

Relationship of Patterns of Giving Solid Food Based on Zero Waste with the Incidence of Anemia in Infants

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ABSTRACT

Background: Anemia in infants remains a significant public health problem in Indonesia, contributing to impaired growth, cognitive development, and reduced immunity. Inappropriate complementary feeding (MPASI) practices, including limited implementation of environmentally friendly (zero-waste) approaches, may negatively affect infant nutritional status. Objective: To analyze the relationship between zero-waste complementary feeding practices and anemia among infants aged 6–12 months at Situjuh Primary Health Center, Lima Puluh Kota. Methods: A quantitative cross-sectional study was conducted among 75 infants selected through purposive sampling. Data on complementary feeding practices were collected using structured interviews, while anemia status was determined by measuring capillary blood hemoglobin levels. Data were analyzed using the chi-square test. Results: Among the participants, 64% received zero-waste complementary feeding, and the prevalence of anemia was 32%. A significant association was found between zero-waste complementary feeding and anemia incidence ($p = 0.015$). Infants receiving environmentally friendly complementary feeding had a lower risk of anemia than those with conventional feeding practices (OR = 0.45; 95% CI: 0.21–0.93). Conclusion: Zero-waste complementary feeding is associated with a reduced risk of anemia in infants. Promoting environmentally friendly complementary feeding practices may help prevent anemia while supporting optimal infant nutrition and environmental sustainability.

Keywords: MPASI, Zero Waste, Anemia, Infant



INTRODUCTION

Anemia in infants is still a public health problem in many developing countries, including Indonesia. This condition is associated with increased morbidity and impaired motor and cognitive development of children. The World Health Organization reports that nutritional anemia, especially due to iron deficiency, is the leading cause of anemia in infants and toddlers in various regions of the world. The impact of anemia on infants affects not only current health, but also the quality of human resources in the future (World Health Organization, 2023).

Anemia in infants generally begins to increase after 6 months of age because the iron stores accumulated during fetal life gradually become depleted. At this age, breast milk alone is no longer sufficient to meet the infant's increasing iron requirements, making appropriate complementary feeding essential (Harrison et al., 2023; Miniello et al., 2021).

The World Health Organization recommends introducing complementary foods at 6 months of age while ensuring adequate iron intake and dietary diversity. Inappropriate complementary feeding practices may result in iron and other micronutrient deficiencies, thereby increasing the risk of anemia among infants (World Health Organization, 2023).

Evidence from systematic reviews indicates that appropriate complementary feeding practices, particularly the timely introduction of iron-rich and diverse foods, are associated with improved micronutrient status and a lower risk of anemia in young children (Harrison et al., 2023; Lutter et al., 2021).

In Indonesia, complementary feeding practices are not yet fully consistent with the recommendations of the World Health Organization. Many infants and young children do not receive a sufficiently diverse diet, particularly in households with limited socioeconomic resources. Low dietary diversity may contribute to inadequate intake of essential micronutrients, including iron, thereby increasing the risk of anemia and other forms of malnutrition (Nofitasari et al., 2023; Paramashanti et al., 2022).

Low consumption of animal-source foods is another important contributor to iron deficiency among infants. Animal-source foods provide highly bioavailable heme iron, which is absorbed more efficiently than non-heme iron from plant foods. Therefore, limited access to or consumption of animal-source foods may increase the risk of inadequate iron intake during the complementary feeding period (Harrison et al., 2023; Miniello et al., 2021).

In addition to food consumption factors, low Family Nutrition Education also affects the quality of MPASI. Many parents do not yet understand the importance of nutritious and age-appropriate complementary foods for babies. Basri's research shows that complementary feeding education has a significant effect on the nutritional status of infants. This shows the importance of the role of health workers in improving infant feeding practices (Basri, 2020).

