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Masters Program in Public Health, Universitas Sebelas Maret
Meta Analysis

Meta-Analysis the Effect of Complementary Feeding Practice on Stunting in Children Aged 6-59 Months

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ABSTRACT

Background: A child's ability to achieve growth standards is determined by the adequacy of food intake. Malnutrition in toddlers increases the risk of stunting, which is a serious problem. Stunting is closely related to neurocognitive development, risk of non-communicable diseases, and decreased productivity. Appropriate complementary feeding is an important milestone in efforts to improve survival and promote healthier child growth and development and can significantly reduce stunting. This study aims to estimate the magnitude of the effect of poor complementary feeding practices on the incidence of stunting in toddlers using a meta-analysis study.
Subjects and Method: The meta-analysis was carried out with the initial step of formulating the research problem using the PICO technique. The study population were children aged 6-59 months with poor complementary feeding, compare with good complementary feeding. The study outcome was stunting. Articles were selected from Google Scholar, PubMed, Springer Link, and Research Gate databases. The keywords used were "complementary Feeding practice" OR "meal frequency" OR "dietary diversity" AND "Stunting". The inclusion criteria were full text, observational studies, and the results reported in Adjusted Odds Ratio (aOR). Analysis of articles using RevMan 5.3.
Results: A meta-analysis involved 16 articles. The results showed that the low variety of complementary feeding increased the incidence of stunting 1.72 times compared to various types of complementary feeding (Aor= 1.72; 95% CI= 1.54 to 1.92; p < 0.001). Infrequent complementary feeding increased the incidence of stunting by 1.85 (aOR= 1.85; 95% CI 1.34 to 2.55; p <0.001).
Conclusion: The diversity of types of complementary foods and low frequency of giving complementary foods increase the incidence of stunting in children aged 6-59 months.

Keywords: complementary feeding practice, feeding frequency, food diversity, stunting.

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BACKGROUND

The period of complementary feeding is a very vulnerable period, contributing significantly to the high prevalence of malnutrition in toddlers worldwide (WHO, 2009). Getting the appropriate complementary foods for young children is an important milestone in efforts to improve survival and encourage healthier growth and development (Menon, 2012).

WHO (2004) recommends that complementary feeding practices be carried out in a timely and adequate manner, namely providing sufficient energy, protein, and micronutrients to meet the nutritional needs of growing children. Safe, that is, food is

stored, prepared and served hygienically, and the frequency of meals is given in accordance with signals that indicate the child's hunger and satiety.

Increasing the variety of foods in the diet ensures that there is an adequate intake of essential nutrients. Food diversity, especially for children aged 6-59 months is very important because they need energy-dense and nutrient-dense foods for physical and mental growth and development (Sagaro and Alemayehu, 2017). The minimum feeding frequency, for a child's energy needs, examines the number of times a child receives food other than breast milk (Wagris et al., 2019).

The period of complementary feeding is a critical life stage. A child's ability to achieve growth standards is determined by the adequacy of food intake. To this end, indicators such as minimum eating frequency, dietary diversity, and adequate diet together with disease prevention and control programmes, are the most effective interventions that can significantly reduce stunting (WHO, 2009).

Support of quality feeding practices, monitoring of diet quality during this period is essential. This provides a window of opportunity to prevent various nutritional problems, such as stunting, wasting, overweight. Giving the wrong complementary foods can affect growth, organ development, and metabolism (Michaelsen et al., 2017).

Ensuring that children get adequate nutritional intake, by increasing the variety of foods in a food diversity diet, especially for children aged 6-59 months is very important because they need energy-dense and nutrient-dense foods for physical growth and development (Sagaro and Alemayehu, 2017).

