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Original Article

Investigating *Minimum Acceptable Diet* and *Infant and Child Feeding Index* as indicators of stunting in children aged 6-23 months

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Abstract

Background The complementary feeding period of 6-24 months of age is one of the most crucial moments in child growth, in which most of the decline in length-for-age Z-score (LAZ) occurs. The *Minimum Acceptable Diet* (MAD) and *Infant and Child Feeding Index* (ICFI) are indicators to assess complementary feeding practices in the children with potential for stunting.

Objective To assess and compare the usefulness of MAD and ICFI scores as indicators of inadequate feeding practice on stunting in children aged 6-23 months.

Methods This case-control study was conducted in South and West Wewewa subdisctricts of Southwest Sumba, East Nusa Tenggara, Indonesia, from February to August 2019. Participants were children aged 6-23 months who had received complementary feeding for a minimum duration of one month. Children with LAZ <-2 were allocated into the case group (stunted) and those with LAZ>-2 into the control group. Both MAD and ICFI scores were assessed in both groups. ICFI was categorized as low, average, and high. The association between complementary feeding practice which depicted by the MAD and ICFI scores and stunting was measured using logistic regression.

Results Of 322 participants, 161 children were allocated into each group. Multivariate analysis revealed that those in low and average ICFI tertile had higher odds of stunting [(OR 2.85; 95%CI 1.35 to 6.00; P<0.01) and (OR 1.95; 95%CI 1.09 to 3.46; P<0.05), respectively]. No association was found between MAD and stunting.

Conclusion Inadequate complementary feeding practice is found to increase the risk of stunting among children aged 6-23 months. Compared to MAD, ICFI is a better indicator in demonstrating an association between complementary feeding practice and stunting. **[Paediatr Indones. 2020;60:259-68 ; DOI: 10.14238/pi60.5.2020.259-68]**.

Keywords: *stunting; complementary feeding; infant and child feeding index; minimum acceptable diet*

Around 30.8% of Indonesian children under five years of age were classified as stunted and severely-stunted.[1] The province of East Nusa Tenggara had the highest stunting prevalence since 2007, and has not made significant progress towards stunting reduction as of 2018.[1,2] Around 42.6% of under-fives and 29.8% of under-twos in the province were stunted.[1,3] Southwest Sumba is one of the municipalities in the province prioritized for the 2017 National Stunting Reduction Program due to its high number of stunted children totaling 26,809 under-fives (61.2%).[4]

The period between birth and two years of age has been identified as the most vulnerable period for becoming undernourished, due to the need for a high quality diet to support optimal growth and development.[5] Most of the decline in length-for-age Z-score (LAZ) occurs during the complementary feeding period between 6-24 months of age. Poor feeding practices with insufficient quantity and

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inadequate quality of complementary foods are important direct risk factors of stunting.[6,7]

Inadequate infant and young child feeding (IYCF) practice is still a common problem in developing countries.[8,9] Inadequate feeding, in terms of poor macronutrient and micronutrient quality, is caused by poor dietary diversity as well as inappropriate energy and nutritional density. Inappropriate feeding frequency and food quantity also contribute to inadequate energy and nutritional intake.[8] Complementary feeding practices vary and are influenced by many factors, thus standard indicators to assess these practices are needed to determine the complementary feeding situation in a region.[7]

The World Health Organization (WHO) developed complementary feeding indicators to assess feeding practices in children between age 6-23 months. The core indicators include *Minimum Dietary Diversity* (MDD), *Minimum Meal Mrequency* (MMF), and *Minimum Acceptable Diet* (MAD).[7,10] The MAD has been used globally as one of the main indicators to assess the adequacy of feeding practices.[7,10,11] Unachieved MAD was associated with stunting in children aged 6-23 months.[10,12] Another indicator to assess IYCF practice is the Infant and Child Feeding Index (ICFI).[13] Its development was based on data from five Latin American countries and includes five components of complementary feeding practice: breastfeeding, bottle-feeding, dietary diversity, food frequency in the previous seven days, and meal frequency.[5,10,13,14] The ICFI score was associated with LAZ in children under five years of age.[8]

Considering the importance of appropriate feeding practices on growth and stunting prevention in children aged 6-23 months, we aimed to assess feeding practices in the high stunting prevalence area of Southwest Sumba. To our knowledge, no such study has been conducted in this area. Thus, we used unachieved MAD and low ICFI scores to assess for inadequate feeding practice in stunted children aged 6-23 months in the Wewewa subdisctrict, Southwest Sumba.

