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Inappropriate complementary feeding practice as a risk factor of stunting in children aged 6-23 months

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ABSTRAK

Latar Belakang: *Stunting hingga kini masih menjadi masalah kesehatan masyarakat yang utama di Indonesia, dengan target nasional untuk menurunkan prevalensinya hingga 14% pada tahun 2024. Salah satu faktor penentu yang krusial adalah kesenjangan gizi yang muncul sekitar usia enam bulan, ketika ASI saja tidak lagi memenuhi kebutuhan gizi bayi. Praktik pemberian makanan pendamping ASI (MPASI) yang tidak tepat seperti inisiasi pemberian makanan pendamping ASI (MPASI) dini, keragaman makanan yang terbatas, dan frekuensi makan yang tidak memadai berkontribusi terhadap asupan gizi yang tidak memadai, sehingga meningkatkan risiko stunting*
Tujuan: *Penelitian ini bertujuan untuk menganalisis indikator praktik pemberian makanan pendamping ASI sebagai faktor risiko terjadinya stunting pada anak usia 6-23 bulan.*
Metode: *Sebuah unmatched case-control study dilakukan dari Desember 2022 hingga Januari 2023 di Kecamatan Pajangan, Kabupaten Bantul, Yogyakarta, yang melibatkan 51 anak stunting dan 51 anak kontrol non-stunting. Pengumpulan data meliputi pengukuran antropometri, karakteristik ibu dan ayah, serta pendapatan rumah tangga. Regresi logistik digunakan untuk memeriksa hubungan antara stunting dan indikator praktik pemberian MPASI, termasuk pengenalan makanan pendamping ASI (MPASI) tepat waktu (timely), keragaman pangan minimum (MDD), frekuensi makan minimum (MMF), pola makan minimum yang dapat diterima (MAD), dan konsumsi pangan hewani (ASF).*
Hasil: *Minimum Dietary Diversity = yang tidak memadai (AOR = 5,17; 95% CI: 1,80-17,52) ditemukan sebagai faktor risiko signifikan untuk stunting. indikator lain seperti timely, MAD, MMF, dan ASF tidak berhubungan dengan stunting.*
Kesimpulan: *Keragaman pangan yang terbatas diidentifikasi sebagai faktor risiko signifikan terhadap kejadian stunting. Temuan ini menegaskan urgensi untuk memperkuat intervensi yang mendorong peningkatan keragaman pangan serta perbaikan praktik pemberian makanan pendamping ASI guna menurunkan prevalensi stunting di Indonesia.*

KATA KUNCI*: anak usia 6-12 bulan; dietary diversity; mp-asi; praktik pemberian makan; stunting*

ABSTRACT

Background: *Stunting remains a major public health problem in Indonesia, with a national target to reduce prevalence to 14% by 2024. A critical determinant is the nutritional gap that arises around six months of age, when breast milk alone no longer meets infants' nutritional needs. Inappropriate complementary feeding (CF) practices such as early initiation, limited dietary diversity, and inadequate meal frequency contribute to insufficient nutrient intake, thereby increasing the risk of stunting..*

Objectives: *This study aimed to analyze complementary feeding practice indicators as risk factors for stunting among children aged 6–23 months.*

Methods: *An unmatched case–control study was conducted from December 2022 to January 2023 in Pajangan District, Bantul Regency, Yogyakarta, involving 51 stunted children and 51 non-stunted controls. Data collection included anthropometric measurements, maternal and paternal characteristics, and household income. Logistic regression was used to examine the associations between stunting and CF practice indicators, including timely introduction of complementary foods (TIMELY), Minimum Dietary Diversity (MDD), Minimum Meal Frequency (MMF), Minimum Acceptable Diet (MAD), and animal-source food consumption (ASF).*

Results: *Inadequate MDD (AOR = 5.17; 95% CI: 1.80-17.52) was found to be significant risk factors for stunting. Other indicators such as TIMELY, MAD, MMF, and ASF were not related to stunting..*

Conclusions: *Limited dietary diversity was identified as significant risk factors for stunting. These findings highlight the urgent need to strengthen interventions that promote dietary diversity and improve complementary feeding practices to reduce stunting prevalence in Indonesia.*

KEYWORD*: complementary feeding; dietary diversity; minimum meal frequency; minimum acceptable-diet; stunting*