Stunting is a condition in which a child's height for age is more than two SD below the median standard of child growth as a result of suboptimal nutrition over a long period of time. Stunting has negative impact on the child's cognitive development, resulting in low productivity and income in adulthood and more susceptible to degenerative diseases (WHO, 2014).

de Onis et al., (2011), estimates that in 2010 there were 171 million stunted children under five, 167 million of whom lived in developing countries. In 2012, the World Health Organization (WHO) adopted a global target resolution to reduce 40% of the number of stunted children under five by 2025. The global target of 3.9% reduction per year is to reduce the number of stunted children from 171 million in 2010 to around 100 million in 2025. However, it is estimated that 127 million children will be stunted by 2025, a decrease of only 26% (de Onis et al., 2013).

Researchers are interested in conducting a meta-analysis to analyze the results of existing research and draw conclusions from previous research reports that discuss the influence of complementary feeding practices such as the diversity of types of complementary feeding, and the rare frequency of complementary feeding with the incidence of stunting in children aged 6-59 months.

SUBJECTS AND METHOD

1. Study Design

This study used a literature study design and meta-analysis. Articles published in 2010-2022 were selected using electronic data base media including: Google Scholar, PubMed, Research Gate, Scopus, Springer Link, and Science direct. The keywords used in the article search were "complementary Feeding practice" OR "meal frequency" OR "dietary diversity" AND "Stunting".

2. Inclusion Criteria

The articles that were analyzed in this study including: Articles were available in full text,

with a cross sectional study design. Research sample were ≥100 samples, published in English, examined or discussed the practice of giving complementary feeding and stunting in children aged 6-59 months, data analysis in the form of multivariate analysis, showing the final results of the adjusted odds ratio (aOR) study.

3. Exclusion Criteria

Articles published before 2010, articles published in Chinese, German, and French, bivariate analysis articles so that the final results displayed are only OR, percent, and mean difference.

4. The Definition of Operational Variables

The population in this study were children aged 6-59 months with poor complementary feeding practices, comparison with good complementary feeding practices and stunting outcomes.

Stunting are children whose height for age <−2 SD from the WHO international growth reference median value.

Various kind of foods is the proportion of children aged 6–59 months who receive at least 4 food groups within 24 hours (grains, nuts, dairy products, eggs, meat, fruits and vegetables) recommended by the World Health Organization (WHO).

Frequency of eating is feeding infants and children who fulfills at least 2-3 times complementary foods in 24 hours for ages 6-8 months and 3-4 times complementary foods in 24 hours for ages >8 months.

5. Study Instrument

The process of assessing the quality of the study using the Critical Appraisal Checklist for Cross-Sectional Study from the Center for Evidence Based Management (CEBMa) 2014.

6. Data Analysis

The process of data analysis in this study was carried out using the Review Manager application (RevMan 5.3), to determine the effect size and heterogeneity of the study. The results of the meta-analysis data processing are presented in the forest plot and funnel plot.

RESULTS

The process of searching for articles through the database can be seen in Figure 1. Figure 2 shows the distribution area of the article.