Methods

This community-based, unmatched case-control study was conducted in the South and West Wewewa subdisctricts, Southwest Sumba, East Nusa Tenggara, from February to August 2019 to assess and compare MAD and ICFI scores as indicators of inadequate feeding practice in stunted children aged 6-23 months. Participants were children aged 6-23 months who had received complementary feeding for a minimum duration of one month at the time of data collection and who visited the nutrition clinic and integrated health service posts (Posyandu) of the Tena Teke Community Health Center (CHC) with their biological mothers. The Tena Teke CHC serves 16 villages situated in South and West Wewewa with an estimated total population of 43,333 people.[15] Children with LAZ $<$-2 or "stunted" based on the 2006 WHO child growth standard were allocated into the case group and those with LAZ $\geq$-2 were allocated to the control group.[16] Mothers provided written informed consent before each interview session. Children with previously diagnosed or treated nutritional disorders, acute conditions affecting oral intake, chronic conditions, congenital anomalies, or preterm, post-term or multiple birth history were excluded.

The minimum required sample size was calculated for an unmatched case-control study. Based on a previous study, the proportion of unachieved MAD in children aged 6-23 months with normal LAZ (P2) was 58%.[9] If the predetermined significant odds ratio was 2.0 with 95%CI ($Z\alpha$=1.96), power of 80% ($Z\beta$= 0.842), and sample size ratio of 1:1 for control and case groups, the minimum required sample size was estimated to be 158 for each group. Participants were chosen using a convenience sampling method until the minimum required sample size for each group was fulfilled.

Recumbent body length was measured using a *Kenko*® infantometer with 0.1 cm precision. Body length was measured twice and the mean of the two measurements was used for the final analysis. The LAZ was calculated using the *Emergency Nutrition Assessment (ENA) for SMART 2011* (*SMART Org*., Toronto, Canada). Demographic characteristics and complementary feeding practices of the participants were collected using a pre-validated questionnaire. Dietary diversity and meal frequency were assessed using a 24-hour food recall technique with the help of a food atlas. Prior to general use by all subjects, the questionnaire was validated by a pediatrician for its content and was pre-tested on 5% of the participants to evaluate the language clarity and consistency.

The child's gender, maternal education and work status, birth order, family size, parental income, sanitation, and episodes of fever, diarrhea, and upper respiratory tract infection in the past two weeks were compared between the case and control groups. Participants' age was presented in mean values and categorized into three age groups to depict the difference of age distribution between case and control groups. Parental income was categorized as "sufficient" if the value was ≥ IDR 1 million/month and "not sufficient" if otherwise. For sanitation, which defined by the WHO as access to and use of facilities and services for the safe disposal of human urine and feces, "improved" and "not improved" status were used.[17] An "improved" sanitation status was given if the child live in a household that had a safe excreta disposal system which was a toilet with septic tank or pit latrine with or without slab and the household had its own toilet or latrine. If one of these conditions were not met, the child was labeled as having "not improved" sanitation.[17]

The main indicators of complementary feeding practice were MAD and ICFI scores. The MAD was defined by the WHO as at least meeting the *Minimum Dietary Diversity* (MDD) and *Minimum Meal Frequency* (MMF) during the previous day. The MDD was defined as receiving foods from ≥4 food groups, including (1) grains, roots and tubers; (2) legumes and nuts; (3) dairy products (milk, yogurt, cheese); (4) flesh foods (meat, fish, poultry and liver/organ meats); (5) eggs; (6) vitamin-A rich fruits and vegetables; and (7) other fruits and vegetables. The MMF was defined as receiving solid, semi-solid, or soft foods including milk feeds for non-breastfed children for the minimum number of times or more during the previous day. For breastfed children, the minimum was defined as 2 times daily for infants aged 6-8 months and 3 times daily for children aged 9-23 months. For non-breastfed children, the minimum was defined as 4 times daily for children aged 6-23 months.[18]

