

RESEARCH STUDY

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The Efficacy of Complementary Foods Instant *Kanji rumbi* Porridge on Increasing Hemoglobin Levels and Reducing Anemia Status in Underweight Toddlers

Efikasi Makanan Pendamping Bubur *Kanji rumbi* Instan dalam Meningkatkan Kadar Hemoglobin dan Menurunkan Status Anemia pada Balita Berat Badan Kurang

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ABSTRACT

Background: Cases of underweight and anemia in Acehnese toddlers are high, requiring urgent intervention. A viable alternative is local food-based supplemental feeding, using high-protein and iron-rich meals. One of the examples is the innovative instant *kanji rumbi* porridge, which is made from Aceh's local protein sources.

Objectives: The study aimed to analyze the effect of instant *kanji rumbi* porridge on hemoglobin (Hb) levels and the anemia status of underweight toddlers through a cluster-randomized control trial design.

Methods: The study was conducted in three community health centers in Aceh Besar district and 15 posyandu (integrated service posts) clusters. 46 subjects selected based on the inclusion and exclusion criteria (23 in the intervention group and 23 in the control group). The intervention of instant *kanji rumbi* porridge was administered for 3 months, with each participant consuming it twice daily.

Results: The instant *kanji rumbi* porridge intervention was successful in reducing the anemia rate from 92.3% of anemic toddlers at baseline to 60.7% by the end of the study. The consumption of instant *kanji rumbi* porridge significantly increased the energy and nutrient intake of the toddlers both before and after the intervention, as well as within the intervention groups. All groups exhibited an increase in Hb levels; however, the rise in the intervention group was substantially greater than that in the control group (p-value=0.013).

Conclusions: Instant *kanji rumbi* porridge has the potential to be used as a complementary food for toddlers to increase macro and micronutrient intake, especially iron, hence elevating hemoglobin levels and reducing anemia in this age group.

INTRODUCTION

The toddler phase is an advanced phase from infancy, when a child is aged more than 12 months to 59 months. The health of toddlers is important to consider because, during this phase, physical and mental growth and development occur rapidly. The health that needs to be considered is the prevention of infection, the feeding of infants and children, and nutrition for breastfeeding mothers. The problem of toddler nutrition is still concerning, based on data from the 2014 Survey Diet Total (SDT), there are still 48.9% of toddlers who have energy intake less than the recommended Energy Adequacy Rate (70%–<100% AKE) and 6.8% of toddlers have very less energy intake (<70% AKE). In addition, 23.6% of toddlers had protein intake less than the

recommended Protein Adequacy Rate (<80% AKP). Based on SSGI 2022, 17.1% of Indonesian children are underweight. Aceh Province has the third highest rate of underweight toddlers, with a prevalence of 24.3%, while in Aceh Besar district, underweight toddlers are at 28.2%, which is far above the national value¹. Aceh is also one of the provinces with a very high rate of anemia in children under five, reaching 67.8%². The evidence shows that toddlers are at higher risk of iron deficiency (ID) and iron deficiency anemia (IDA) compared to newborns aged 0-6 months³. Anemia is a severe public health problem with a prevalence of ≥40%⁴.

The high number of anemia problems in toddlers is related to the increasing nutritional needs of iron intake during the rapid growth phase, along with the

depletion of iron reserves at birth⁵, as well as changes in diet⁶. During the early age of life (0-6 months), the consumption of breast milk can provide a large amount of energy and nutrients, but in the second year of life, not all nutrients can be fulfilled, especially energy, iron, and protein, which are more needed from MP-ASI⁷. Consequently, supplementary feeding is intended to fulfill the requirements for macronutrients and micronutrients, including iron, which is essential for sustaining hemoglobin levels^{8,9}.

The food-based strategy has demonstrated to be safe and effective for overcoming iron and other micronutrient deficiencies in the general population, including children aged 6 to 24 months¹⁰. Porridge is a toddler complementary food cereal that is often used as a fortified food and is a potential strategy to reduce the burden of iron deficiency anemia in children aged 6-23 months¹¹. The main source of Fe or iron comes from animal products such as eggs, fish, meat, and their food products¹². Utilization of high protein and iron in complementary food for toddlers in various innovative products can be carried out so that it can be used for practical intervention of nutritional problems in toddlers. A local Acehnese food that has been innovated into complementary food products is quail eggs in the making of instant *kanji rumbi* porridge¹³. The protein and micronutrient content, particularly iron, in instant *kanji rumbi* porridge may enhance the nutritional status of underweight toddlers^{14,15}. This study was conducted to assess the effect of instant *Kanji rumbi* porridge consumption on Hb levels and anemia status in underweight toddlers.

