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Efficacy of Essential Nutrient Intake from Local Food Products Bada Fish (*Rasbora Argyrotaenia*) on the Nutritional Status of Stunting Toddlers

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Abstract: Stunting in toddlers poses a significant public health challenge worldwide, with Indonesia recording a prevalence of 27.70% in 2019. This research investigates the efficacy of essential nutrient intake from local food products, specifically Bada fish (Rasbora argyrotaenia), in improving the nutritional status of stunted toddlers. The study employs a three-phase experimental design: Phase I focuses on laboratory preparation of nutritional supplements; Phase II involves the development of standardized recipes for complementary foods; and Phase III implements a Single Blind Randomized Controlled Trial to assess intervention impacts. The target population consists of children under five living within the Ophir and Suka Menanti Health Center regions, with selection criteria rigorously defined. Ethical considerations were upheld throughout the study, adhering to relevant regulations. This investigation is poised to provide critical insights into leveraging local nutritional resources to address stunting in vulnerable populations. Data indicated significant post-intervention improvements in micronutrient adequacy ($p<0.05$), although overall energy and protein intake did not show significant changes ($p>0.05$). Nutritional assessments revealed enhanced weight-for-age and weight-for-height indices, while height-for-age scores showed no significant improvement, highlighting a potential limitation in the duration of the intervention. This study underscores the viability of incorporating fish-based supplements in dietary programs designed to address child malnutrition and suggests that sustained interventions, complemented by maternal education on nutritional practices, are crucial for promoting lasting health benefits.

Keywords: Bada fish (*Rasbora Argyrotaenia*); Nutrition; Status; Stunting; Toddlers

Introduction

Stunting in toddlers is a global public health issue that requires serious attention. The latest data from UNICEF shows that the prevalence of stunting in Indonesia reached 27.70 percent in 2019, meaning one in four children under the age of five experiences this growth problem (Sari et al., 2021). This nutritional issue is particularly pressing, given its long-term impact on children's physical growth and cognitive development. In fact, inadequate intake of essential nutrients during the early years of life, known as the "first thousand days," can lead to devastating long-term consequences, including developmental delays and increased susceptibility to disease (Suratri et al., 2023). One important source of nutrition that can help improve the nutritional status of toddlers is consuming fish, such as the Bada fish (*Rasbora argyrotaenia*) (Maulu et al., 2021).

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Fish is a rich source of protein, healthy fats, and micronutrients like omega-3 and minerals, which play a vital role in children's growth. Studies show that omega-3 intake plays a positive role in bone metabolism and bone mass formation, which contributes to children's height growth (Adjepong et al., 2018). However, even though fish is a staple food in Indonesia, fish consumption among toddlers is still low, with studies showing that only 28% of toddlers consume fish regularly (Kawanto et al., 2019).

These findings suggest the need for interventions to increase fish consumption among stunted children (Cartmill et al., 2022). Several studies indicate a significant relationship between protein intake from fish and children's physical growth. Children who receive adequate fish intake tend to have better height growth than those who consume less fish (Elisanti et al., 2023; Cunha et al., 2018). As a source of protein, fish can also supply essential fatty acids and micronutrients such as calcium and phosphorus, which are essential for children's brain and physical development (Semba et al., 2017; Utri-Khodadady & Głąbska, 2023). Furthermore, studies also show that consuming a varied diet, including fish, can improve overall nutritional intake and reduce the risk of stunting (Kusumawardani & Ashar, 2022; Shapiro et al., 2019). Therefore, increasing knowledge and awareness about the importance of fish-based foods for toddler nutrition should be part of any nutrition intervention program. Approaches that involve educating mothers and families about the benefits of fish as an important source of protein can help bridge the gap between knowledge and practice (Taufiqurrahman et al., 2021).

One of the challenges in combating stunting is limited access to nutritious food in marginalized areas, where households often rely on less diverse and quality foods (Nshimyiryo et al., 2019). Therefore, more holistic interventions, which take into account socioeconomic and cultural factors, are crucial in stunting reduction strategies. Government and community programs should focus on creating better food supply systems and easier access to vital nutritional sources such as fish, with efforts to improve food consumption patterns among children, especially in communities at high risk of stunting (Putra et al., 2023). The aim of this research is to analyzeEfficacy of Essential Nutrient Intake from Local Food Products Bada Fish (*Rasbora Argyrotaenia*) on the Nutritional Status of Stunting Toddlers.The novelty of this study lies in its in-depth analysis of the efficacy of essential nutrient intake from local food products, specifically bada fish (*Rasbora argyrotaenia*), on the nutritional status of stunted toddlers.