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INTRODUCTION

In Indonesia, stunting has increased in children aged 6 months when breastfeeding alone is not enough to meet the nutritional needs (energy, protein, vitamins and minerals) of infants. The prevalence of stunting in Indonesia according to (LAZ) in children aged 6-23 months is 16.5-17.7% (1). The prevalence of stunting in toddlers decreased in 2018 by 6.4% from 2013 and in toddlers decreased by 2.9% (1). Based on the results of data from the Indonesian Nutritional Status Survey (SSGI) and during the COVID-19 Pandemic, the stunting rate was 24.4% in 2020 to 21.6% in 2022 or decreased by 2.8% (2). Prevalence data from the World Health Organization (WHO), Indonesia is ranked third with stunting prevalence in the Southeast Asia/South-East Asia Regional (SEAR) region (3). The Indonesian government's target for reducing stunting is to reduce it to 14% by 2024, and a consistent reduction of around 3.8% is needed to achieve this target. The prevalence of stunted toddlers (LAZ) by district/city in Yogyakarta Province is 16.4% and in Bantul Regency it is 14.9% (2).

This condition of growth failure is caused by chronic malnutrition which results in disturbances in cognitive, motoric and metabolic growth and development in adulthood, which can put them at risk of experiencing Non-Communicable Diseases (NCDs) (4). Providing complementary feeding starting at 6 months of age is very important because breast milk needs at 6-11 months of age are only two-thirds and one-third must be met from complementary feeding (5). The practice of providing complementary feeding is a risk factor for stunting because breastfeeding is not exclusive and the provision of inappropriate quantity, quality and variety of complementary feeding. According to the results of the 2017 Indonesian Demographic and Health Survey, the practice of providing complementary feeding in Indonesia is inadequate, >40% of babies are

introduced to complementary feeding too early (before the age of 6 months), 40% of toddlers do not get a variety of foods, and 28% of children do not get sufficient meal frequency (6). Indicators for assessing feeding practices for infants and children according to WHO include the introduction of solid, semi-solid or soft food, minimum dietary diversity, minimum meal frequency, and minimum acceptable diet, however the prevalence of adequacy in these indicators in Indonesia is still quite low, namely minimum dietary diversity 53.9%, minimum meal frequency 71.7%, and minimum acceptable diet 40.3% (7.8).

During the pre-pandemic and COVID-19 pandemic periods, there was a greater risk for mothers to wean their children (not exclusively breastfeed) during the first six months and introduce complementary foods earlier (9). Based on the results of research conducted by Nguyen (2021) in India, household food insecurity increased sharply from 21% in December 2019 to 80% in August 2020, with 62% of households changing status from food secure to food insecure (insecure) during that period. Therefore, there is a high possibility of the emergence of nutritional problems of stunting at the household level, especially in households with infants and golden age children (toddlers). One action that can be focused on preventing stunting, besides ensuring the nutritional status of pregnant women and achieving exclusive breastfeeding, is by providing adequate complementary foods (10). The age of children 0-2 years is a very critical transition period for optimal child growth and development (11). Therefore, providing appropriate, safe, frequency-appropriate, nutritious, and responsive complementary foods is very important during this period (5). Many factors cause obstacles for mothers or caregivers to feed their children that can cause inappropriate complementary foods during the age of 6-23 months and have been widely studied, including economic factors, knowledge factors, education, and maternal history. Several studies have been conducted in Indonesia that examine factors that can influence child feeding practices such as economic factors, knowledge, education, and maternal history (12–21).

This study seeks to address these gaps by employing a case-control design to directly compare stunted and non-stunted children aged 6–23 months, while applying the WHO IYCF framework in combination with a 24-hour multiple-pass recall capturing detailed dietary intake. This methodological approach enhances the accuracy of identifying risk factors and provides novel evidence on how complementary feeding practices contribute to stunting.

By clarifying the association of dietary diversity and acceptable diet with stunting, this study advances scientific understanding and offers practical recommendations to strengthen complementary feeding strategies aligned with Indonesia's 2024 reduction target. Therefore, our study aimed to analyze complementary feeding practice indicators, including timely introduction of food (TIMELY), Minimum Dietary Diversity (MDD), Minimum Meal Frequency (MMF), Minimum Acceptable Diet (MAD), and animal source food consumption (ASF), as risk factors for stunting among children aged 6–23 months.

