sufficient knowledge tend to implement proper complementary feeding practices more consistently. However, 41 mothers (82.9%) with poor knowledge practiced inappropriate complementary feeding, indicating a strong link between insufficient knowledge and suboptimal child nutrition. Only seven mothers (17.1%) successfully adhered to the appropriate complementary feeding practices. An odds ratio (OR) of 24 indicates that mothers with good nutritional knowledge were more likely to implement appropriate complementary feeding than those with limited knowledge.

Moreover, parental attitudes towards complementary feeding practices also influence appropriate feeding practices. Fifty mothers (69.4%) with a good attitude had appropriate CF practices, while 22 (30.6%) with a good attitude had inappropriate practices. In contrast, 34 mothers (68%) with poor attitude had inappropriate CF practices, while 16 mothers (32%) with poor attitude had appropriate CF practices. An OR of 7.289 (CI 95%: 3.268–16.255; p<0.001) revealed that a positive attitude increased the likelihood of correct complementary feeding practices by more than seven times compared to a poor attitude.

Parents' active involvement is important for promoting better CF. Fifty-seven respondents (70.4%) with active involvement had appropriate CF practices, whereas 24 respondents (29.6%) with active involvement had inappropriate CF practices. In contrast, 32 respondents (78%) who were not involved had inappropriate practices, while only 9 respondents (22%) who were not involved had appropriate CF practice. The OR of 7.289 (CI 95%: 3.268–16.255; p<0.001) indicates that active involvement increases the likelihood of appropriate CF practices by seven times compared with non-involvement. Chi-square analysis showed a significant association between maternal self-confidence and CF feeding practices in children aged 6–24 months (P = 0.001).

Maternal Knowledge and Appropriate Complementary Feeding Practices

Community- and facility-based interventions, including nutrition education, interpersonal communication, and group-based complementary feeding sessions, have significantly improved infant and young child feeding (IYCF) practices. Dietary diversity and meal frequency are associated with a reduced risk of stunting (Ahmed et al., 2021). In food-secure settings, purely educational programs in Peru enhanced height-for-age (Penny et al., 2005). Recent studies have also confirmed that maternal knowledge strongly predicts appropriate feeding practices, including in stunted children aged 6–24 months (Bimpong et al., 2020; Faradila F, 2021; Elsa et al., 2024). Future studies should examine the influence of knowledge on CF practices (Hutabarat et al., 2022).

Maternal knowledge is important for informed feeding practices, particularly during the golden growth period. A lack of understanding

often leads to inappropriate complementary feeding, resulting in a higher risk of stunting. This study highlights the need for targeted educational interventions, such as health counseling, cadre training, and community outreach, to enhance maternal awareness. Strengthening collaboration among health workers, the government, and communities is important to support optimal child nutrition (Bimpong et al., 2020).

Maternal knowledge significantly influences complementary feeding (CF) practices. Gaps in mothers' understanding of feeding frequency, appropriate food choices, and nutritional content may hinder optimal nutritional intake (Riekert et al., 2014). Good knowledge promotes the selection of nutritious foods, portion control, and proper texture adjustment after six months to support growth and development. Improving CF knowledge through regular, high-quality health education, such as leaflets and community engagement, is important. Empowering families and increasing public awareness can reduce stunting and support long-term human development (Aisha et al., 2022; Bimpong et al., 2020).

Mother's Attitude and Complementary Feeding Practices

Bivariate analysis demonstrated that mothers with positive attitudes were more likely to adopt appropriate complementary feeding practices. This supports the idea that favorable perceptions of child nutrition influence day-to-day feeding decisions. Positive attitudes often reflect openness to health information and a greater sense of maternal responsibility, both of which are essential for preventing poor nutrition. However, without the support of resources and social reinforcement, attitudes alone are insufficient.