METHODS

Study Design and Setting

The study design was a cluster-randomized control trial. The study was conducted in three health centers in Aceh Besar district, which are Ingin Jaya Health Center, Simpang Tiga Health Center, and Mesjid Raya Health Center. The three health centers formed 15 posyandu clusters for the study. The list of underweight nutritional status of children aged 12-24 months, with names and demographics were collected based on the prevalence of underweight toddlers $\geq 10\%$ obtained from the Aceh Besar District Health Office's e-PPGBM data (Community Based Nutrition Recording and Reporting

online application system). The data obtained were confirmed with the respective puskesmas nutrition assistants (TPGs). Each cluster had 6 to 9 eligible underweight toddlers, with a total of 80 underweight toddlers. The health centers were randomly assigned to one of two intervention groups: 1) Complementary Feeding of Instant *Kanji rumbi* Porridge (CFP group); 2) Control group (CG group). We used a random number table to determine the samples between the intervention groups. All toddlers in any group received the same intervention. The study was conducted in June to August 2024. Figure 1 shows the subjects enrolled until the final analysis.

Sample and Sampling Methods

The subject of this study is underweight children aged 6-12 months who were selected by random sampling according to the inclusion and exclusion criteria based on the sampling frame obtained from the selected posyandu. Subject inclusion criteria consisted of 1) toddlers aged 12-19 months; 2) underweight (Weight-for-Age z-score index or $-3.0 \leq WAZ < -2.0$); 3) not sick or have congenital diseases; and 4) willing to participate in this study by signing informed consent. Subjects were excluded if they were allergic to the ingredients used in the porridge products and were involved in other interventional studies. The minimum sample was calculated based on the mean increase in Hb levels from 10.0 until 11.45 [13]. The confidence level was set at 95%, and the predicted precision of 10%, involving 20 subjects per group. To account for a 20% dropout rate, each treatment group required a minimum of 22 subjects.

For the chemical analysis, CuSO₄, H₂SO₄, HCl, Na₂CO₃, petroleum ether, and NaOH were required. Proximate analytical tools (content of water, ash, fat, protein, and carbohydrates). The equipment used for proximate tests includes an Erlenmeyer flask, distillation flask, bracket glass, glass funnel, Buchner funnel, burette, separating funnel, long-necked measuring flask, measuring cylinder, condenser, filler, measuring pipette, volumetric pipette, dropper, stirrer, test tube, spatula, desiccator, universal indicator, filter paper, tripod, wire gauze, test tube rack, clamp, stirrer, crucible, evaporating dish, clamp and stand, heater, hit plate, oven, furnace, and incubator.