This study distinguishes itself by focusing on bada fish, which is a local protein source that is underexplored in the context of child nutrition. Through qualitative and quantitative approaches, this study will examine the nutritional composition of bada fish and its impact on improving nutritional status. Furthermore, the results are expected to provide new insights into the potential use of local natural resources for nutritional interventions in areas affected by stunting. Thus, this study not only contributes to the academic literature on child nutrition and health but also paves the way for policy recommendations to improve child nutrition through local food sources.

Method

Types and Design

This research is an experimental researchs with 3 stages of research, namely phase I, II phase III. Phase one (I) research: laboratory experimental research to prepare essential nutritional supplementation products from bada fish, namely several additional food products for children under five, in addition to functional biscuits "Radania cookies" in accordance with the diet and eating habits of stunted children and local wisdom. Phase two (II) research: Experimental research to create standardized recipes for supplementation products in the form of complementary foods and MTAB (mixed toddler additional food) based on bada fish and other local foods and local food-based balanced nutrition guidelines for the management of stunted children. Phase three (III) research: field experimental research to see the efficacy (impact of interventions) using the research design "Single Blind Randomized Controlled Trial".

Stage of Research

Phase I research was carried out in the Food Technology laboratory, Food Microbiology Laboratory, Food Chemistry and Biochemistry Laboratory of the Health Polytechnic of the Ministry of Health Padang, the laboratory of the Padang Industrial Research and Standardization Center and the Laboratory of PT Saraswati Bogor. Phase II research at the location of the Ophir Puskesmas Work area and the Suka Menanti Health Center, West Pasaman Regency. Phase I research time starts from February to November 2020, while phase II and Phase III research will be carried out in 2021.

Population and Sample

The study population was all children under five who were at the research site of the Ophir and Suka Menanti Health Center working areas of West Pasaman Regency. The sample criteria for the study subjects were children under five at the study site who met the inclusion and exclusion criteria, namely nutritional status with a H/U index Z value score of <-2 elementary

schools, did not suffer from chronic diseases, mothers/ parents were willing for their children to be made research subjects by signing informed consent and exclusion criteria suffering from malnutrition or overnutrition, both parents were stunted, allergic to fish, the child physically has a deformity, the child during the study is sick and must be sick, or suffers from chronic pain (doctor's diagnosis).

Sample Size and Sampling Method

The sample size was determined using the approach of the mean difference between two independent groups (Normayanti et al., 2020). The total number of research subjects was 20 individuals, with a sample ratio of 1:1 for the intervention and control groups (n intervention = n placebo). Therefore, the total required sample was 19 x 2 groups = 38 children (research subjects). Each location contributed 40/2 = 20 children, with a breakdown per location: Intervention Group A: 20 samples, Control Group B: 20 samples.

Types and Data Collection Methods

The collected data encompasses the characteristics of the research subjects. Anthropometric data were measured using standard procedures, conducted by trained field personnel who had previously carried out measurement standardization with commendable precision and accuracy. Daily nutrient intake data, particularly intake of protein, zinc, iron, vitamin A, and other nutrients, as well as the dietary patterns and habits of the children over the past month, were gathered through interviews employing a semi-quantitative Food Frequency Questionnaire (FFQ) and a 24-hour food recall form. These interviews were conducted over two consecutive days with the children's parents and were carried out by two nutrition experts who had received training. The process was augmented with the use of visual aids such as food models.

Data Processing

The collected data from questionnaires, forms, direct examinations and measurements, as well as laboratory analysis results, are processed and analyzed. The anthropometric data obtained were converted into standard deviation scores (Z-scores) using the WHO-Antro computer software program. Food recall and FFQ data were collected repeatedly three times: before the supplementation period (pre-supplementation), during the supplementation, and at the end of the supplementation. This was done to obtain sufficiently representative data that can better describe the dietary habits of children aged 6-36 months with stunting.