This finding is consistent with a previous study showing that a positive maternal attitude toward child nutrition influences feeding practices. Cultural values, experience, and education shape attitudes (Faradila, 2021). Community-based efforts to shift maternal attitudes have been effective in lowering the stunting rate. This study aligns with Richie (2022) and Faradila (2021) in that attitudes and complementary feeding practices correlate significantly.

Positive maternal attitudes are strongly linked to better complementary feeding practices, emphasizing the role of behavioral interventions in preventing stunting. However, without enabling factors such as access to resources and social support, positive attitudes alone are insufficient (Riekert et al., 2014). Respondents with supportive spouses, extended families, and health providers were more likely to practice appropriate CF after exclusive breastfeeding. This study also found that some mothers with positive attitudes failed to provide appropriate CF practices, indicating that perception does not always lead to action. Bridging this gap requires addressing external barriers, including work demands and limited support systems (Azizah et al., 2022).

Parental Involvement and Complementary Feeding Practices

Active parental involvement is associated with more appropriate complementary feeding practices in children. Parents who are actively involved tend to be more attentive to their children's dietary needs, feeding frequency, and food diversity. Active involvement indicates better household food planning and adherence to nutritional recommendations. Strengthening family based interventions that encourage parents to participate in feeding decisions may improve child nutrition quality.

Beyond physical and emotional engagement and knowledge, parents with active involvement foster better feeding decisions in their children. Therefore, health and education programs should prioritize parental involvement in building CF skills (Susilowati et al., 2018).

Maternal Self-Confidence and Complementary Feeding Practices

Maternal self-confidence plays a critical role in shaping feeding behaviors. Mothers who are confident in their ability to feed and care for their children are more likely to adopt appropriate CF practices. Self-confidence influences decision-making, consistency, and willingness to adopt new practices recommended by health professionals. Interventions aimed at strengthening maternal self-efficacy, such as peer mentoring, counseling, and practical demonstrations, can provide long-term benefits in improving child nutrition outcomes. Moreover, strong self-efficacy enhances goal setting and persistence in providing care for children. Mothers with higher self-efficacy pursue more ambitious and consistent feeding objectives

(Gizaw et al., 2023), while Farah et al. (2019) found that confident mothers are more receptive to health worker guidance and actively seek solutions to CF challenges. Consequently, targeted education and psychosocial support to increase maternal confidence are important for ensuring appropriate CF practices, particularly when addressing feeding difficulties.

Table 4. Multivariate analysis for determinant factors of cf practices

Step	Determinants	Exp(B)	95% C.I. for EXP(B)		P-*Value*
			Lower	Upper	
Step 1[a]	Knowledge	4,740	1,573	14,287	0,006
	Attitude	1,782	0,671	4,734	0,246
	Involvement	2,562	0,856	7,666	0,092
	Self-Confidence	3,257	1,271	8,346	0,014
	Constant	0.002			<0,001
Step 2[a]	Knowledge	5,029	1,690	14,972	0,004
	Attitude	2,966	1,026	8,577	0,045
	Self-Confidence	3,605	1,430	9,089	0,007
	Constant	0.003			<0,001

Data are presented as 95% C.I. for EXP(B).

Table 4 presents the results of the multivariate analysis. The researcher evaluated the factors influencing complementary feeding (CF) practices using logistic regression analysis. The factors included knowledge, attitude, parental involvement, and self-confidence, and stepwise regression was used to filter out the most significant variables. In Step 1, knowledge had a significant effect on CF practices, with a Wald value of 7.629 (p=0.006) and an odds ratio (Exp(B)) of 9.796 (95%CI= 1.940–49.468). He suggested that parents with high knowledge were 9.8 times more likely to implement appropriate CF practices than those with limited knowledge.

Attitude also had a significant effect, with a Wald value of 8.941 (p<0.003) and Exp(B) of 3.871 (95%CI=1.594–9.399), suggesting that a positive change in attitude increases the likelihood of appropriate CF practices by 3.87 times. However, involvement did not demonstrate a significant influence, with a Wald value of 2.086 (p=0.149), indicating that involvement did not statistically contribute to the model in Step 1.

