

# FISH-BASED COMPLEMENTARY FEEDING PRACTICES INCREASING MACRO AND MICRO NUTRITION INTAKE AND HEMOGLOBIN LEVELS IN ANEMIA TODDLERS

Bustami<sup>1\*</sup>, Suryana<sup>2</sup>, Dini Junita<sup>2</sup>, Andi Eka Yuniarto<sup>3</sup>

<sup>1</sup>Informatics Engineering Study Program, Faculty of Engineering, Universitas Malikussaleh, Lhoksumawe, Indonesia

<sup>2</sup>Undergraduate Study Program in Applied Nutrition and Dietetics, Poltekkes Kemenkes Aceh, Banda Aceh, Indonesia

<sup>3</sup>Medical Education Study Program, Faculty of Medicine, Universitas Lampung, Bandar Lampung, Indonesia

\*E-mail: busabiel@gmail.com

## ABSTRACT

Iron deficiency anemia in toddlers can be prevented by introducing complementary foods alongside breastfeeding. Fish, rich in protein and iron, offers a valuable nutritional source for young children, but proper processing is crucial. This research investigated the impact of fish-based complementary food processing practices (known as MP-ASI in Indonesia) on the nutritional intake and hemoglobin levels of children under five in Tiro District, Pidie Regency. Using a quasi-experimental design, this study involved 40 toddlers from the stunting-prone area of Tiro District, Pidie Regency, along with their mothers as respondents. The toddlers, aged 12-36 months without severe illnesses, were included in the study. The intervention comprised educating and practicing complementary food processing. Before-and-after intervention comparisons showed significant improvements in energy, carbohydrate, protein, zinc, and iron intake levels. Additionally, there was a notable increase in the average hemoglobin (Hb) level, rising by 1.06 g/dl after one month of fish-based complementary food processing intervention. In summary, this intervention effectively enhanced the nutritional quality of children's intake and increased their hemoglobin levels, contributing to the prevention of iron deficiency anemia in toddlers.

**Keywords:** anemia, nutritional intake, hemoglobin, fish consumption, education

## INTRODUCTION

One of the priorities of the Program Indonesia Sehat through a Family Approach is reducing the prevalence of stunting. Stunting (low height for age) affects about a quarter of children aged <5 years worldwide (Gharpure et al., 2021). The problem of stunting in toddlers is the main nutritional problem faced in Indonesia.

According to SSGI 2022, Indonesia has a stunting prevalence of 21.6%. This figure is still above the threshold set by WHO, which is 20%. Based on national data, Aceh Province is ranked 5th in the highest prevalence of toddlers after East Nusa Tenggara Province and West Sulawesi Province. The success that the Aceh Government has achieved in reducing the stunting rate from 41.5% in 2013 to 37.3% in 2018 to 31.2% in 2022 (Kemenkes RI, 2014, 2018, 2022).

Stunting is a condition where children under five have a low height for their age. Stunted children experience malnutrition, which affects the maturity of nerve cells. Stunted children experience abnormal developmental delays such as slow motor movements, reduced intelligence, and slow social responses (Rosyidah et al., 2021). Several factors influence stunting, namely the age of the child, family size, number of children under five years in the household, wealth status, source of drinking water, eating habits, and food insecurity (Mengesha et al., 2021).

Previous studies stated that eating habits are one of the factors related to the incidence of stunting (Mulyaningsih et al., 2021). Eating habits affect the nutritional intake of stunted children. Hendraswari et al., pada tahun 2021 found that the intake of macronutrients such as energy and

protein intake is the main factor influencing the incidence of stunting. In addition, low iron is also a factor associated with stunting. Stunted toddlers generally have lower hemoglobin levels than toddlers who are not stunted (Flora et al., 2019; Losong & Adriani, 2017).

Nutrient intake for stunted toddlers can be done by providing additional food as a complementary food for breast milk. Providing additional food can increase nutritional intake, especially increasing hemoglobin levels (F. Wang et al., 2017; J. Wang et al., 2017). One additional food source of iron is derived from animal food sources (H.J. et al., 2011). Fish is a source of animal food with good nutritional content, especially a source of protein and iron (Safitri & Puspita, 2018; Syahril et al., 2016). Fish can also be used as a variety of innovative products such as biscuits, food bars, and cookies to address the problem of malnutrition, especially stunting, which can improve malnutrition status in children under five (Darawati et al., 2021; Susyani et al., 2022; Yuliana et al., 2019).