MATERIALS AND METHODS

This observational case–control study involved mothers of children aged 6–23 months in Pajangan District, Bantul Regency, Yogyakarta Special Region, between December 2022 and January 2023, with only one child per household included, selecting the older child when multiple were eligible. The study population comprised all children aged 6–23 months in Pajangan District, while the sample consisted of children within the same age range and their mothers. Inclusion criteria were: (1) children aged 6–23 months residing in Pajangan District, (2) living with their biological mother, and (3) mothers who agreed to participate and signed informed consent. Exclusion criteria were: (1) children with congenital abnormalities or chronic illness that could affect growth or dietary patterns, and (2) mothers unable to complete interviews due to illness or communication barriers.

Cases were defined as children with a Length-for-Age Z-score (LAZ) between –3SD and < –2SD, and controls as children with a LAZ ≥ –2SD. Sample selection followed a purposive sampling technique. Sample size was calculated using Power and Sample Size Software, with 80% power, 5% significance, and prior data indicating a stunting prevalence of 14.9% in Bantul Regency

(2020). Based on a comparable study reporting an odds ratio of 17.76 for dietary diversity, the required sample size was 51 cases and 51 controls (total n = 102). Data collection was conducted through home visits, including structured questionnaire interviews, 24-hour multiple-pass dietary recalls, and anthropometric measurements of child length using a Seca infantometer (portable length board). LAZ was calculated according to the Indonesian Ministry of Health Regulation No. 2 of 2020, which adopts WHO growth standards. Independent variables included timing of complementary feeding (TIMELY), Minimum Dietary Diversity (MDD), Minimum Meal Frequency (MMF), Minimum Acceptable Diet (MAD), and animal-sourced food consumption (ASF). The definition of each indicator were described below:

TIMELY: categorized as appropriate if initiation occurred at 6 months of age, and inappropriate if earlier or later than 6 months. MDD: met if the child consumed foods from at least 5 out of 8 WHO-recommended food groups in the previous 24 hours. These eight-food group were breast milk; grains, roots, tubers, and plantains; pulses (beans, peas, lentils), nuts, and seeds; dairy products (milk, infant formula, yogurt, cheese); flesh foods (meat, fish, poultry, and organ meats); eggs; vitamin A–rich fruits and vegetables; and other fruits and vegetables MMF: met if breastfed children aged 6–8 months received solid/semi-solid food at least twice per day, breastfed children aged 9–23 months at least three times per day, and non-breastfed children aged 6–23 months at least four times per day. MAD: met if both MDD and MMF criteria were fulfilled. ASF: assessed from 24-hour multiple-pass recall and categorized as adequate if the child consumed at least one portion of animal-sourced food (e.g., meat, poultry, fish, eggs, or dairy products) during the recall period.

Covariates included breastfeeding history, child sex, maternal height, parental education, parental occupation, and caregiver identity. Data were analyzed using STATA version 17.0. Analyses comprised univariate (descriptive statistics), bivariate (chi-square test), and multivariate (logistic regression) approaches. Variables with $p < 0.25$ in bivariate analyses were included in the multivariate model, and the most parsimonious model was selected as the final model. Statistical significance was set at $p < 0.05$. All participating mothers provided written informed consent. Ethical approval was obtained from the Research Ethics Committee of Universitas Alma Ata (KE/AA/XII/10982/EC/2022).

RESULTS AND DISCUSSIONS

The majority of stunting respondents were children aged 9-23 months (100%) and the non-stunting group was also predominantly aged 9-23 months (52.94%; in the stunting group, it was more common in boys than girls. Most of the respondents' parents were high school graduates, in mothers of stunted children (21%) and fathers (39.22%), as well as in the non-stunting group, the majority of parents had a high school education. The history of LBW occurred in both the stunting and non-stunting groups, and short birth length occurred more often in children in the stunting group (41.18%). Based on the characteristics of toddlers' parents, the majority of low incomes below the minimum wage occurred in the group with parents who had stunted children (64.71%) with the majority of mothers' occupations being unemployed/housewives and the majority of fathers' occupations in the case group as private employees and laborers (**Table 1**).

Child age has been statistically proven to have a relationship with the incidence of stunting with a p-value of 0.021. This can indicate that at this age the majority of children aged 9-23 months, the diet at that age changes from liquid food (breast milk only) to solid food, with the condition of the child being in the growth phase, children often have difficulty adjusting to the changes that occur so that it can affect the condition of the body, especially the nutritional status of toddlers. Parental education is also closely related to the incidence of stunting as evidenced by statistics in **Table 1**. Parental education is fundamental to achieving good toddler nutrition. The level of education is associated with the process of ease of mothers in receiving information, insight from outside. Parents with a higher level of education will easily get access to information related to nutrition compared to parents with a lower level of education.