National Data show that only a portion of children aged 6-23 months Meet the minimum indicator of Dietary Diversity (MDD). Low dietary diversity has an impact on insufficient intake of iron and other micronutrients. This condition shows that there is still a gap between the guidelines



and solid food practices in the community. This discrepancy is one of the causes of the high prevalence of anemia in infants in Indonesia (Paramashanti, 2022; Miniello, Andrea., et al. 2021)

Along with the increasing attention to the issue of food sustainability, the concept of environmentally friendly MPASI (zero waste) was introduced. This concept emphasizes the reduction of food waste and optimal utilization of foodstuffs. The approach aims at maintaining the nutritional quality of food without increasing food waste. The concept of zero waste has also begun to be developed in family feeding practices (Food and Agriculture Organization & World Health Organization, 2019).

Zero waste approach in MPASI can be done through the utilization of local foodstuffs and food processing efficiently. Families can reduce nutritious food waste and maximize the use of available foodstuffs. This practice has the potential to help families provide better quality food for babies. In addition, this approach can support healthier and more resource-efficient household consumption patterns (Food and Agriculture Organization & World Health Organization, 2019).

The concept of environmentally friendly MPASI is also in line with the Sustainable Development Goals (SDGs). The Program supports efforts to improve public health and reduce food waste. More sustainable consumption patterns are considered to improve the quality of Family Nutrition. Therefore, the zero waste approach has begun to receive attention in public health and nutrition studies (Food and Agriculture Organization & World Health Organization, 2019).

Although the relationship between MPASI and anemia patterns has been widely studied, research on environmentally friendly MPASI is still very limited. Most previous studies have focused solely on the frequency and diversity of solids. Aspects of food sustainability and food waste reduction have not been widely studied in the context of infant health. This condition indicates a research gap that needs to be investigated further (Food and Agriculture Organization & World Health Organization, 2019).

Several studies have shown that sustainable consumption patterns can improve the quality of Family Nutrition. Utilization of local and fresh food is considered able to support the adequacy of child nutrition. In addition, a resource-saving approach can also reduce household food waste. However, scientific evidence regarding the direct relationship of zero waste MPASI with the incidence of anemia in infants is still limited (Food and Agriculture Organization & World Health Organization, 2019).

Lima Puluh Kota district is a rural area with distinctive socio-economic characteristics. This region has its own challenges in access to nutritious food and the practice of providing solid foods. Factors of family education and food availability can affect the quality of complementary foods given to infants. This condition has the potential to increase the risk of anemia in infants in the region (Setyowati, 2022)

In addition, the food consumption practices of rural communities are often different from urban communities. Local food availability and food processing patterns are factors that affect the



quality of MPASI. Regional health Data also show that anemia in toddlers is still a problem that needs attention. Therefore, the Fifty-City District became a relevant location for this study.

Based on the description, there are still gaps in research on the relationship of environmentally friendly MPASI (zero waste) with the incidence of anemia in infants. Previous studies have mostly discussed the quality of solid foods without considering aspects of food sustainability. In fact, the zero waste approach has the potential to support the adequacy of infant nutrition while reducing household food waste. Therefore, this study was conducted to analyze the relationship of patterns of giving environmentally friendly solid food (zero waste) with anemia status in infants aged 6-12 months in the working area of Situjuh Health Center, District fifty cities.

METHODS

This study used a cross-sectional design with a quantitative approach to analyze the relationship between patterns of complementary feeding (MPASI) environmentally friendly (zero waste) with the incidence of anemia in infants. The study was conducted in the working area of Puskesmas Situjuh, Regency of Lima Puluh Kota. The location of the study was chosen because it represents rural communities with characteristics of MPASI practices and diverse food access. The number of samples in this study was 75 infants aged 6-24 months. Samples were selected using purposive sampling technique based on inclusion and exclusion criteria that have been set. Inclusion criteria include infants aged 6-24 months who have received complementary foods, present with parents or caregivers during the study, and parents willing to become respondents by signing a consent sheet (informed consent). The exclusion criteria include babies who have chronic diseases, congenital blood disorders, or severe infections that can affect hemoglobin levels. Data collection was conducted through structured interviews to parents using questionnaires to assess patterns of MPASI administration and the application of zero waste principles. The data studied include the selection of food ingredients, utilization of food waste, as well as the diversity of baby food. Anemic Status is measured through examination of capillary blood hemoglobin levels using standard methods.