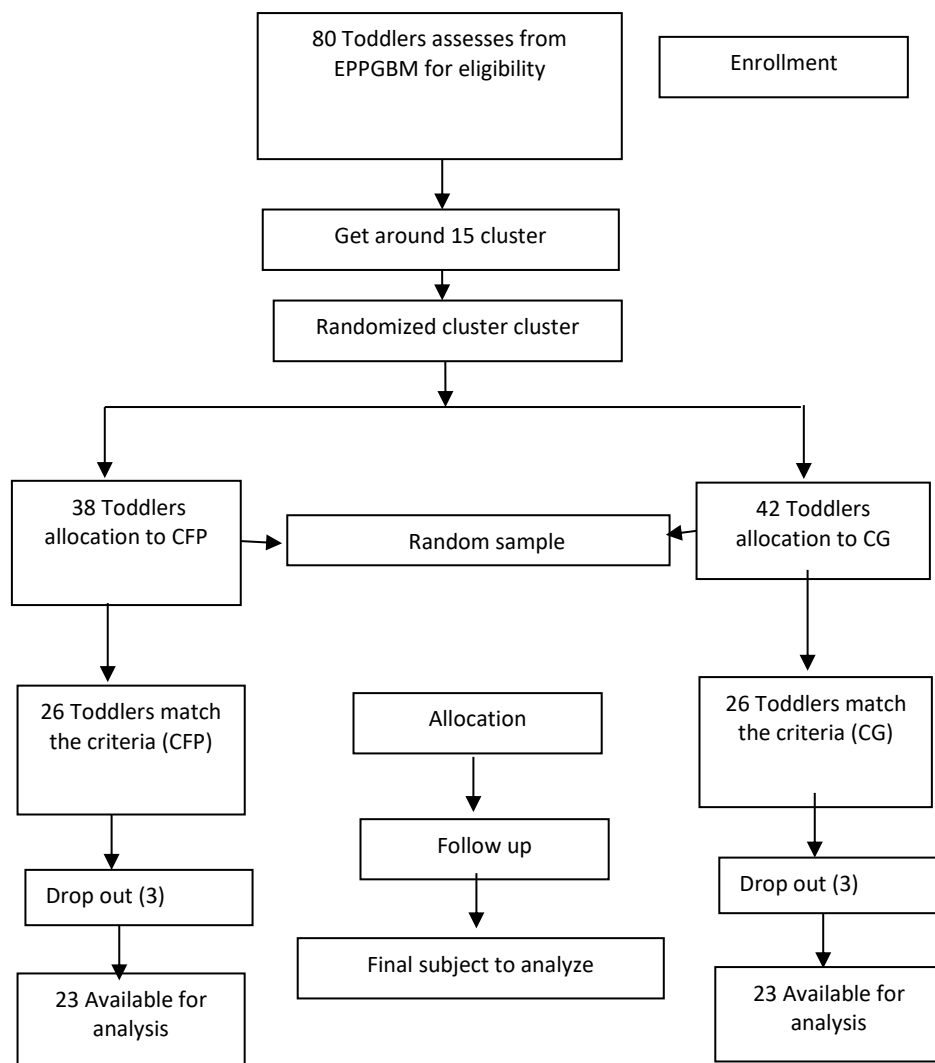


Figure 1. Flowchart of the subject enrolled to the final analysis

Baseline Assessment

The toddlers who had been registered as research subjects were collected at the posyandu to collect baseline data, which included socio-demographic characteristics, food consumption data, and anthropometric measurements, and assessment of blood hemoglobin levels. Baseline data collection was carried out by trained nutritionists, while the assessment of Hb levels was carried out by a team of analysts from the Aceh Ministry of Health Polytechnic. Maternal and Child Health (MCH) books were used as a tool to detect children's age. Children's weight was evaluated and documented using national standard Gea Medical digital scales, while blood Hb level were measured using Dr. Family's equipment. All equipment was calibrated in advance of the measurement.

Technical Intervention

Making *kanji rumbi* porridge in its fresh form first, followed by its instant version, is the first step in the procedure. Figure 2 illustrates how to make quick *kanji rumbi* porridge. It is evident that there are several steps involved in creating quick fresh *kanji rumbi* porridge. (1) using a steam jacket to boil rice until the water reduces (nearly creating porridge); (2) using a Teflon frying pan to sauté chicken meat with fine spices and coarse herbs until the meat is tender; (3) using a steamer to cook potatoes and carrots until they are tender; (4) making porridge by re-boiling all the ingredients A smooth slab of instant *kanji rumbi* porridge is created by; (5) utilizing a drum dryer to dry fresh *kanji* porridge (T outlet: 90°C, T inlet: 130°C, speed: 10 rpm); and (6) combining instant *kanji rumbi* porridge with quail egg flour¹⁴.