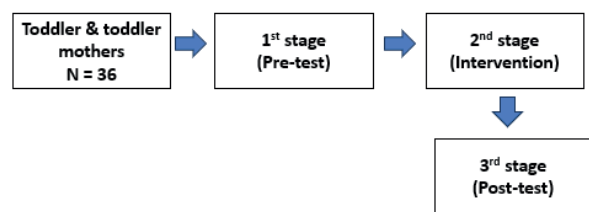
Based on this, the authors conducted this study to analyze the effect of fish-based complementary breastfeeding (in Indonesia: MP-ASI) processing interventions on the intake of macronutrients (Carbohydrate, protein, fat) and micronutrients (Vitamin A, C, calcium, zinc, and Fe) also Hemoglobin of toddlers. This activity was carried out in the stunting locus area designated as a sub-district with a high category of nutritional problems in Aceh, namely Tiro District, Pidie Regency.

## METHOD

This type of research used a Quasi-Experimental one-group pretest-posttest design, where the research design was to compare before and after the intervention was given. This research was conducted in the Stunting Locus area, Tiro District, Pidie Regency, in July-August 2022.

The initial stage of this research was sampling, such as selecting villages, posyandu (an integrated health center), and households. The research subjects consisted of toddlers aged 12-36 months in the stunting locus area, Tiro District, Pidie Regency. There were 5 locus of stunting villages in the working area of the Tiro Health Center, namely

Pulo Masjid Village, Peuneudok Village, Pulo Siblah Village, Panton Beunot Village, and Panah Village. Sample calculations in this study using the Lemeshow formula obtained a minimum number of 36 people. Furthermore, respondents were taken by consecutive sampling by taking toddlers who met the inclusion criteria and obtained a total of 40 samples. Subject/sample inclusion criteria were toddlers aged 12-36 months, not currently seriously ill, their mothers, or respondents willing to participate in research activities up to signing informed consent.



**Figure 1.** Research Stages

This research consisted of several stages: pretest/baseline, intervention I and II, and posttest (Figure 1).

1. Stage I, namely baseline data or pretest. At this stage, baseline data were collected, including data on household socioeconomic characteristics, subject characteristic data, macronutrient intake data (carbohydrates, protein, fat), and micro (Vitamins A, C, calcium, zinc, and iron) from subjects taken through 24-hour food recall method for toddlers. Meanwhile, data on blood hemoglobin levels were known in the fingertip capillaries using the digital easy touch method.
2. Stage II, the intervention was carried out 2 times during 1 month, 2 times 45 minutes each. The interventions carried out were in the form of nutritional counseling and behavior change practices in the form of processing fish-based complementary breastfeeding with demonstrations of processing fish-based complementary breastfeeding under the rules or principles of processing complementary breastfeeding for toddlers (guide in the recipe book). At the same time, the practice of processing fish-based complementary breastfeeding which was practice, was The practice of processing fish was carried out following the recipes contained in the recipe pocketbook. Nutrition education intervention

steps for respondents and posyandu cadres are as follows:

- a. Team opening
  - b. Administration of questionnaires before intervention
  - c. Collecting completed questionnaires
  - d. Explanation of material by the research team or resource persons, including 1) IYCF (Toddler Feeding); 2) problems of stunting and anemia; 3) the importance of fish in the growth and development of toddlers and fish-based complementary breastfeeding processing. Explanation of material using lecture and discussion methods using infocus tools, leaflets, and posters.
  - e. The team's practice of processing fish-based complementary breastfeeding included processing fish-based complementary breastfeeding menus high in nutrients to support growth and increase blood hemoglobin levels to prevent stunting and anemia. All participants would be given a fish-based complementary breastfeeding processing recipe book and leaf leads related to anemia in children under five.
3. The next stage was the posttest. The posttest stage consisted of collecting data on macronutrient intake (carbohydrates, protein, fat) and micronutrient intake (Vitamins A, C, calcium, zinc, and iron), blood hemoglobin levels in fingertip capillaries using the digital easy touch method.

The nutrient intake data collected was first converted to weight in grams, then the nutritional content was calculated, such as energy (kcal), protein (grams), fat (grams), calcium (grams), iron (mg), vitamin C (mg), and vitamin A ( $\mu\text{g}$ ) using the Nutri-Survei 2007 program software. Then, it was compared with the nutritional adequacy figures for each toddler.