Data Analysis

Prior to analysis, the collected data are first cleaned, coded, and tabulated. Subsequently, an analysis was conducted in accordance with the hypothesis. Descriptive analysis is carried out to provide an overview of subject characteristics through frequency distributions, mean values, and standard deviations for each group. Furthermore, bivariate analysis was performed to identify differences between the intervention group and the placebo (non-supplementation) group regarding the improvement of physical growth in stunted children. Statistical tests such as independent t-tests and paired t-tests are employed, with a significance level set at $p < 0.05$ and a 95% confidence interval (CI) for variables with ratio data, while the χ^2 test is applied for categorical data. Multivariate analysis is conducted to compare the intervention group and the control group, using simple linear regression.

Research Ethics

This research was carried out after obtaining ethical approval from the Research Ethics Commission (Ethics Committee Approval). Researchers always comply with and adhere to the Regulation of the Minister of Health of the Republic of Indonesia No. 657/MENKES/Per/VII/2025 concerning the delivery and use of clinical specimens, biological materials and their information content. If this research is published, the confidentiality of patients is maintained.

Results and Discussion

Table 1 shows the distribution of characteristics of stunted toddlers and their families. Of the 40 respondents, the majority were female (52.50%), with the largest age group being between 48 and 72 months (37.50%). Regarding fathers' education, the majority had primary school education (60.0%), while mothers' education showed that the majority had junior high school education (42.50%). Fathers' occupations were predominantly farmers (70.0%), while mothers were mostly housewives (87.50%). Knowledge of parents' education and occupation can provide insight into socioeconomic factors contributing to stunting in toddlers. These characteristics are important for further understanding stunting, which can be influenced by family and economic environments.

Table 2 presents the distribution of essential nutrient intake levels before and after the intervention in the study group of 40 participants. The data show significant changes in energy, protein, fat, carbohydrate, and several micronutrients (zinc, iron, calcium, and vitamin A) intake as a result of the

intervention. In terms of energy intake, there was a dramatic decrease in the "Weight Deficit" category, from 100% before the intervention to 37.50% afterward, while the "Usual" category increased to 32.50%. A similar trend was observed for protein, where both adequate and excess intakes increased after the intervention. Fat intake showed a shift from a deficit (80% before) to the 'Usual' category (65% after). Carbohydrate and micronutrient intake showed a similar trend, with the proportion of participants consuming sufficient amounts increasing significantly, particularly calcium (58% increase) and vitamin A (35% increase). Overall, the results indicate that the intervention was effective in improving participants' intake of essential nutrients. This data is important for designing better nutrition programs in the future.

Table 1. Distribution of Characteristics of Stunting Toddlers and Families

Characteristics Of Respondents		N	%
Gender	Man	19	47.50
	Woman	21	52.50
	Total	40	100
Age	12 Months – 36 Months	22	17.50
	48 Months-72 Months	18	37.50
	Total	40	100
Father's Education	Sd	24	60.0
	Junior	8	20.0
	Senior high school	6	15.0
	Pt (D3, S1)	2	5.0
	Total	40	100
Maternal Education	Sd	11	27.50
	Junior	17	42.50
	Senior high school	10	25.0
	Pt (D3, S1)	2	2.50
	Total	40	100
Dad's Job	Farmer	28	70.0
	Laborer	5	12.50
	Self-Employed	5	12.50
	Merchant	1	2.50
	Honorary Teacher	1	2.50
	Total	40	100
Mom's Job	Farmer	2	5.0
	Self-Employed	1	2.50
	Merchant	2	5.0
	Housewife	35	87.50
	Total	40	100

Table 2. Distribution of Essential Nutrient Intake Levels Before and After Intervention

Categories Intake		Before		After	
		N	%	N	%
Energy	Weight Deficit	40	100	15	37.5
	Mild Level Deficit	0.0	0.0	12	30.0
	Usual	0.0	0.0	13	32.5
	Total	40	100	40	100
Protein	Weight Deficit	25	62.5	1	2.5
	Mild Level Deficit	4	10.0	8	20.0
	Usual	6	15.0	29	72.5
	More	5	12.5	2	5.0
	Total	40	100	40	100
Fat	Less	32	80.0	13	32.5
	Usual	6	15.0	26	65.0
	More	2	5.0	1	2.5
	Total	40	100	40	100
Carbohydrates	Less	39	97.5	19	47.5
	Usual	1	2.5	12	30.0
	More	0	0	9	22.5
	Total	40	100	40	100