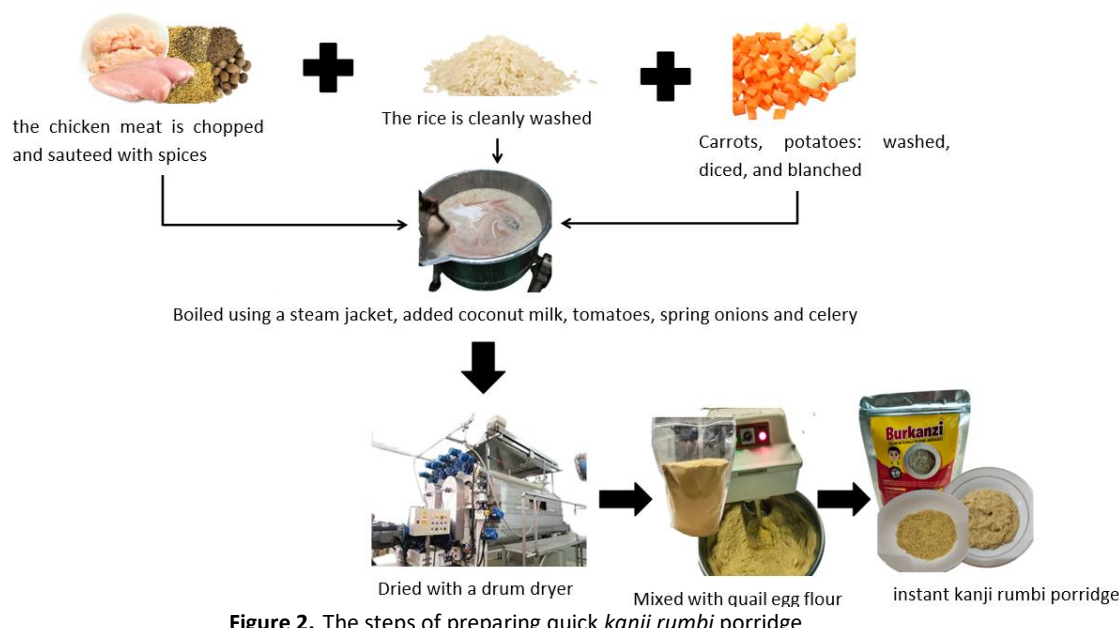


Figure 2. The steps of preparing quick *kanji rumbi* porridge

Instant *kanji rumbi* porridge is the result of the development of complementary food snacks for children aged 12-23, according to children's acceptability and nutritional needs. The instant *kanji rumbi* porridge, which will be intervened, is packaged in aluminum foil, containing 5 serves per box. The nutritional content of *kanji rumbi* porridge per serving is 113 cal energy, 5.06 g protein, 1.04 mg iron, and 43.91 mcg vitamin A. To ensure that the standard dosage is met, it is advised to consume instant *kanji rumbi* porridge twice daily. The serving dose follows the requirements for the feeding of complementary food snacks for children aged 12-23 months, which is a minimum of 160 kcal of energy¹⁴. Nutritional information and serving procedures are on the packaging of instant *kanji rumbi* porridge.

The implementation of the intervention for feeding instant *kanji rumbi* porridge was conducted by trained cadres. The intervention of instant *Kanji rumbi* porridge was carried out for 3 months, with feeding 5 days per week. Instant *kanji rumbi* porridge that will be distributed to subjects is stored in each posyandu in the study area, and once a week is distributed by home visits. One cadre will monitor every 5-6 subjects.

Follow-Up Measurement

Every week, trained health workers visit all toddlers and mothers to monitor and reinforce adherence to the intervention program. Supervisors or researchers met with cadres once a week to evaluate the implementation of the intervention, explore constraints, and provide support in the implementation of the intervention, and refresh cadres on the intervention. To monitor the intervention process, cadres, supervisors and researchers, and mothers/caregivers made daily

activity reports in logbooks. Compliance with the consumption of instant *kanji rumbi* porridge was assessed using the instant *kanji rumbi* porridge consumption compliance form.

Ethics Approval

This study was authorized by the Health Polytechnics of Aceh Advanced Study Research Board (reference number: No Dp.04.03/12.7/078/2023) on July 28, 2023. The parents or guardians of the children who took part in the study gave their written informed consent.

Statistical Analysis

The normality and skewness of the data were evaluated. An independent t-test was employed to compare outcome measures between the intervention and control groups, while a paired Student t-test was employed to evaluate outcome measures within intervention groups prior to and following the intervention. We employed a 95% Confidence Interval (CI) for all statistical tests and p-value<0.05 was deemed statistically significant. The analyses were conducted using SPSS version 26 (IBM, New York, USA).

RESULTS AND DISCUSSIONS

Socio-Demographic Characteristics of Families and Underweight Toddlers

Table 1 displays the distribution of samples based on the subjects' characteristics between the intervention groups. This study had a total of 46 toddlers exhibiting undernutrition status, consisting of 23 in the intervention group with instant *kanji rumbi* porridge and 23 in the control group.

Table 1. Frequency distribution of characteristics of underweight toddlers in Aceh