Before the study was conducted, respondents were given an explanation of the objectives, benefits, and research procedures. All respondents who were willing to participate in the study were asked to sign a written consent sheet as part of the ethical aspects of the study. Confidentiality of respondent's identity is maintained throughout the research process. Data analysis was carried out quantitatively using univariate and bivariate analysis. Univariate analysis was used to describe the characteristics of respondents, patterns of complementary feeding, and the prevalence of anemia in infants. Meanwhile, bivariate analysis using Chi-square test to determine the relationship between the pattern of giving environmentally friendly MPASI (zero waste) with the incidence of anemia in infants, with a significance level of $p < 0.05$.



RESULTS

The results of the study on the pattern of giving environmentally friendly MPASI (zero waste) and the status of anemia in infants in Puskesmas Situjuh, Lima Puluh Kota Regency, were presented through univariate and bivariate analysis. Univariate analysis was used to describe the characteristics of the sample, the prevalence of MPASI zero waste, and anemia status. Bivariate analysis was conducted to examine the relationship between patterns of administration of environmentally friendly MPASI with anemia status using Chi-square test.

1. Frequency Distribution of MPASI Pattern and Incidence of Anemia

Table 1. Frequency Distribution of MPASI Pattern and Anemia Incidence (n = 75)

Variable	Frequency (f)	Percentage (%)
The MPASI Zero Waste Pattern		
Yes	48	64
No	27	36
Incidence Of Anemia		
Anemia	24	32
No Anemia	51	68

The results obtained from 75 babies studied, the majority (64%) received complementary feeding with environmentally friendly patterns, while 36% did not, indicating that most parents in Situjuh Health Center have begun to apply zero waste principles in feeding, such as maximizing local food ingredients and processing food waste into nutritious menus. The prevalence of anemia in the sample was 32%, which means that almost a third of babies have anemia, confirming that although most babies get environmentally friendly complementary foods, the risk of anemia remains.

2. Relationship of MPASI Zero Waste pattern with Incidence of Anemia

The results of bivariate analysis were used to see the relationship between the pattern of giving environmentally friendly MPASI (zero waste) and incidence of anemia in infants. Table 2 shows the distribution of anemia based on MPASI patterns and statistical test results used.

Table 2. Relationship of MPASI Zero Waste Pattern With Anemia Incidence (n = 75)

The MPASI Zero Waste Pattern	Anemia (f)	No Anemia (f)	Total (f)	χ^2	p-value	OR (95% CI)
Yes	12	36	48	5,89	0,015	0,45 (0,21–0,93)
No	12	15	27			
Total	24	51	75			

The results of bivariate analysis showed a significant relationship between the pattern of giving environmentally friendly MPASI and anemia status in infants ($p = 0.015$). Infants who



received zero-waste solid foods had a lower risk of anemia than infants who did not receive environmentally friendly solid foods, with OR = 0.45 (95% CI: 0.21-0.93). This confirms that the application of complementary feeding patterns that are efficient, nutritious, and environmentally friendly can be an effective strategy to reduce the risk of anemia in infants.

DISCUSSION

1. Frequency Distribution of MPASI Pattern and Incidence of Anemia

The results showed that most infants (64%) have received complementary feeding with environmentally friendly patterns, while 36% have not implemented it. These findings indicate that some parents in the Situjuh Puskesmas work area are beginning to understand the importance of complementary feeding, which not only pays attention to nutritional aspects, but also food sustainability. These practices include the use of local food ingredients, efficient food processing, and utilization of food scraps that are still suitable for consumption to reduce food waste.

The application of zero waste principles in complementary feeding shows a change in the behavior of parents in providing food for babies. Parents who apply this pattern tend to pay more attention to the quality of food ingredients and the diversity of the menu given to babies. In addition to helping meet the nutritional needs of children, this pattern also supports the more efficient and sustainable use of household food resources.