Table 1. Characteristic of respondent

Variabel	Stunting (n=51)		Normal (n=51)		*p-value*
	n	%	n	%	
Characteristic of Child					
Gender					
Male	30	58.82	24	47.08	0.233
Female	21	41.18	27	52.94	
Age					
6-8 months	0	0	7	13.72	0.021*
9-23months	51	100	44	86.27	
Birth Weight					
<2500 gr	6	11.76	6	8.45	0.544
≥2500 gr	45	88.24	65	92.55	
Birth Lenght					
<48 cm	21	41.18	16	31.37	0.027*
≥48 cm	30	58.82	35	68.62	
Characterisctic of Maternal					
Age					
<19 years	1	1.96	1	1.96	
20-35 years	37	72.55	35	68.62	0.820
>35years	13	25.49	15	29.41	
Maternal education					
Primary School	5	9.80	1	1.96	
Junior high school	14	27.45	11	21.56	0.049*
Senior high school	21	41.18	22	43.13	
College	11	21.56	16	31.37	
Maternal occupation					
Farmer/breeders	1	2	0	0	
Factory workers	2	4	3	5.88	
Private sector employee	8	16	12	23.52	0.817
Self-employed	4	8	7	13.72	
Housewife/Not Working	35	70	29	56.86	
Parental Characteristic					
Aged					
20-35 years	31	60.78	30	58.82	0.688
>35 years	20	39.22	20	39.21	
Parental education					
Primary school	10	19.61	4	7.84	
Junior high school	16	31.37	13	25.49	0.093
Senior high school	20	39.22	24	47.05	
College	5	9.80	10	19.60	
Parental occupation					
Farmer/breeders/fisherman	4	7.84	2	3.92	
Factory workers	11	21.57	14	27.45	
Farm worker	3	5.88	4	7.84	
Private sector employee	23	45.10	18	35.29	0.213
Civil Servants/TNI/Polri	1	1.96	1	1.96	
Self-employed	7	13.73	12	23.52	
Not working	2	3.92	0	0.00	
Family income**					
Low	33	64.71	26	50.98	0.124
High	18	35.29	25	49.01	
Exclusive breastfeeding					
Exclusive breastfed	43	84.31	39	76.47	0.858
Not Exclusive breastfed	8	15.69	12	23.52	
Coninued-Breastfeeding					
Yes	37	72.55	41	80.39	0.067

Variabel	Stunting (n=51)		Normal (n=51)		*p-value*
	n	%	n	%	
No	14	27.45	10	19.60	

*p<0,05; **low social economic: <UMK Bantul District (IDR 2.066.438,-), social economiccukup ≥ UMK Kabupaten Bantul (IDR 2.066.438,-),

Table 2 shows the results of the analysis of indicators of complementary feeding, including timing of complementary food introduction, MDD, MMF, and MAD. MDD indicator has a 5.63-fold greater influence on the incidence of stunting (95% CI: 1.80-17.52). The distribution of dietary diversity in toddlers shows that toddlers without stunting are more diverse when compared to toddlers with stunting, in other words, the number of types of food consumed is less. The distribution of Minimum Dietary Diversity consumed by toddlers is presented in **Figure 1**. Children with stunting LAZ status have a smaller amount of dietary diversity compared to children who are not stunted. Stunting is also often associated with animal protein consumption, research conducted by Hayrani, et al (2023) animal protein intake is related to stunting in toddlers in the Minggir Community Health Center work area.

Stunting reflects growth disorders in toddlers and one factor that can directly influence is nutrient intake, especially lack of energy and protein intake. Protein is needed to build, maintain, and repair body tissue, so that if there is a protein deficiency it can cause growth retardation. Although the stunting group consumes more animal protein sources in the meat and fish, egg groups, the stunted group of children consumes less dairy products. Dairy products are a source of protein and fat which are also important nutrients during the growth period of toddlers. The WHO states that 25-33% of protein consumption should come from milk because it will have a positive impact on weight gain and linear growth (Sjarif et al., 2019). There are biological mechanisms in nutrient metabolism that underlie the fact that consuming sufficient milk can reduce the risk of stunting. Milk intake will increase the circulation of the hormone IGF-1 which can support growth and reduce the incidence of stunting. Milk is also a nutrient-dense food containing carbohydrates, protein, fat, vitamin B12, calcium, zinc, magnesium, and phosphorus which are important for child growth and development, especially the growth of children who are stunted. MAD has a protective effect (OR=0.38) against stunting (95% CI: 0.15-0.95), meaning that children who meet MAD can protect themselves from stunting. MAD is an indicator calculated from the sum of MDD and MMF. Other variables such as the time of introduction of the first solid food and MMF were not associated with stunting in children aged 6-23 months.