The ICFI, as previously mentioned, consisted of five different components as shown in **Table 1**. The ICFI assessment was divided into 3 age categories, each with a total maximum score of 12.[13] The dietary diversity score assessed the consumption of complementary food from food groups using a 24-hour food recall technique. Meal frequency assessed the intake of solid, semi-solid, and soft foods in the previous 24 hours. In addition, the food frequency score component reflected the consumption of certain food groups in the previous 7 days. Total ICFI scores were categorized into tertiles as low (ICFI score of ≤4), average (ICFI score of 5-6), and high (ICFI score of ≥7).[13,19] Each of the ICFI components and the mean total ICFI score were also compared between case and control groups.

Characteristics of participants and the achievement of ICFI indicators were presented as proportions and percentages. Mean age and total ICFI score were presented as continuous data. Bivariate analyses of the categorical data were done using Pearson's Chi-square and Fisher's exact tests and analysis of continuous data was done using Mann-Whitney U test. Logistic regression analysis was used to compare MDD, MMF, MAD, and ICFI tertiles with stunting. Sociodemographic characteristics that had a P values of <0.25 were included in the final logistic regression model for adjustment. Odds ratio (OR) with 95%CI was presented as the final result. Results with P values <0.05 were considered to be statistically significant. Statistical analyses were done using *Statistical Package for Social Science (SPSS) version 21.0* (*SPSS Inc*., Chicago, IL, USA). This study was approved by the National and Political Unity Unit (Kesbangpol) of the Southwest Sumba municipality.

Results

A total of 322 children aged 6-23 months and their mothers were enrolled, with 161 children allocated into each group. Sociodemographic characteristics of the case and control groups are presented in **Table 2**. Around 56% of the children were male and there was no significant gender difference between groups. In contrast, children in the case group were significantly older than those in the control group, with mean ages of 14.9 (SD 4.9) and 11.2 (SD 4.3) months, respectively (P<0.001). Also, 69.6% of children in the case group were 12-23 months of age, compared to only 32.3% of the control group.

Lower maternal educational level and unemployment were significantly higher in the case than the control group. About half of the mothers

Table 1. The ICFI components based on age groups[13]

Variables	6-9 months	9-12 months	12-36 months
Breastfeeding	No = 0 Yes = 2	No = 0 Yes = 2	No = 0 Yes = 1
Use of bottle	No = 0 Yes = 2	No = 0 Yes = 2	No = 0 Yes = 2
Dietary diversity (previous 24 hours)	Sum of: (grains + tubers + milk + egg + meat/fish/poultry + vitamin A-rich fruits and vegetables + other fruits/veg) 0=0 1-3=1 ≥4=2	Sum of: (grains + tubers + milk + egg + meat/fish/poultry + vitamin A-rich fruits and vegetables + other fruits/veg) 0=0 1-3=1 ≥4=2	Sum of: (grains + tubers + milk + egg + meat/fish/poultry + vitamin A-rich fruits and vegetables + other fruits/veg) 0=0 1-3=1 ≥4=2
Food frequency (previous 7 days)	For each of: • egg/fish/poultry • meat 0 times in previous 7d=0 1-3 times in previous 7d=1 ≥4 times in previous 7d=2 For staples (grains or tubers) 0-2 times=0 ≥3 times=1 Food frequency=sum of scores for staples + egg/fish/poultry + meat	For each of: • egg/fish/poultry • meat 0 times in previous 7d=0 1-3 times in previous 7d=1 ≥4 times in previous 7d=2 For staples (grains or tubers) 0–3 times=0 ≥4 times=1 Food frequency=sum of scores for staples + egg/fish/poultry + meat	For each of: • milk • egg/fish/poultry • meat 0 times in previous 7d=0 1-3 times in previous 7d=1 ≥4 times in previous 7d=2 Food frequency=sum of scores for milk + egg/fish/poultry + meat
Meal frequency* (previous 24 hours)	0 meals/day=0 1 meal/day=1 2 meals/day=2	0 meals/day=0 1-2 meals/day=1 ≥3 meals/day=2	0-1 meal/day=0 2-3 meals/day=1 ≥4 meals/day=2
Maximum total score	12 points	12 points	12 points