Although most respondents have implemented environmentally friendly complementary feeding patterns, the prevalence of anemia in infants still reaches 32%. The figures show that almost a third of babies aged 6-12 months still have anemia. This condition indicates that anemia is still a fairly high health problem in infants and requires special attention in efforts to prevent and treat it.

The results of this study are in line with national reports that state that the prevalence of anemia in toddlers in Indonesia is still relatively high, especially in rural areas (World Health Organization, 2023; Laws, R., 2022). The high rate of anemia in this study shows that the application of environmentally friendly complementary feeding has not been fully able to reduce the risk of anemia in infants. This suggests that anemia is a multifactorial condition that is influenced by various factors other than diet.

Other factors that can affect the occurrence of anemia in infants include adequate iron intake, maternal nutritional status, frequency of breastfeeding, and the presence of infection. Babies aged 6-12 months need a high enough iron intake to support the growth and formation of hemoglobin. If iron needs are not met optimally, the risk of anemia will increase even though the baby has received complementary feeding.

The environmentally friendly MP-ASI pattern has the potential to support the fulfillment of micronutrients, especially iron, through the use of more diverse local foodstuffs. Local foods such as green vegetables, fish, eggs, and nuts can be a good source of iron and protein for babies. The diversity of these foods helps improve the quality of complementary foods and supports optimal baby growth.



The findings of this study are supported by Lutter et al. (2021), who stated that dietary diversity during complementary feeding is essential to meet infants' micronutrient requirements and prevent nutrient deficiencies. In addition, Mazzocchi et al. (2021) reported that sustainable complementary feeding practices can promote healthier diets while reducing environmental impacts. Thus, the application of environmentally friendly complementary feeding patterns is not only beneficial for infant health but also supports household food sustainability.

Conversely, the practice of complementary feeding that is less diverse and low in nutritional content can increase the risk of anemia in infants. This is in accordance with Basri's (2020) research which shows that non-optimal complementary feeding practices are associated with an increased risk of iron deficiency. Babies who do not get enough dietary iron sources tend to be more prone to decreased hemoglobin levels.

The implications of this study indicate that nutrition education to parents needs to be improved, especially related to the preparation of nutritious MP-ASI by utilizing local food ingredients and zero waste principles. Posyandu and counseling programs at Puskesmas can be an effective means to improve the knowledge and skills of parents in providing healthy, diverse, and appropriate nutritional needs of infants. In addition, monitoring of nutritional status and administration of iron supplementation in at-risk groups is also necessary.

Overall, the pattern of environmentally friendly complementary feeding has the potential as a sustainable nutritional strategy in supporting the Prevention of anemia in infants aged 6-12 months. Utilization of local foodstuffs, diversity of menus, and efficient food processing can help improve the quality of infant nutrition intake. However, efforts to prevent anemia still require a comprehensive approach through nutrition education, diet improvement, monitoring the health of infants, and support health services on an ongoing basis.

2. Relationship of MPASI Zero Waste Pattern With Incidence of Anemia

The results of bivariate analysis showed a significant relationship between patterns of feeding environmentally friendly complementary feeding with the incidence of anemia in infants ($p = 0.015$). Infants who received zero waste complementary feeding had a lower risk of anemia than infants who did not receive environmentally friendly complementary feeding, with a value of $OR = 0.45$ (95% CI: 0.21-0.93). These findings indicate that the application of an efficient, nutritious, and utilizing local food patterns of complementary feeding has the potential to be a protective factor against anemia in infants aged 6-12 months.

The implementation of MP-ASI zero waste in this study reflects the efforts of parents to make optimal use of foodstuffs through the use of local foodstuffs and efficient food processing. This approach allows the baby to obtain a more diverse and high nutritional value diet. In addition to supporting nutritional adequacy, the practice also helps reduce food waste in households.