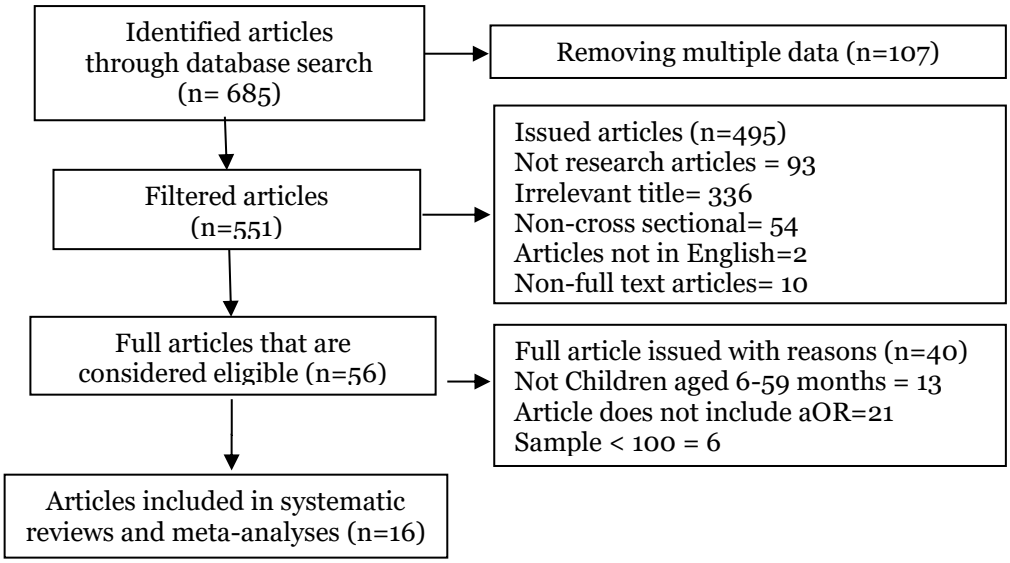

Figure 1. PRISMA Flowchart

Figure 2. Map of Research Locations

A total of 1,371 articles were identified through the electronic database. After removing duplication, 1,007 articles were screened. Of these, 51 articles were assessed for eligibility. The following reasons are given for full-text articles that meet the exclusion criteria:

1. The article does not meet the criteria for the PICO formulation.
2. The population in the article is not mothers and newborns.
3. The article does not include the mean and standard deviation values.

A total of 10 articles that met the quality assessment were included in the quantitative synthesis using the Meta-Analysis. Critical Appraisal Checklist for Randomized Controlled Study published by CEBM University of Oxford (2020). This assessment criteria consists of twelve criteria, with each measure given a score of 1 = if you answered yes, 0 = if you answered no. The following are the assessment criteria of the Controlled Study published by CEBM University of Oxford.

The next step is to calculate the overall effect of combining the data. Data analysis was performed using Review Manager (RevMan) 5.3 software released by the Cochrane Collaboration. Table 1. Shows the assessment of study quality using the Controlled Study Checklist published by CEBM University of Oxford (2020) as follows:

The forest plot in Figure 2 shows that mothers who breastfed their newborns with skin-to-skin contact had a 1.10 unit greater probability of successful first breastfeeding than without skin-to-skin contact, and the effect was statistically significant (SMD= 1.10; 95% CI=0.63 to 1.58) and statistically significant $p < 0.001$. Statistical heterogeneity among studies was I^2= 93% indicating a heterogeneous distribution of data (random effect model).

A funnel plot is a plot that depicts the estimated effect size of each study against its estimated accuracy which is usually the standard error. The following funnel plot shows the risk of publication bias among the included studies.

Figure 3 shows a balanced distribution of effect estimates (symmetrical) to the right and left of the estimated average vertical line, so that it does not indicate any publication bias.

Assessment of research quality using 12 questions Critical Appraisal Checklist for a cross sectional study from the Center for Evidence Based Management (CEBMa) 2014, 16 articles included in the synthesis of the meta-analysis met the requirements in the assessment of research quality. Assessment of research quality can be seen in Table 1.

Table 1. Assessment of research quality for a cross sectional study of the effect of complementary feeding practices on the incidence of stunting

No	Checklist Questions	Publication (Author and Year)							
		Udoh et al. (2016)	Derso et al. (2017)	Darsene et al. (2017)	Tariku et al. (2017)	Berhanu et al. (2018)	Hein et al. (2019)	Khamis et al. (2019)	Girma et al. (2019)
1	Do these objectives clearly address the research focus/problem?	1	1	1	1	1	1	1	1
2	Does Cross sectional method suitable for answering the research questions?	1	1	1	1	1	1	1	1
3	Is the research subject selection method clearly written?	1	1	1	1	1	1	1	1
4	Does the sampling method give rise to bias (selection)?	1	1	1	1	1	1	1	1
5	Does the research sample taken represent the designated population?	1	1	1	1	1	1	1	1
6	Is the sample size based on pre-study considerations?	1	1	1	1	1	1	1	1
7	Is a satisfactory response achieved?	1	1	1	1	1	1	1	1
8	Are the research instruments valid and reliable?	1	1	1	1	1	1	1	1
9	Is statistical significance assessed?	1	1	1	1	1	1	1	1
10	Is a confidence interval given for the main outcome?	1	1	1	1	1	1	1	1
11	Are there any confounding factors that haven't been taken into account?	0	1	1	0	0	1	1	1
12	Are the results applicable to your study?	1	1	1	1	1	1	1	1
	Total	11	12	12	12	11	12	12	12