Subject and Respondent Characteristics	CFG n (%)	CG n (%)	p-value
Gender			
Male	12 (52.2)	13 (56.5)	0.562
Female	11 (47.8)	10 (43.5)	
Child's Age			
12-18 Month	13 (56.5)	14 (60.9)	0.369
19-24 Month	10 (43.5)	9 (39.1)	
($\bar{x} \pm sd$)	17.00 $\pm$ 3.67	17.65 $\pm$ 3.12	
Birth Weight			
Low Birth Weight ($\leq$ 2500 g)	2 (8.7)	3 (13.1)	0.320
Normal ($>$ 2500 g)	21 (91.3)	20 (86.9)	
($\bar{x} \pm sd$)	2878.26 $\pm$ 534.24	3021 $\pm$ 426.35	
History of Acute Respiratory Infection (ARI)			
Yes	5 (21.7)	4 (17.4)	0.718
No	17 (73.9)	18 (78.2)	
History of Diarrhea			
Yes	3 (13.0)	3 (13.0)	1.00
No	20 (87.0)	20 (87.0)	
Mother's Age			
25-28 Years Old	11 (45.8)	10 (41.7)	0.733
29-32 Years Old	6 (26.1)	7 (29.2)	
$\geq$ 33 Years Old	6 (26.1)	6 (26.0)	
($\bar{x} \pm sd$)	29.34 $\pm$ 4.29	30.26 $\pm$ 5.36	
Mother's Education			
$\leq$ Elementary School	1 (4.3)	3 (13.0)	0.511
Junior High School	5 (21.7)	5 (21.7)	
Senior High School	11 (47.8)	9 (39.1)	
University	6 (26.1)	6 (26.1)	
Mother's Occupation			
Not Working/Housewife	16 (69.6)	18 (78.2)	0.737
Working	7 (30.4)	5 (21.8)	
Family Income			
Below the Regional Minimum Wage	18 (78.3)	16 (69.6)	0.513
Above the Regional Minimum Wage	5 (21.7)	7 (30.4)	
($\bar{x} \pm sd$)	11.50 $\pm$ 9.19	11.50 $\pm$ 6.36	
Number of Family Members			
Small ($\leq$ 4 People)	13 (56.5)	13 (56.5)	1.00
Medium (5-6 People)	9 (39.1)	9 (39.1)	
Large ($\geq$ 7 People)	1 (4.4)	1 (4.4)	
($\bar{x} \pm sd$)	4.30 $\pm$ 1.25	4.34 $\pm$ 1.19	

CFG=Instant *Kanji rumbi* Porridge Group, CG=Control Group, n=Frequency, %=Percentage, *) Independent T-Test, Test for Differences between Groups

Statistical test results showed there was no difference in subject characteristics and family socio-demographic characteristics between intervention groups ($P > 0.05$). Therefore, we assumed that the subject characteristics and socio-demographic characteristics of the families in this study were homogeneous. The majority of toddlers in the intervention and control groups (CFG; CG) were aged 12-18 months (56.5% and 60.9%), and the average age of the study subjects in the control and intervention groups was 17 months. Most toddlers in both groups (CFG; CG) had a normal birth weight (91.3%; 86.9%). Subjects in the intervention group had an average birth weight of 2878.3 g, while the control group was 3021.0 g. The intervention group had a history of normal birth length (78.3%; 56.5%). Most of them did not have a history of acute respiratory infection (ARI) and diarrhea, but in the intervention group there were still

toddlers with ARI disease at 21.7%, while in the control group it was 17.4%. The proportion of toddlers with a history of diarrhea was the same in both the intervention and control groups, at 13.0%.

Energy and Nutrient Intake of the Subject

The energy and nutrient intake of toddlers in this study was measured by asking what they ate in the 24 hours before the intervention started (baseline) and on the last day of the intervention (endline) (Table 2). Based on the data processing results, there was no difference in the intake of the intervention group and the control group at baseline for energy, macronutrients (protein, fat, and carbohydrates), and micronutrients (vitamin A, vitamin C, zinc, iron). There were differences in the intake of the intervention and control groups for energy, macronutrients (protein, fat, carbohydrates) and

micronutrients (zinc and iron), while for micronutrients vitamin A and vitamin C in both groups were not significantly different. The intervention group had a higher intake of energy and macronutrients (protein, fat,

and carbohydrates), and micronutrients (vitamin A, zinc, and iron) than the control group, but there was no increase in vitamin C intake in the intervention group.

Table 2. Average energy and nutrient intake of underweight toddlers in Aceh

Energy and Nutrient Intake	CFG	CG	P ²
Energy (kal)			
Baseline	698.31±128.52	691.23±114.68	0.844
Endline	1029.28±144.77	733.10±163.48	0.000*
p ¹	0.000*	0.336	
Δ	330.96±145.54	41.86±204.19	0.000*
Protein (g)			
Baseline	19.47±4.82	19.55±4.68	0.962
Endline	35.07±4.18	21.55±6.20	0.000*
p ¹	0.000*	1.34	
Δ	15.60±4.93	2.00±6.18	0.000*
Fat (g)			
Baseline	23.08±6.29	21.52±7.21	0.441
Endline	34.43±5.71	23.42±7.58	0.000
p ¹	0.000*	0.348	
Δ	11.35±6.60	1.89±9.47	0.000*
Carbohydrates (g)			
Baseline	105.04±26.49	109.123±28.22	0.616
Endline	144.02±30.01	109.355±26.06	0.000*
p ¹	0.000*	0.976	
Δ	38.97±0.22	32.65±36.61	0.000*
Vitamin A (μg)			
Baseline	172.99±168.37	189.94±93.87	0.232
Endline	280.03±246.10	245.23±144.80	0.562
p ¹	0.050	0.110	
Δ	107.03±258.35	55.29±159.15	0.418
Vitamin C (mg)			
Baseline	19.34±22.82	15.43±11.67	0.469
Endline	14.90±17.60	15.59±13.34	0.881
p ¹	0.110	0.276	
Δ	-4.4319.04	0.16±17.47	0.398
Iron (mg)			
Baseline	3.98±2.25	3.77±1.62	0.729
Endline	7.03±2.55	4.09±1.80	0.000*
p ¹	0.000*	0.406	
Δ	3.05±1.54	0.31±1.76	0.000*