In Step 2, knowledge, attitude, and self-confidence significantly affected the outcome. The Wald value for knowledge increased to 10.960 (p<0.001) with an Exp(B) of 13.718 (95%CI=2.911–64.654), demonstrating a stronger effect than in Step 1. In Step 2, attitude had a Wald value of 11.001 (p<0.001) and Exp(B) of 4.356 (95% CI=1.826–10.393), indicating a greater effect than that in Step 1. The constant in both steps was significant (p<0.001), indicating that the regression model was relevant. Overall, the results of this analysis emphasize the importance of knowledge, attitude, and self-confidence in influencing appropriate CF practices, while parental involvement did not show a significant contribution to the model. These findings provide valuable insights for designing interventions that focus on enhancing knowledge and attitudes to achieve the expected changes.

Key Factors Influencing Complementary Feeding Practices

Logistic regression analysis identified knowledge, self-confidence, and involvement as significant predictors of appropriate CF practice. Based on the highest Odds, knowledge was the strongest factor, followed by self-confidence and involvement. This indicates the necessity of community-based educational programs tailored to local needs, particularly in isolated, disadvantaged, frontier, and outermost areas, such as the Natuna District. Strategies should prioritize strengthening maternal knowledge and confidence through sustained health education, peer-led support groups, and improved access to credible nutritional information. Collaborative efforts involving local health workers, cadres, and government institutions are important for reducing stunting. Mothers who are more involved tend to be more responsive to their children's dietary needs, which improves nutritional outcomes (Martin et al., 2020).

Knowledge was the most significant predictor of complementary feeding (CF)

practices (p = 0.004; Exp(B) = 13.718), indicating that mothers with higher knowledge were nearly 14 times more likely to have appropriate CF practices. This highlights knowledge as the foundation for informed decision-making, surpassing the influence of positive attitude. This is in line with Hagger et al. (2020), who found that increased knowledge is associated with improved health choices. In addition, attitudes play a role in supporting behavior change (Ajzen, 2021).

In contrast, Hovland et al. (2019) and Hagger et al. (2020) did not identify parental involvement as a significant determinant of complementary feeding behaviors. This reflects differences in the depth or quality of participation and contextual factors in each study setting. Instead, our results highlight maternal knowledge and attitudes as key determinants of change. Interventions deepen caregivers' understanding of appropriate foods, preparation techniques, and nutrient requirements. They also foster positive perceptions of complementary feeding, which supports the greatest improvements in CF practices (Hagger et al., 2020).

Consistent with Faradila F. (2021), mothers' nutrition literacy was the strongest predictor of feeding adequacy, where knowledgeable caregivers were five times more likely to have appropriate CF practices (OR = 5.029). Therefore, targeted education and counseling programs are required. Integrated approaches empowering community cadres (Afifah et al., 2023) can reinforce these gains, suggesting that policy and programmatic efforts should prioritize caregiver training and active engagement to reduce stunting and other forms malnutrition. Optimizing breastfeeding practices alongside appropriate complementary feeding is an important strategy, considering that gastrointestinal infections contribute to impaired nutrient absorption and an increased risk of stunting. Integrating breastfeeding and complementary feeding education into community nutrition programs can provide dual benefits in preventing infection and stunting (Paramashanti et al., 2024).

Conclusion

Maternal knowledge is a key determinant of appropriate complementary feeding practices for children aged 6–24 months. This finding indicates the crucial role of nutritional literacy in preventing stunting. Mothers' positive attitudes and self-confidence significantly contribute to appropriate feeding practices, highlighting the importance of addressing psychosocial aspects of parenting in public health programs. To achieve optimal outcomes, integrated interventions of nutrition education and family involvement in disadvantaged, frontier, and outermost regions, such as the Natuna District, can help improve children's nutritional status and achieve stunting reduction targets.

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