Note: meal frequency did not include breastmilk or other liquids and only refered to solid, semi-solid, or soft foods received in the previous 24 hours

in the case group had less than secondary school education and around two-thirds were unemployed. Birth order, family size, family income, sanitation level, and episodes of fever, diarrhea and upper respiratory tract infection (URTI) were not significantly different between groups.

With regards to the WHO IYCF indicators, more than 80% of all subjects did not achieve MAD and MDD (**Table 3**). The MMF was slightly better, with achievement by more than half of all subjects. Bivariate analysis revealed that MAD, the main WHO IYCF indicator, was not associated with stunting. This result was similar for MDD. The MMF was the only indicator associated with stunting (P=0.001). Significantly more unachieved MMF was found in children in the case group compared to the control group (40.4% *vs.* 23.6%, respectively; P<0.01).

For ICFI tertiles, only approximately one-fourth of the case group achieved high ICFI score compared to more than half of the control group (**Table 3**). Also, significantly more children in the case group had low ICFI score compared to the control group (36.0% *vs.* 12.4%, respectively). Bivariate analysis showed that significantly more stunted children had low ICFI scores than non-stunted controls. The mean total ICFI score of the case group was 5.3 (SD 1.6), which was significantly lower than that of the control group [6.4 (SD 1.4)]. After stratifying ICFI scores by age category, we found that total ICFI scores were the highest in the 6 to 8-month age group, and decreased in the older age groups, as shown in **Table 4**. In the 12 to 23-month age group, mean total ICFI was significantly lower in the case group compared to the control group [4.6 (SD 1.4) *vs.* 5.2

Table 2. Sociodemographic characteristics of subjects

Characteristics	Case (n=161)	Control (n=161)	P value
Gender, n(%)			
Male	97 (60.2)	86 (53.4)	0.216
Female	64 (39.8)	75 (46.6)	
Age group, n(%)			
6-8 months	23 (14.3)	69 (42.9)	<0.001
9-11 months	26 (16.1)	40 (24.8)	
12-23 months	112 (69.6)	52 (32.3)	
Maternal education, n(%)			
< middle school	82 (50.9)	62 (38.5)	0.033
≥ middle school	79 (49.1)	99 (61.5)	
Maternal employment status, n(%)			
Working	49 (30.4)	70 (43.5)	0.015
Not working	112 (69.6)	91 (56.5)	
Birth order, n(%)			
≤2	80 (49.7)	83 (51.6)	0.738
>2	81 (50.3)	78 (48.4)	
Family size, n(%)			
≤4	81 (50.3)	85 (52.8)	0.656
≥5	80 (49.7)	76 (47.2)	
Family income, n(%)			
Insufficient	104 (64.6)	88 (54.7)	0.069
Sufficient	57 (35.4)	73 (45.6)	
Fever, n(%)			
Yes	101 (62.7)	101 (62.7)	1.000
No	60 (32.3)	60 (32.3)	
Diarrhea, n(%)			
Yes	19 (11.8)	26 (16.1)	0.261
No	142 (88.2)	135 (83.9)	
Upper respiratory tract infection, n(%)			
Yes	122 (75.8)	134 (83.2)	0.098
No	39 (24.2)	27 (16.8)	
Sanitation, n(%)			
Improved	109 (67.7)	117 (72.7)	0.33
Not improved	52 (32.3)	44 (27.3)	

Table 3. Bivariate analysis of complementary feeding practice indicators and stunting in the case and control groups