CFG=Instant *Kanji rumbi* Porridge Group, CG=Control Group, Δ=Difference, P¹=Paired Sample T-Test of Baseline and Endline Data, P²=Independent T-Test of between Group Data

Toddlers remain within the initial 1000 days of life, a critical phase for their intake of energy and nutrients essential for proper growth and development¹⁶. Toddlers can receive complementary food to support their nutrient intake. The Indonesian government is currently focusing on the fulfillment of complementary feeding based on local food¹⁷. The Indonesian complementary feeding category includes kanji porridge as one of its alternatives. This study showed that consumption of 3-month instant *kanji rumbi* porridge can significantly increase nutrient intake in toddlers, resulting in increased levels of energy, carbohydrates, protein, and fat. Energy and carbohydrates are derived from rice. Rice is the primary food of the Indonesian people.

It is essential to complement carbohydrate sources with other foods to achieve balanced nutrition, particularly in toddlers¹⁸. The sources of protein in *kanji rumbi* porridge are meat and eggs as animal protein¹⁹.

The use of eggs as raw materials were not only as a source of protein to increase body weight in underweight toddlers but also can have a positive impact on the motor skills in toddlers²⁰. The source of fat used in *kanji rumbi* porridge is coconut milk. Coconut milk is one of the types of vegetable fat. Previous research has shown that coconut milk can be given to toddlers and has a positive impact on underweight conditions²¹. In addition to macronutrient intake, consumption of instant *kanji rumbi* porridge significantly increases micronutrient intake, especially iron. The findings of this study demonstrate a substantial increase in Hb following the intervention and within the intervention groups. Providing food with micronutrients, including Fe has been shown to help reduce the risk of nutritional problems in toddlers²². The fulfillment of micronutrients in complementary feeding is crucial for the fulfillment of micronutrients in toddlers. The results of the Strategic Review of Food Security and

Nutrition in Indonesia show that Indonesia still experiences micronutrient deficiencies²³. Indonesia is presently facing a triple burden of malnutrition, characterized by issues of undernutrition, overnutrition, and micronutrient deficiencies²⁴. The main source of iron in this porridge is from additional protein derived from quail egg flour. In 100 g quail eggs contain as much as 3.65 mg of iron, which meeting the recommended nutritional adequacy rate (RDA) of 18.3%^{25,26}. During the toddler stage, iron is important for the development of the central nervous system as it plays role in brain energy metabolism, myelination, and neurotransmission²⁷.

Consumption Compliance of Instant *Kanji rumbi* Porridge

The level of consumption compliance is an indicator used to assess the subject's consumption of intervention products over 12 weeks using a compliance form that was filled out with the parents of the subject. The enumerator, who was assisted by posyandu cadres, was responsible for distributing and monitoring the compliance of product consumption. The compliance form was given every week; the form that had been filled in by the respondent was collected once a week to be handed over to the researcher. The subjects were asked to consume the product every day according to the dose of 50 g, which was divided into two times of consumption; the morning snack around 10:00-11:00 and the afternoon snack around 15:00-16:00. We used a measuring spoon for each feeding and the remaining product in the package for compliance assessment.