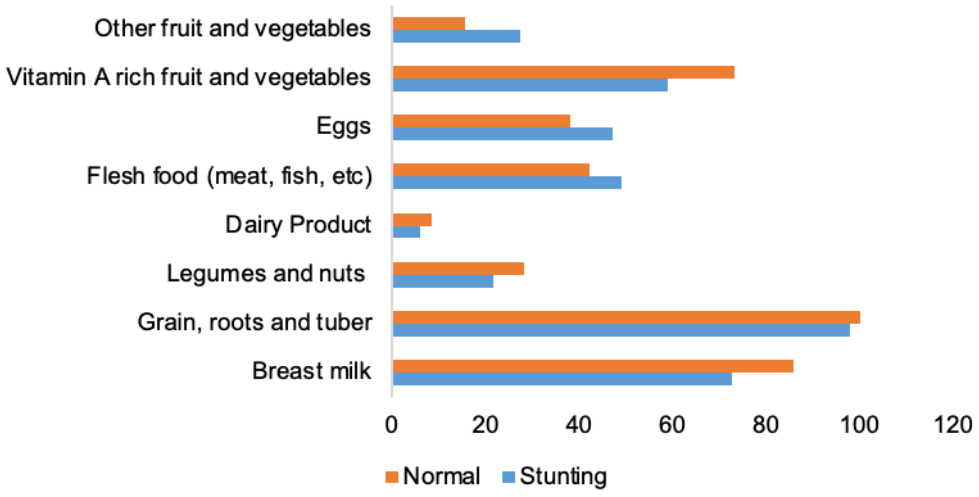

Figure 1. **Distribution of minimal dietary diversity for children aged 6-23 months**

However, all variables with p<25 in the chi-square test were included in the multivariate analysis. These variables include age (p=0.021), birth length (p=0.027), maternal education (p=0.049), and family income (p=0.15). After analyzing variables such as age, birth length, maternal education, and family income, four multivariate models were presented in **Table 3**. Among these, the first model was selected as it provided the most parsimonious explanation. This model revealed a significant association between the minimum dietary diversity (MDD) indicator and an increased risk of stunting in children aged 6–23 months in Pajangan District (OR = 5.17; 95% CI: 1.57–16.99). Dietary diversity reflects the quality of food consumed by infants and young children. In this study, toddlers who did not meet the MDD criteria faced a 5.63 times higher risk of stunting compared to those who met the requirement. Multivariate analysis further identified MDD as the strongest risk factor, with a 5.17-fold increased risk of stunting in children aged 6–23 months.

These findings align with research by Komarudin et al. (2019), which demonstrated a significant relationship between dietary diversity and stunting. The MDD indicator can serve as a robust measure of complementary feeding quality and a predictor of stunting, particularly in populations with low economic status (25). Additionally, dietary diversity is linked to both stunting and wasting, underscoring its role in nutritional outcomes. The nutritional adequacy of toddlers during the complementary feeding (CF) period can be assessed using dietary diversity indicators.Diverse foods consist of various food groups per day which include: (1) Breast Milk; (2) grains, roots, and tubers/staple foods; (3) nuts; (4) Milk (Dairy products such as milk, yogurt, and cheese; (5) flesh food (meat, fish, poultry and offal); (6) eggs; (7) fruit sources of vitamin A (carrots, mangoes, dark green leaves, pumpkin, orange sweet potatoes; (8) other fruits and vegetables. Children under two years old are said to consume a variety of foods if they consume 5 food groups a day (14). With the variety of foods consumed by children, there will be a greater chance of fulfilling their micronutrient needs, including the need for vitamin A, iron, calcium, thiamine, folate, zinc, vitamin B6 and vitamin B12 (14,21). The micronutrient needs required from food diversity are used because the growth and development of children in the golden period during the first 2 years of life is very rapid, so that the nutritional needs per unit weight of babies and children are very high. Breastfeeding (food group 1) can significantly contribute to the total nutritional intake of children aged 6-24 months, particularly in protein and vitamin content. However, breast milk is relatively low in some minerals such as iron and zinc. For example, in children aged 9-11 months, the proportion of nutritional intake that must be met from complementary foods is 97% iron, 86% zinc, 81% phosphorus, 76% magnesium, 73% sodium, and 72% calcium. Therefore, it is very important to meet the nutritional density of complementary foods for children aged 6-23 months (4).