Indicators	Achieved	Case	Control	P value
Minimum Meal Frequency, n (%)	Yes	96 (59.6)	123 (76.4)	0.001*
	No	65 (40.4)	38 (23.6)	
Minimum Dietary Diversity, n (%)	Yes	24 (14.9)	26 (16.1)	0.758
	No	137 (85.1)	135 (83.9)	
Minimum Adequate Diet, n (%)	Yes	18 (11.2)	22 (13.7)	0.499
	No	143 (88.8)	139 (86.3)	
ICFI categories, n (%)	Low	58 (36.0)	20 (12.4)	<0.001**
	Average	65 (40.4)	52 (32.3)	
	High	38 (23.6)	89 (55.3)	

(SD 1.5), respectively; P<0.05]. But mean total ICFI were not significantly different in the younger age categories between the case and control groups.

As shown in **Table 5**, for all ages combined, the case group had significantly lower percentages than the control group with regards to breastfeeding (50.9% *vs.* 78.3%, respectively; P<0.001) and high meal frequency score (45.5% *vs.* 67%; respectively; P<0.001). In addition, bottle-feeding was significantly higher in the case group, with almost half of the children. There were no significant differences for dietary diversity score and food group frequency components between groups.

In contrast, when the components were stratified by age category, there were no significant differences between groups for all five ICFI components. Breastfeeding and meal frequency scores were highest in 6 to 8-month age category in both groups, and decreased in the older age groups.

After adjustment for sex, age, maternal education and work, family income, and URTI variables in the logistic regression model, low and average ICFI for all children was the only indicator with significant risks for stunting, as shown in **Table 6**. Compared to children in the high tertile, those in the low and average tertiles were more likely to become stunted [OR 2.85; (95%CI 1.35 to 6.00); P<0.01 and OR 1.95; (95%CI 1.09 to 3.46); P<0.05, respectively]. In contrast, no associations were found between the WHO IYCF indicators and stunting in the multivariate analysis.

Discussion

Our study confirms an association between inadequate complementary feeding practice and stunting among children 6-23 months in the Wewewa subdistrict, Southwest Sumba. ICFI as a composite index for assessing complementary feeding practice was found to reflect the risk of stunting. Furthermore, children in the low and average ICFI tertiles had higher odds

Table 4. Mean total ICFI scores based on age category

Age categories	Case		Control		P value
	n	Mean (SD)	n	Mean (SD)	
6-8 months	23	6.7 (0.9)	69	7.0 (0.9)	0.275
9-11 months	26	6.6 (1.2)	40	6.7 (1.2)	0.700
12-23 months	112	4.6 (1.4)	52	5.2 (1.5)	0.025
All age categories	161	5.3 (1.6)	161	6.4 (1.4)	<0.001

Table 5. Comparison of ICFI components by age category

ICFI component	6-8 months			9-11 months			2-23 months			All ages		
	Case n=23	Control n=69	P value[a]	Case n=26	Control n=40	P value[a]	Case n=112	Control n=52	P value[a]	Case n=161	Control n=161	P value[a]
Breastfeeding (%)												
Yes	95.7	95.7	1.00[b]	88.5	87.5	1.00[b]	33.0	48.1	0.06	50.9	78.3	<0.001
Bottle feeding (%)												
No	56.5	76.8	0.06	57.7	62.5	0.69	54.5	69.2	0.07	55.3	70.8	0.04
Dietary diversity score (%)												
Medium (1)	100	89.9	0.18[b]	84.6	87.5	0.73[b]	82.1	73.1	0.18	85.1	83.9	0.75
High (2)	0	10.1		15.4	12.5		17.9	26.9		14.9	16.1	
Food group frequency												
Low (0-2)	95.7	95.7	1.00[b]	92.3	95.0	0.64[b]	86.6	84.6	0.70	88.8	91.9	0.44
Medium (3,4)	4.3	4.3		7.7	5.0		12.5	15.4		10.6	8.1	
High (5,6)	0	0		0	0		0.9	0		0.6	0	
Meal frequency score												
Low (0)	0	0	0.33[b]	0	0	0.53	0.9	5.8	0.15	0.6	1.9	<0.001
Medium (1)	0	8.7		34.6	27.5		69.6	63.5		54.0	31.1	
High (2)	100	91.3		65.4	72.5		29.5	30.8		45.4	67.0	

a=Chi-square; b=Fisher's exact test

Table 6. Multivariate analysis of IYCF practice indicators and stunting after adjustment of several potential confounding variables