Continue.

	Checklist Questions	Publication (Author and Year)							
		Mya et al., 2019	**Tafese, et al., 2019**	**Workie, et al., 2020**	**Bayih et al., 2020**	**Afework et al., 2021**	**Mengesha et al., 2021**	**Saaka et al., 2021**	**Gebreayohanes et al., 2022**
1	Do these objectives clearly address the research focus/problem?	1	1	1	1	1	1	1	1
2	Does Cross sectional method suitable for answering the research questions?	1	1	1	1	1	1	1	1
3	Is the research subject selection method clearly written?	1	1	1	1	1	1	1	1
4	Does the sampling method give rise to bias (selection)?	1	1	1	1	1	1	1	1
5	Does the research sample taken represent the designated population?	1	1	1	1	1	1	1	1
6	Is the sample size based on pre-study considerations?	1	1	1	1	1	1	1	1
7	Is a satisfactory response achieved?	1	1	1	1	1	1	1	1
8	Are the research instruments valid and reliable?	1	1	1	1	1	1	1	1
9	Is statistical significance assessed?	1	1	1	1	1	1	1	1
10	Is a confidence interval given for the main outcome?	1	1	1	1	1	1	1	1
11	Are there any confounding factors that haven't been taken into account?	1	1	1	1	1	1	1	1
12	Are the results applicable to your study?	1	1	1	1	1	1	1	1
	Total	12	12	12	12	12	12	12	12

Note 1: Yes 0:No

Table 2. Summary Source of pengaruh ketidakberagaman jenis MP-ASI terhadap kejadian stunting

Author, year	Country	Design Study	Sample size	Population	Intervention	Comparison	Outcome
Udoh and Amodu., 2016	Nigeria	Cross sectional	330	Children aged 6-11 months	Getting no variety of complementary food	Getting a variety of complementary food	Stunting
Tariku et al., 2017	Ethiopia	Cross sectional	1295	Children aged 6-59 months	Getting no variety of complementary food	Getting a variety of complementary food	Stunting
Derso et al., 2017	Ethiopia	Cross sectional	587	Children aged 6-24 months	Getting no variety of complementary food	Getting a variety of complementary food	Stunting
Berhanu et al., 2018	Ethiopia	Cross sectional	1039	Children aged 24-59 months	Getting no variety of complementary food	Getting a variety of complementary food	Stunting
Hein et al., 2019	Myanmar	Cross sectional	320	Children aged 6-59 months	Getting no variety of complementary food	Getting a variety of complementary food	Stunting
Khamis et al., 2019	Tanzania	Cross sectional	2960	Children aged 6 -23 months	Getting no variety of complementary food	Getting a variety of complementary food	Stunting
Tafese et al., 2020	Ethiopia	Cross sectional	464	Children aged 6 -23 months	Getting no variety of complementary food	Getting a variety of complementary food	Stunting
Bayih et al., 2020	Ethiopia	Cross sectional	616	Children aged 12-59 months	Getting no variety of complementary food	Getting a variety of complementary food	Stunting
Mengesha et al., 2021	Ethiopia	Cross sectional	660	Children aged 6 -59 months	Getting no variety of complementary food	Getting a variety of complementary food	Stunting
Saaka et al., 2021	Ethiopia	Cross sectional	301	Children aged 6-23 months	Getting no variety of complementary food	Getting a variety of complementary food	Stunting
Gebreayohanes and Dessie., 2022	Ethiopia	Cross sectional	554	Children aged 6–59 months	Getting no variety of complementary food	Getting a variety of complementary food	Stunting