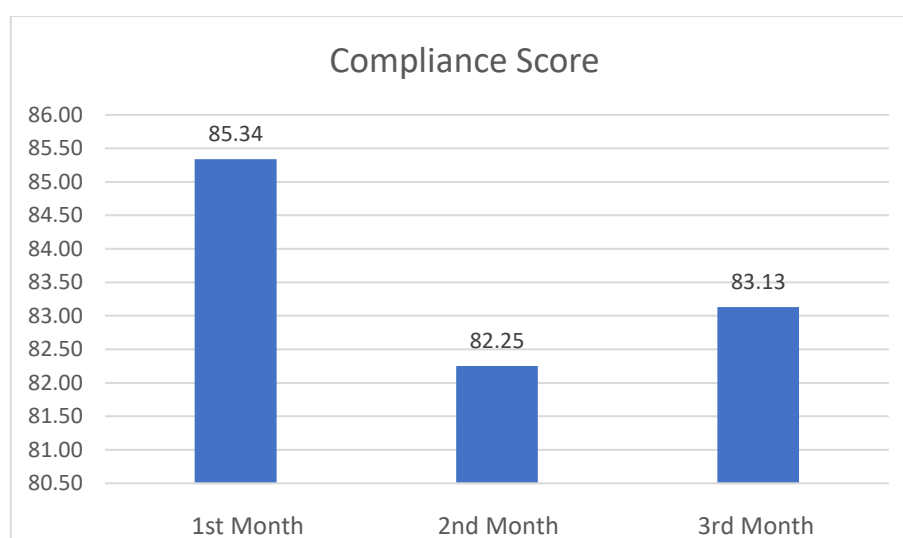


Figure 2. Compliance score for consumption of instant *kanji rumbi* porridge

The level of compliance for consuming instant *kanji rumbi* porridge was categorized into three: low, if compliance is <50%; moderate, if compliance is 50-70%; and high, if compliance is 70%. The average compliance scores for consuming instant *kanji rumbi* porridge per month over three months were 85.34%, 82.25%, and 83.13%, respectively, all falling into the high compliance category. The organoleptic aspect of the porridge was acceptable to the toddlers, and the mothers' cooperation in this research activities was very good.

Overview of Anemia Status of Subjects Before and After Intervention

The anemia status of the subjects in this study was determined based on the measurement of hemoglobin (Hb) levels in the blood samples of the toddlers. The subject is categorized as having anemia if

the Hb level in the blood sample is less than 11 g/dL and as not having anemia if it is equal to 11 g/dL. The result showed that anemia status in the intervention group was successfully decreased from 92.3% at the baseline of the study to 60.7% at the endline of the study, while in the control group there was an increase in anemia rates from 78.2% to 82.6%. The increase in anemia rates in the control group was caused by low iron intake from complementary feeding; the average iron intake of subjects from baseline to end line was below the nutritional adequacy rate (AKG). Children aged one year and older require elevated iron intake from complementary feeding due to the increased demand for iron during periods of rapid growth, along with the beginning of depletion of iron reserves established at birth⁵, as well as shifts in eating patterns⁶.

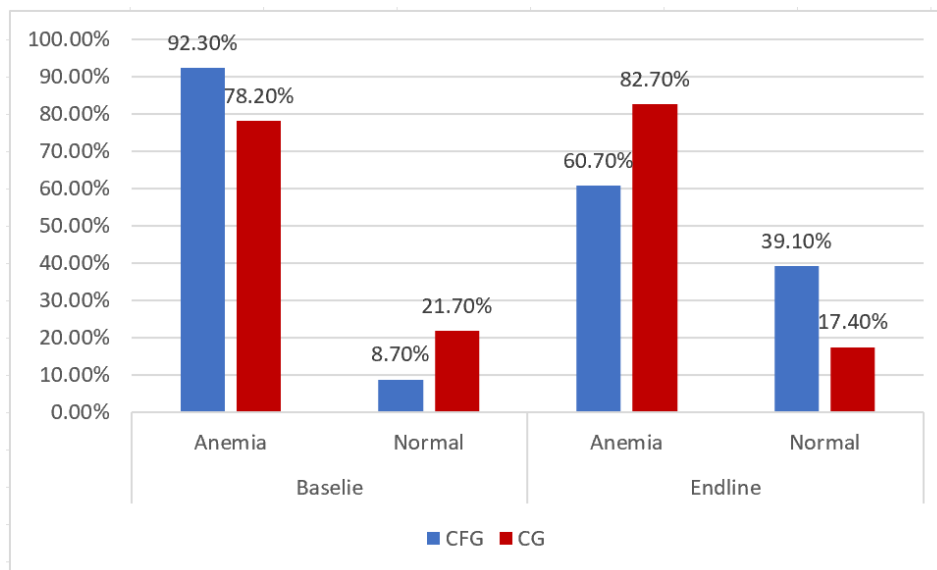


Figure 3. Anemia status of subjects between intervention groups before and after intervention