Indicators		OR[a]	95% CI	P value
MMF	Yes	1.00 (ref.)		
	No	0.83	0.44 to 1.54	0.55
MDD	Yes	1.00 (ref.)		
	No	0.95	0.43 to 2.07	0.90
MAD	Yes	1.00 (ref.)		
	No	1.28	0.23 to 7.14	0.77
ICFI category	Low	2.85	1.35 to 6.00	0.006
	Average	1.95	1.09 to 3.46	0.02
	High	1.00 (ref.)		

OR[a]=adjusted for sex, age, maternal education, maternal work, family income, and upper respiratory tract infection event

of being stunted compared to those in the high tertile, even after the adjustment of several potential confounding variables. The odds of stunting increased as the ICFI tertile decreased. Children in low ICFI tertile were 2.85 (95%CI 1.35 to 6.00; P<0.01) times more likely to be stunted compared to those in the high tertile. The odds were still nearly doubled even for children in the average tertile (OR 1.95; 95%CI 1.09 to 3.46; P<0.05) compared to those in the high tertile, indicating that better complementary feeding practice would reduce the risk of stunting.

In contrast, we found no association between MAD, as the main WHO IYCF indicator, and stunting. Nor were MDD or MMF associated with stunting. In addition, the majority of the children in our study were not adequately fed. Only less than 15% of children in both groups achieved MAD, and most subjects did not receive appropriate meal frequency or dietary diversity.

We did not find an association between the WHO IYCF main indicators (MMF, MDD, and MAD) and stunting. An Aceh, Indonesia study also confirmed this finding and showed no association between these indicators and stunting in children aged 6-23 months.[8] A study in Northern Ghana also showed no association.[9] A previous study concluded that WHO IYCF indicators might be better in explaining weight-for-height Z-scores (WHZ) than LAZ, and were more associated with acute malnutrition. The lack of association might have been caused by the low sensitivity of these indicators, since they were assessed based on a 24-hour reference period which best reflects recent diet.[9] However, a Nigerian study in children aged 6-11 months showed that infants who did not achieve the MDD and MMF were significantly more likely to be stunted [(OR 2.17; 95%CI 1.43 to 4.20; P<0.05) *vs.* (OR 1.57; 95%CI 1.53 to 4.03; P<0.05), respectively].[20] Considering this discrepancy, further studies are needed to address the association between WHO IYCF indicators and stunting in different regions of Indonesia.

The lack of association between WHO IYCF indicators and stunting indicates that ICFI would be a better tool to assess complementary feeding practices in children aged 6-23 months in relation to stunting. A Cambodian study similarly showed a significant association between LAZ and ICFI score, but no association between LAZ and WHO IYCF indicators.[10] ICFI was regarded as a more useful indicator in demonstrating an association between IYCF practices and LAZ, compared to the simpler WHO IYCF indicators. They also found that the more ICFI criteria met by caregivers, the more likely the children (aged 6-23 months) achieved age-appropriate length.[10]

Several studies have also demonstrated an association between complementary feeding practice which assessed by using the ICFI and linear growth of children aged 6-23 months.[5,10,19,21] A study from Burkina Faso, West Africa, showed that mean LAZ was significantly and positively related to ICFI tertiles in children aged 6-23 months.[19] In addition, a study in urban slums of Mumbai also confirmed this finding and showed a significant association between ICFI and LAZ. The ICFI was considered to better reflect chronic malnutrition in young children and better capture representative information on various components of young child feeding practices.[5]