Microsoft Excel 2007 and SPSS 16.0 for Windows were used to analyze data descriptively and inferentially. Before testing the data in SPSS, the data normality test was first performed using the Kolmogorov-Smirnov test. The test for differences in normally distributed numerical data uses Paired T Test analysis to analyze the differences before and after the intervention of fish-based complementary breastfeeding processing practices on the adequacy of macro and micro-nutrients and hemoglobin levels of children under

five. Commission on Research Ethics Involving Human Subjects Number: LB.01.03/6/5621/2022.

## RESULTS AND DISCUSSION

The sample characteristics in this study consisted of age, gender of the toddler, birth weight and height, and health history (Table 1). The sample in this study were toddlers aged 12 months to 36 months who were selected to meet the criteria, namely as many as 40 people. Most of the toddlers are in the age range of 12-24 months, namely 80.0%, male (60.0%), do not have LBW (Low Birth Weight) status (92.5%), and with birth length  $>45$  cm (57.5%).

Children with birth weight lower than 2,500 g had a 5.9 times the risk of becoming stunted compared to children born weighing more than 2,500 g ( $p < 0.05$ ; 95% CI: 0.93–37.8). Furthermore, children with birth length below 48 cm (short) had a 15.0 times higher risk of experiencing stunting ( $p < 0.05$ ; 95% CI: 2.58–87.9) compared to children born with body length over 48 cm (Lukman et al., 2021). The child's birth weight and birth length are greatly influenced by the nutritional status and health of the mother before and during pregnancy, which affects the growth and development of the fetus during the neonatal period. Birth weight and length are closely related to the child's growth after birth. It was further explained that newborns with low birth weight have a higher risk of death in the first 28 days of life. Surviving people are more likely to suffer from stunted growth and lower IQs (Barker, 2007).

**Table 1.** Distribution of Toddler Characteristics

Toddler Characteristics	Number of toddlers	%
<b>Age</b>		
12-24 months	32	80.0
25 -36 months	8	20.0
<b>Gender</b>		
Male	24	60.0
Female	16	40.0
<b>LBW status</b>		
LBW ( $\leq 2500$ g)	3	7.5
Not LBW ( $>2500$ g)	37	92.5
<b>Birth length</b>		
$\leq 45$ cm	17	42.5
$>45$ cm	23	57.5

Intake of essential nutrients is related to the need for adequate health. The intake needs for several nutrients that must be met come from the food consumed. Nutritional adequacy is a comparison between nutritional needs and the intake of a particular individual or population, expressed as a percentage of recommended nutritional adequacy (Damara & Muniroh, 2021; Yuniar & Mahmudiono, 2022).

The sample nutrient intake data in this study were compared with the Nutrition Adequacy Rate based on the age of each toddler. The results obtained can be seen in Table 2.

**Table 2.** Average Adequacy Level of Energy and Other Nutrients Samples Before and After Intervention

Adequacy level	Pretest		Posttest		p-value
	Mean	SD	Mean	SD	
Energy (%)	43.3	18.75	60.9	14.2	0.00*
Carbs (%)	31.4	14.4	46.5	17.5	0.00*
Protein (%)	136.6	54.30	162.3	43.9	0.02*
Fat (%)	55.3	32.8	56.0	32.6	0.89
Vit A (%)	149.6	247.6	113.4	182.8	0.36
Vit C (%)	16.9	24.8	25.3	24.8	0.15
Calcium (%)	38.0	34.9	48.20	48.2	0.06
Zink (%)	94.6	54.4	122.0	50.9	0.00*
Fe (%)	52.1	27.3	66.8	32.5	0.00*

Table 2 shows the level of nutritional adequacy of the toddler samples in the study, most of whom were deficient or lacking, below 70% compared to the Nutrition Adequacy Rate. Only the average protein, vitamin A, and zinc values showed good results. The Paired T-test tests showed significant differences in the mean values before and after the intervention on the level of adequacy of energy, carbohydrates, protein, zinc, and iron. While the rest are not significantly different.

Fish is a source of animal food which is rich in nutrients. As a highly nutritious food, fish consumption is highly recommended for children for normal growth and development (Maulu et al., 2021). Fish has a high protein content with complete amino acids, so it can be developed as a good additional food for toddlers (Kadir, 2021). The high nutritional content in fish is

protein, calcium, oleic, palmitic, linoleic, and stearic acids. The highest amino acids are aspartic acid, glutamic acid, arginine lysine, and leucine (Nuryanto et al., 2022). Besides that, fish is also rich in micronutrients such as vitamins and minerals. Complementary foods substituted with fish have higher vitamin A and zinc content than complementary foods not mixed with fish (Hope et al., 2021).