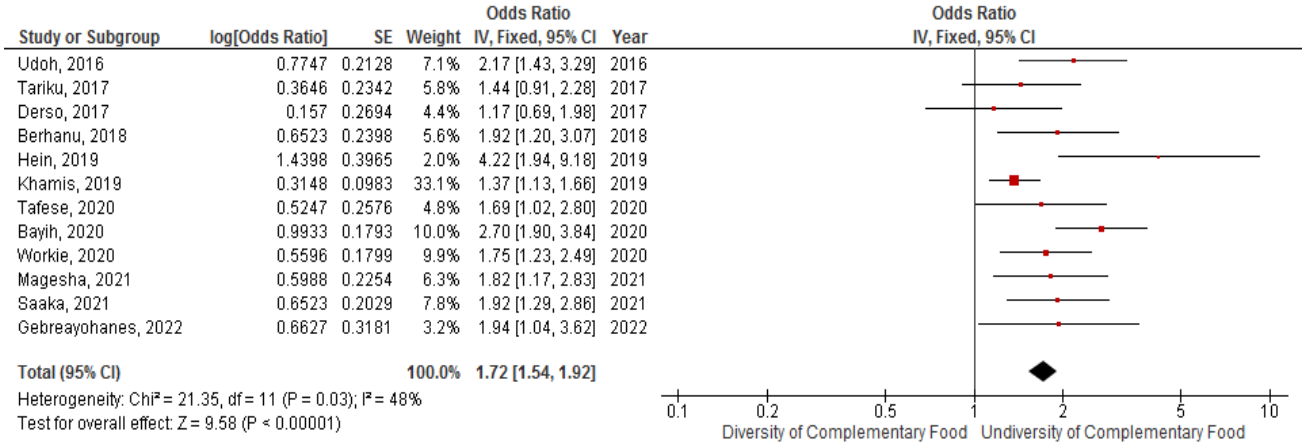

Figure 2. Forest plot of the effect of non-variety types of complementary foods on the incidence of stunting

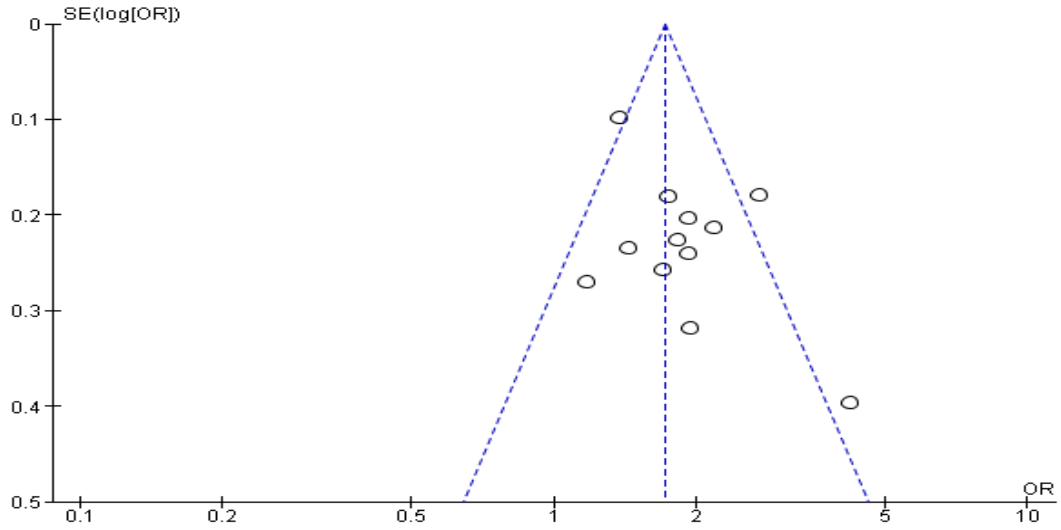

Figure 3. Funel plot of the effect of non-variety types of complementary foods on the incidence of stunting

Table 2 shows that there are 12 cross-sectional study articles that show that there is a significant effect of the diversity of complementary foods on the incidence of stunting in children aged 6-59 months.