In our study, stunted children tended to receive poorer feeding practices compared to the normal controls. This finding was reflected by the lower mean total ICFI score in the case group compared to the control group. This result was in agreement with a rural Cambodian study showing that stunted children had significantly lower ICFI scores compared to those without stunting [6.4 (SD 1.5) *vs.* 6.8 (SD 1.8), respectively; (P=0.003)].[10]

After our groups were stratified by age category, mean total ICFI score was significantly lower in children aged 12-23 months. A previous study demonstrated the role of age as a moderator in the relationship between LAZ and ICFI. But interestingly, they found that the association was present only in children under 1 year of age, which differed from our results.[10] However, another study found that ICFI categories were positively related to mean LAZ in children aged 6-11 months and 12-23 months.[19] Thus, these results indicate that children in certain age categories might be more vulnerable to stunting due to inadequate IYCF practices in different settings.

Other studies have also demonstrated that some ICFI components might affect the risk of stunting in children aged 6-23 months more than other components.[10,19] We found that the breastfeeding, bottle-feeding, and meal frequency components of ICFI were significantly different between the case and control groups, although after age stratification, none of these components showed significant results. In addition, there were no significant differences in terms of dietary diversity and food group frequency between groups. A study also showed that LAZ scores were not associated with dietary diversity, but were positively correlated with higher food frequency.[10] In contrast, another study found that dietary diversity and feeding frequency were associated with LAZ.[19] They also concluded that dietary diversity was an important component of ICFI and that it mattered more than consumption of a particular food group. In addition, they noted that breastfeeding was negatively associated with LAZ, especially in children over 12 months of age.[19] Differing results from these studies indicate that some ICFI components might play more or less of a role than others in affecting child growth in certain settings. Thus, region-to-region assessment could be done to address which IYCF practice components have a predominant role in stunting in each region.

Appropriate instruments that accurately assess IYCF practices are crucial for successful interventions to improve child nutrition. However, consistent and reliable indicators to assess these practices remain limited. Since feeding practice is a multidimensional and age-specific process, a more comprehensive indicator is needed to fully capture feeding practices. The use of a composite index such as ICFI would combine various feeding dimensions that could quantify feeding practices into one objective variable.[22]

Although further studies are needed to test the applicability of ICFI in assessing IYCF practice in different Indonesian settings, our results suggest that ICFI as a composite index would be useful as an objective indicator to evaluate both IYCF practice and the improvement of feeding practices after intervention. However, interventions to improve complementary feeding practices should be made on a region-to-region basis because different components of feeding practices may have a more prominent role than others in affecting the risk of stunting in different settings.

Our study had several limitations. Since the development of stunting is a long-term process and feeding practices can vary on a day-to-day basis, the one point of data collection used in this study might not completely reflect feeding practices received by children or their impact on growth. In addition, since we used a non-randomized sampling method, generalizability of the results might be limited. Interviews on past events and the 24-hour food recall technique used in this study are also prone to recall bias, which might have affected the validity of the result. Considering these limitations, a longitudinal study with a randomized sampling method that periodically assesses IYCF practices and children's growth is needed to better capture the longitudinal relationship between complementary feeding practice and stunting. Despite these limitations, our study is the first to assess the impact of complementary feeding practice as reflected by the achievement of WHO IYCF indicators and ICFI score on stunting in the Southwest Sumba region, as a high stunting burden area in Indonesia. Also, to our knowledge, this is the first study in Indonesia to use ICFI as an indicator to assess IYCF practices received by children aged 6-23 months.

In conclusion, inadequate complementary feeding practice is associated with the risk of stunting among children aged 6-23 months in the Wewewa subdistrict of Southwest Sumba, Indonesia. The odds of stunting are doubled in children who received poor complementary feeding practice. Compared to WHO IYCF indicators, ICFI, as one of the tools to assess IYCF practices, is found to better demonstrate the association between complementary feeding practice and stunting. Measures to improve complementary feeding practices among children aged 6-23 months may decrease the burden of stunting in Southwest Sumba. Further studies are needed to assess the validity of ICFI as a tool to evaluate the association between IYCF practices and stunting in different settings in Indonesia.

Conflict of interest

None declared.

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