In this study, the Minimum Acceptable Diet (MAD) was considered achieved when both Minimum Dietary Diversity (MDD) and Minimum Meal Frequency (MMF) were met. The bivariate analysis revealed that children under two who met the MAD criteria had a one-fold higher risk of stunting compared to those who did not. This finding may be attributed to the relatively low sensitivity of the MAD indicator, as MDD and MMF are components of MAD and are assessed based on dietary intake within the past 24 hours, which may only capture recent dietary patterns rather than long-term feeding practices. Moreover, the limited sample size and population variability could also have influenced these results. After controlling for confounding variables, no statistically significant association was found between MAD and stunting. Nevertheless, achieving MAD appeared to serve as a protective factor against stunting, suggesting that children who met MAD were less likely to experience stunting, although this was not statistically proven. This result is consistent with the study by Limardi (2020), which reported no significant association between MAD and stunting. However, a study conducted in Nigeria among children aged 6–11 months found that infants who did not achieve MDD and MMF were at a significantly higher risk of stunting (OR 2.17; 95% CI 1.43–4.20; p<0.05).

Tabel 3. Multivariate analysis of indicators of complementary feeding practices as a risk factor for stunting in children aged 6-23 months

Variable	Stunting			
	Model 1	**Model 2**	**Model 3**	**Model 4**
	AOR (95% CI)	**AOR (95% CI)**	**AOR (95% CI)**	**AOR (95% CI)**
Minimum Dietary Diversity			-	-
Appropriate	1 (Ref.)			
Inappropriate	5.17 (1.57-16.99)*			
Minimum Meal Frequency	-		-	-
Appropriate		1 (Ref.)		
Inappropriate		2.19 (0.64-7.49)		
Minimum Acceptable Diet	-	-		-
Appropriate			1 (Ref.)	
Inappropriate			0.40 (0.15-1.05)	
Animal-derived protein consumption	-	-	-	
Yes				1 (Ref.)
No				1.71 (0.73-3.12)
Gender				
Male	1.39 (0.57-3.11)	1.51 (0.70-3.32)	1.55 (0.71-3.39)	1.4 (0.36-0.65)
Female	1 (Ref.)	1 (Ref.)	1 (Ref.)	1 (Ref.)
Birth Lenght				
<48 cm	1.9 (0.83-4.74)	2.34 (1.01-5.42)*	2.27 (097-5.31)	2.36 (0.045-1.01)*
≥48 cm	1 (Ref.)	1 (Ref.)	1 (Ref.)	1 (Ref.)
Maternal education				
Low	0.70 (0.25-1.96)	0.94 (0.36-2.47)	0.80 (0.30-2.13)	1.83 (0.15-0.80)
High	1 (Ref.)	1 (Ref.)	1 (Ref.)	1 (Ref.)
Family income				
Low	1.7 (0.74-4.24)	1.65 (0.72-3.78)	1.61 (0.70-3.73)	0.15-0.8
High	1 (Ref.)			

Appropriate infant and young child feeding practices are considered one of the key strategies to reduce the risk of malnutrition and stunting. The quality of these feeding practices is reflected through the MAD indicator, which incorporates both MDD and MMF. To achieve MAD, parents and caregivers are expected to provide diverse foods with adequate frequency according to the child's age. However, this remains a challenge, particularly among families with lower socio-economic status. In this study, the proportion of children from low-income households who did not achieve MAD was higher (60.44%) compared to those from higher-income families. Considering the inconsistencies across studies regarding the relationship between MAD and stunting, further research is needed in various regions of Indonesia. Such studies are essential to better elucidate the association between Infant and Young Child Feeding (IYCF) WHO indicators and stunting, and to inform the development of more targeted nutrition interventions.

CONCLUSION AND RECOMMENDATION

This study confirms that suboptimal complementary feeding practice is one of the important risk factors for stunting in children aged 6-23 months. Findings of this study suggest that in population where stunting is more prevalent, improving dietary diversity could be the key strategy for fulfilling nutrient intakes and enhancing children nutritional status. Public health policies may have to develop better complementary feeding programs by improving dietary diversity of the children. Health care workers require training to provide effective counseling on affordable, nutrient-rich local foods. Research should identify specific socioeconomic barriers to diverse diets. Empowering caregivers with practical resources is crucial for implementing these guidelines and reducing stunting.

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