The Forest Plot in Figure 1 showed that the variety of complementary types affected the risk of stunting in toddlers. Toddlers who received different types of complementary foods had a risk of experiencing stunting by 1.72 times (aOR 1.72; 95% CI 1.54 to 1.92; p < 0.001). The heterogeneity of the research data showed I^2= 48% so that the distribution of the data was declared homogeneous (fixed effect model).

The funnel plot in Figure 2 showed the distribution of the effect estimates across all studies in this meta-analysis to the right of the mean vertical line of the effect estimates. Thus, the funnel plot indicates publication bias, because the distribution of effect estimates in this funnel plot tends to the right of the effect mean vertical line, which is in the direction of the overall average effect estimate in the forest plot which is also on the right. So the publication bias tends to overestimate the true effect (overestimate).

DISCUSSION

This systematic review and meta-analysis study discusses data on the variety of types of complementary foods on the incidence of stunting and the low frequency of giving complementary foods on the incidence of stunting. This meta-analysis was carried out by analyzing the results of 16 primary studies from the continent of Asia, and Africa spread over the region of Myanmar, Nigeria, Ethiopia, Tanzania.

The causes of stunting in childhood tend to be multifactorial, the practice of complementary feeding in infants and children is considered a critical factor. Quality feeding, monitoring the quality of the diet during this period is very important, increasing the variety of foods in the diet ensures that there is an adequate intake of essential nutrients. Therefore, information on early childhood feeding practices is important in developing strategies to reduce stunting (Wagris et al., 2019).

The number of relevant studies published and accessible was still small and also has data access problems (data duplication). Most of the statistical results reported were in percentages or crude odd ratios (cOR), where research does not control for confounding factors (Murti, 2018).

1. The Effect of Low Variety Types of Complementary foods on the Incidence of Stunting

Based on the results of the forest plot, children under five who received different types of complementary feeding had a 1.72 times risk of experiencing stunting compared to those receiving various complementary foods (aOR 1.72; 95% CI 1.54 to 1.92; p < 0.001).

Poor complementary feeding has been identified as a risk factor directly related to stunting (Bhutta et al., 2013). From conception until about 6 months of age, the child is completely dependent on the mother's nutrition, either through the placenta during pregnancy or through breast milk during the initial 6 month period of exclusive breastfeeding. Provision of adequate complementary feeding is very important to support optimal physical growth and brain development in children. Complementary foods should be rich in nutrients and given according to the child's needs to prevent stunting (Aguayo and Menon, 2016).

Food variety is defined as the number of different food groups consumed in a given period. A diverse diet is a good source of a variety of macro and micronutrients and ensures the best nutritional adequacy. Food diversity is a qualitative measure of food consumption that reflects a household's access to a variety of foods, and is also a proxy for assessing the nutritional adequacy of an individual's diet (Masuke et al., 2021).

Food diversity was assessed based on consumption of 4 groups of foods or more than 7 recommended food groups, namely grains, roots and tubers, legumes and nuts, dairy products (milk, yogurt, cheese), eggs and meat (meat, fish, poultry and offal), fruits and vegetables rich in vitamin A, other fruits and vegetables. 4 of the 7 food groups above were chosen because they were associated with better food quality for breastfed and non-breastfed children (Masuke et al., 2021).