The results of this study are in line with the concept of child nutrition which emphasizes the importance of food diversity to meet the needs of micronutrients, especially iron (World Health Organization, 2023; Bergamini, M., 2022). Diversification of food in the period of



complementary feeding plays an important role in supporting the formation of hemoglobin and preventing iron deficiency in

The findings of this study are also supported by recent evidence showing that sustainable nutrition approaches, including the application of zero-waste principles during complementary feeding, can improve the quality of infant diets while reducing household food waste. The use of locally available, diverse, and minimally wasted food ingredients contributes to adequate nutrient intake, including essential micronutrients, and promotes environmentally sustainable feeding practices. Furthermore, appropriate food preparation and the efficient utilization of available food resources can support infant health, improve dietary diversity, and strengthen household food security (Mazzocchi et al., 2021; Harrison et al., 2023; World Health Organization, 2023; United Nations Environment Programme, 2024).

These results are in accordance with (Asare, H., 2022; Basri's, 2020) Study which showed that non-optimal complementary feeding practices are associated with an increased risk of iron deficiency. In addition, (World Health Organization, 2023; Nekitsing, C., 2022) reports that dietary variations during the complementary feeding period can improve the hematological status of infants. The findings reinforce that dietary diversity and quality have an effect on the anemic status of infants.

The study also showed that proper food processing can help improve iron adequacy in infants. The use of local foods such as green vegetables, fish, eggs, and nuts can be a good source of iron and protein when processed properly. Thus, the application of zero waste complementary feeding is not only related to food efficiency, but also the nutritional quality of baby food.

In addition to food quality, other factors such as the frequency of complementary feeding, maternal nutritional status, infection, and breastfeeding patterns can also affect the incidence of anemia in infants. Therefore, although MP-ASI zero waste shows a protective relationship against anemia, anemia Prevention still requires a comprehensive and multidimensional approach.

The implications of this study indicate that nutrition education to parents needs to be improved, especially regarding the preparation of nutritious MP-ASI by utilizing local food ingredients and zero waste principles. Posyandu and counseling programs at Puskesmas can be an effective means to increase parents' knowledge in providing healthy, diverse, and appropriate complementary feeding for babies.

Overall, the results showed that the pattern of environmentally friendly complementary feeding has the potential to be an effective strategy in the Prevention of anemia in infants aged 6-12 months. The combination of using local food ingredients, efficient food processing, and nutrition education can help improve the quality of infant intake and reduce the risk of anemia. These findings support the application of sustainable nutrition approaches in Community Child Health Programs.



CONCLUSIONS

The results showed that the majority of infants in Puskesmas Situjuh received complementary feeding with an environmentally friendly pattern, where 64% of respondents had applied the principle of zero waste in complementary feeding. Bivariate analysis showed a significant relationship between patterns of environmentally friendly complementary feeding with the incidence of anemia in infants. Infants who received zero waste complementary feeding had a lower risk of anemia than infants who did not apply the pattern (OR = 0.45; 95% CI: 0.21–0.93; $p = 0.015$). These findings indicate that the provision of efficient, nutritious complementary feeding, and utilizing local foodstuffs has the potential to be an effective strategy in the Prevention of anemia in infants aged 6-12 months.

The implementation of the zero waste principle in complementary feeding not only supports meeting the nutritional needs of infants, especially iron and other micronutrients, but also encourages sustainable nutrition practices at the household level. Utilization of local food ingredients, efficient food processing, and reduction of food waste can help families provide healthy, diverse, and high nutritional value foods for babies. These findings reinforce the importance of a sustainable nutrition approach in supporting children's health and Family Food Security. The results of this study also provide prospects for the development of community-based nutrition education programs, especially through Posyandu activities and counseling at Puskesmas. Education to parents about the preparation of MP-ASI zero waste can be directed to the use of local food, menu variations, hygienic food processing, as well as meeting the needs of baby iron. With this approach, the practice of healthy and environmentally friendly complementary feeding is expected to be applied more widely in the community. In addition, the results of this study can be the basis for the development of further studies related to the effectiveness of the application of zero waste MP-ASI on the nutritional status and health of infants in the long term. Subsequent research may develop interventions based on nutrition education, local food diversification, and iron supplementation to see their impact on reducing the prevalence of anemia.

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