Foods of animal origin derived from water, such as fish, can provide important nutrients and bioactive factors for human health. Animal food sources in the form of fish contain many nutrients such as docosahexaenoic acid [DHA], choline, vitamin B12, iron, and zinc. (Iannotti et al., 2022). Previous studies have shown that there is an increased effect of giving fish to anemic toddlers with a frequency of consumption of 7 times a week can improve the anemia status of children with indicators of increased blood profile in the form of ferritin, serum transferrin, and Hb. The existence of nutrition education interventions and fish-based complementary breastfeeding processing practices in this study can encourage mothers of toddlers to increase giving fish to their children. Intervention in giving fish to children who are anemic affects higher Hb repair and lower serum transferrin (Werner et al., 2022).

### Hemoglobin levels

Test toddlers' Hb levels were measured twice before and after providing educational interventions and fish-based complementary breastfeeding processing practices. In Table 3, it can be seen that most of the samples of toddlers had anemia status, both before (87.5%) and after the intervention (77.5%). However, several samples showed a slight decrease in anemia status after providing nutritional education interventions and fish-based complementary breastfeeding processing practices.

**Table 3.** Anemia Status and Average Hb Levels of Samples Before and After Intervention

Anemia Status	Pretest		Posttest	
	n	%	n	%
Anemia	35	87.5	31	77.5
Not Anemia	5	12.5	9	22.5

Micronutrient deficiencies and stunting are significant problems in most children aged 6-59 months. The average Hb level of the samples before and after the intervention was in the low or anemia category (Ernawati et al., 2021). The incidence of anemia in stunted children is largely due to low consumption of animal foods (Mohammed et al., 2019). The average Hb level before the intervention was 8.64 g/dL and increased to 9.70 g/dL after the intervention. There was an increase in the average Hb level after giving counseling interventions and fish-based MP-ASI processing practices for 1 month of 1.06 g/dL. Even though there was an increase in posttest Hb levels, the average Hb level was in the anemia category.

**Table 5.** Average Hb Levels of Samples Before and After Intervention

Hb Level	Mean	SD	Mean	SD	p-value
Hb level	8.64	2.40	9.70	1.51	0.00*

The results of the different tests in this study used the Paired T-test. Table 4 shows a significant difference in the mean values of pretest and posttest Hb levels ( $p=0.000$ ;  $p>0.05$ ) before and after receiving nutritional education interventions and fish-based complementary breastfeeding processing practices. Anemia and stunting are closely related to a synergistic improvement in child health (Gaston et al., 2022). Previous studies have shown that most stunted children have a significant relationship with high anemia status (Rahman et al., 2019). Anemia is a comorbid factor in stunting that negatively impacts later life (Orsango et al., 2021). High anemia status in stunting toddlers is associated with increased cognitive abilities and lower physical growth of children (Orsango et al., 2021; Tampy, 2020). Demographic, socioeconomic, and geographic characteristics are also important drivers of stunting and anemia in children under 5 years (Gaston et al., 2022).

Factors of nutritional status and health can cause anemia in children. Malnutrition may not be directly related to anemia, but it leads to certain changes in the body that make it susceptible to health hazards that can cause anemia. Children and women who suffer from malnutrition are more likely to have a weaker immune system, making

them susceptible to various diseases and health hazards such as parasitic infections or chronic inflammation. Conditions like this can reduce hemoglobin levels in the blood, which causes an increase in the prevalence of anemia (Lukman et al., 2021). Stunted children of anemic mothers are at high risk for anemia (Lukman et al., 2021). This is explained based on certain factors that influence anemia and stunting. For example, mothers and children can have a healthy diet and access to micronutrient food sources rich in iron. Apart from that, they share the same things in the environment, have access to the same health facilities, and tend to have the same genetic characteristics. To overcome the problem of anemia in children, it is vital to design programs that target mothers and children. Empowering women or mothers of toddlers is one way to reduce the high prevalence of anemia and malnutrition in toddlers (Lukman et al., 2021).

## CONCLUSION

There were significant differences in the average energy, carbohydrate, protein, zinc and iron intake values before and after the intervention. Increased energy intake, carbohydrates, protein, zinc, and iron were obtained after administering the intervention. There was an increase in the average Hb level after giving counseling interventions and fish-based complementary breastfeeding processing practices for 1 month of 1.06 g/dL. Further studies are needed with larger subjects and an extended number of intervention days to see the impact on anemia status.

## ACKNOWLEDGEMENT

This research was funded by Non-Tax State Revenue Funds (PNBP) in the Budget Execution List (DIPA) of Malikussaleh University for the 2022 Fiscal Year.

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