The Effect of Intervention on Hemoglobin (Hb) Level

Underweight in toddlers is a serious problem because it can impact their nutritional status and hemoglobin levels as a whole. If toddlers underweight, it implies that they are not receiving enough nutrients to support their growth and development²⁸. This can lead to a lack of essential vitamins and minerals, which in turn can affect their hemoglobin levels and overall health²⁹. Factors contributing to underweight in toddlers include inadequate food intake, poor feeding practices, and underlying health conditions such as malabsorption disorders or chronic infections³⁰. Underweight toddlers may also suffer from stunted growth, a weak immune system, and reduced cognitive function³¹. It is crucial for parents and caregivers to provide a balanced diet that is rich in nutrients to ensure that children can maintain a healthy weight and optimal hemoglobin levels for proper growth and development. One approach to increase hemoglobin levels and reduce anemia in children is through supplementary feeding. *Kanji rumbi* porridge is a local food commonly consumed by the people of Aceh. This study aims to examine the efficacy of giving instant *kanji rumbi* porridge in increasing hemoglobin levels and reducing anemia status in underweight toddlers. Instant rumbi kanji porridge is rich in iron due to its composition of diverse food sources, primarily rice, along with

supplementary ingredients such as chicken, quail egg flour, potatoes, carrots, tomatoes, and other additional ingredients consisting of coconut milk, coconut oil, shallots, garlic, nutmeg, coriander, fennel, cumin, star anise, cardamom, ginger, galangal, curry leaves, celery leaves, spring onions, and pandan leaves. Although the control group received no intervention, all groups received counseling and practiced processing child meals following WHO guidelines at the end of the session.

The results showed that there was no difference in the average Hb levels in the *Kanji rumbi* porridge intervention group and the group at the beginning of the study (baseline). The average Hb level in the intervention group was 8.97 ± 1.45 g/dL, while in the control group it was 9.53 ± 1.53 g/dL (p -value=0.211). At endline there was also no significant difference, the average Hb level in the intervention group increased to 10.50 ± 1.62 g/dL, while in the control group it increased slightly to 9.71 ± 1.54 g/dL (p -value=0.098). The difference in Hb levels (Δ) between the two groups was significant (p -value=0.013), and the intervention group showed a significant difference between Hb levels before and after the intervention (p -value<0.000). Based on the results, it can be implied that there is an effect of *kanji rumbi* porridge intervention on the increase in hemoglobin levels of toddlers.

Table 3. Hemoglobin (Hb) levels of subjects between intervention groups

Variable	Intervention Groups		P ²
	CFP	CG	
Hb Level (g/dL)			
Baseline	8.97±1.45	9.53±1.53	0.211
Endline	10.50±1.62	9.71±1.54	0.098
P ¹	0.000*	0.647	
Δ	1.53±1.69	0.17±1.83	0.013*

CFP=Instant *Kanji rumbi* Porridge Group, CG=Control Group, Δ=Difference, P¹=Paired Sample T-Test of Baseline and Endline Data, P²=Independent T-Test of between Group Data

Anemia in toddlers is characterized by a deficiency of healthy red blood cells in the body, leading to a decrease in the blood's capacity to transport

oxygen³². Anemia in toddlers is a serious concern due to its potential adverse effects on their growth and development, and their overall health and well-being³³.

Early detection and treatment of anemia in toddlers is crucial to prevent long-term complications and ensure optimal health outcomes. Untreated anemia in toddlers can lead to delayed cognitive development, physical growth problems, and increased susceptibility to infections³⁴. The intervention of instant *kanji rumbi* porridge as a supplementary food for toddlers is proven to increase blood hemoglobin levels and reduce anemia status in toddlers. This result is in line with previous studies that supplementary feeding can improve the health status and growth of toddlers, especially in reducing the prevalence of anemia^{35–37}. Another similar study in Ethiopia showed that supplementary feeding for toddlers can increase hemoglobin levels and reduce anemia status and morbidity³⁸. This is affected by the iron content contained in instant *kanji rumbi* porridge, which contains additional quail eggs, which are known to increase hemoglobin levels and reduce anemia status³⁹. This is supported by similar research conducted on toddlers in Malawi, which found that consuming eggs derived from poultry can increase hemoglobin levels and reduce the prevalence of anemia in toddlers⁴⁰.

This study has advantages in terms of design using cluster randomized control trials so that the data distribution is improved. Nevertheless, this investigation has a limitation as it only evaluates hemoglobin (Hb) levels to detect anemia. It should also assess ferritin levels to elucidate the underlying causes of anemia in children. Notwithstanding its limitations, this study continues to advance theory and practice in the field under investigation.

CONCLUSIONS

This study concluded that the potential of local food, instant *Kanji rumbi* porridge as supplementary food for toddlers, can increase the intake of macro and micronutrients, especially iron, and increase hemoglobin levels, and reduce anemia in toddlers. Implementation of a large-scale model is needed to overcome anemia where there are still many toddlers with insufficient food consumption of animal sources.

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CONFLICT OF INTEREST AND FUNDING DISCLOSURE

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AUTHOR CONTRIBUTIONS

BB: conceptualization and investigation; SS: methodology and collecting the study; DJ: analysis data; AEY: writing and editor manuscript; RK: writing original draft and review.

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