Consumption of foods from at least 4 food groups indicates that in a large part of the population children are most likely to eat at least one animal source food, one fruit or vegetable that day, in addition to staple foods (grains, roots or tubers). A diverse diet provides all the essential nutrients for children to achieve normal growth and development. Food quality has an important impact on children's growth which can progressively interfere with the child's linear growth if the child consumes

food of poor quality (Abebe et al., 2019).

Children who do not get a variety of foods have a higher risk of stunting compared to children who receive various types of complementary foods. This finding is in line with Abate and Belachew, (2017) who reported that children with suboptimal dietary diversity were 3.95 times more likely to experience stunting. Children who do not get a variety of foods have a 1.3 times higher risk of stunting compared to children who receive various types of complementary foods (Masuke et al., 2021).

A very diverse diet is reflected in the high diversity of foods as a guide to micronutrient intake, the diversity of foods reveals whether children receive a complete and balanced diet or not (Solanki et al., 2022). Khalil et al. (2022) reported that children aged 6-59 months who consumed a variety of foods had an appropriate height when compared to children who did not get a variety of complementary foods.

Dietary diversity is a long-term and sustainable strategy to reduce micronutrient malnutrition. A very diverse diet reflected in a high diversity of foods as a guide to adequate micronutrient intake.

2. The Effect of Low Frequency of Giving Complementary Foods on the Incidence of Stunting

Based on the results of the forest plot, it was shown that the frequency of giving complementary foods infrequently increased the incidence of stunting by 1.85 times higher compared to the frequency of giving complementary foods frequently at the age of 6-59 months and was statistically significant ($p < 0.001$).

Minimum meal frequency is a question that reports on the number of times per day a child receives or gets complementary foods. A child is stated to have eaten an adequate amount if he or she receives at least the minimum meal frequency. That is, 2 times for 6-8 months and 3 times for 9-11 months, 3 times for children aged 12-23 months for children who are breastfed and 4 times for children who are not breastfed (Masuke et al., 2021).

At the age of 6 months, children begin to be introduced to foods with a mashed or semi-solid consistency. Because breast milk can only provide half of the energy needs of children between the ages of 6-12 months and a third of the energy and nutritional needs of children 12-24 months. The amount (weight or volume) of food required depends on the energy density of the food being offered which is calculated in kilocalories per ml, or per gram. Breast milk contains about 0.7 kcal per ml, complementary foods are more varied usually contain between 0.6 and 1.0 kcal per gram. Thin, smooth foods contain only about 0.3 kcal per gram (WHO, 2009).

Stunting is higher in children who have a frequency of eating less than 3 times per day (Sewnet et al., (2021), this may be due to the less frequent feeding of children per day based on their age resulting in a lack of nutrient intake which is one of the causes of malnutrition. direct cause of stunting. Minimum meal frequency is a proxy for a child's energy needs. The indicator is based on how much energy a child needs (Solanki et al., 2022).

This finding is in line with Masuke et al, (2021) showing that children who received a low minimum eating frequency were 2.9 times more likely to be stunted. A minimum number of meals per day is required to achieve energy levels and nutritional requirements and prevent deficiencies that can lead to malnutrition. Shaka et al, (2020) reported that children who did not receive the recommended daily meal frequency were 4.5 times more likely to be stunted. This finding can be explained by the fact that if the child does not get com-

plementary foods (for breastfeeding children) or regular daily meals (for non-breastfeeding children) as recommended, the chances of getting adequate nutritional intake will be reduced, which can significantly reduce the risk of malnutrition and can affect the nutritional status of children.

AUTHOR CONTRIBUTION

Isna Yuswella Babys is the main researcher who chose the topic, explored and collected the data. Yulia Lanti Retno Dewi and Setyo Sri Rahardjo played a role in analyzing data and reviewing research documents.

FUNDING AND SPONSORSHIP

This study is self-funded.

CONFLICT OF INTERESTS

There is no conflict of interest in this study.

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