Categories Intake		Before		After	
		N	%	N	%
Zinc	Less	34	85.0	20	50.0
	Enough	6	15.0	20	50.0
	Total	40	100	40	100
Fe	Less	35	87.5	26	65.0
	Enough	5	12.5	14	35.0
	Total	40	100	40	100
Calcium	Less	21	52.5	7	17.5
	Enough	19	47.5	33	82.5
	Total	40	100	40	100
Vitamin A	Less	30	75.0	16	40.0
	Enough	10	25.0	24	60.0
	Total	40	100	40	100

Table 3 summarizes the average intake of essential nutrients before and after an intervention aimed at improving dietary quality. For each nutrient, mean values (± standard deviation) and their corresponding percentage of adequacy are presented. Notably, after the intervention, there was a significant increase in energy, protein, fat, carbohydrates, zinc, iron, calcium, and vitamin A intake. For example, energy intake rose from 650.7 ± 125.1 to 1094 ± 175.1, with a difference of 443.3 ± 50 and a p-value of 0.948, indicating no significant difference. However, iron, calcium, and vitamin A showed significant changes ($p < 0.001$), underscoring the effectiveness of the intervention. These findings suggest that the intervention positively influenced nutrient intake levels, with most nutrients approaching or achieving post-intervention adequacy. Future research should investigate long-term dietary adherence and health outcomes associated with such interventions.

Table 3. Average Values of Essential Nutrient Intake Before and After Intervention

Nutrient Intake	Before Intervention		After intervention		Differences		
	Mean + SD	% Adequacy	Mean + SD	%Adequacy	Mean + SD	% Adequacy	PValue
Energy	650.70± 125.1	125.13	1094 ± 175.1	176.09	443.3±50	50.96	0.94 a
Protein	22.87 ± 25.3	3.57	20.40 ± 2.27	2.28	2.47 ± 23.03	1.29	0.96 a
Fat	21.35± 12.95	12.95	32.08 ± 6.11	6.24	10.73 ± 6.84 pm	6.7	0.37 a
Carbohydrates	82.25±32.65	32.66	181.77 ± 55.43	55.43	99.45± 22.78	22.27	0.13 a
Zinc	1.50±1.09	1.09	2.75 ± 0.95	0.95	1.25 ± 0.14	0.14	0.00 a
Iron	3.95±1.47	1.57	5.30 ± 1.54	1.54	1.35 ± 0.07	0.03	0.00 a
Calcium	516.35±155.93	155.93	668.40 ± 120.62	120.63	152.05 ± 35.31	35.30	0.00 a
Vitamin A	270.88±51.22	51.22	329.25± 44.91	44.92	58.37 ± 6.29	6.30	0.00 a

Dependent Test of t-Test Sample

Table 4 shows the distribution of toddlers' nutritional status before and after the intervention. In the WEIGHT/AGE category, there was a decrease in the number of severely underweight toddlers from 14 (35.0%) to 9 (22.50%) after the intervention, while the proportion of normal weight increased from 12 (30.0%) to 16 (40.50%). In the weight/age category, there was a decrease in the number of severely underweight toddlers from 14 (35.0%) to 9 (22.50%) after the intervention, while the proportion of normal weight increased from 12 (30.0%) to 16 (40.50%). Height /Age (height for age), the proportion of very short toddlers remained constant at 17 (42.50%). In the categoryWeight/Age, there was a decrease in malnutrition from 8 (20.0%) to 1 (2.50%) and an increase in good nutrition from 30 (75.0%) to 37 (92.50%). The BMI/Age category also showed improvement, with an increase in the proportion of good nutrition from 31 (77.50%) to 33 (82.50%). Overall, this table reflects a significant improvement in the nutritional status of toddlers after the intervention, with a reduction in malnutrition and an increase in the proportion of good nutrition.

Table 4. Distribution of Nutritional Status of Toddlers Before and After Intervention

Nutritional Status	Beginning		End	
	N	%	N	%
Very Underweight	14	35.00	9	22.50
Underweight	12	30.00	13	32.50
Normal Weight	12	30.00	16	40.50

Nutritional Status		Beginning		End	
		N	%	N	%
Weight/Age	Risks of More Weight Loss	2	5.00	2	5.00
	Total	40	100	40	100
	Very Short	17	42.50	17	42.50
Height/Age	Short	10	25.00	10	25.00
	Usual	12	30.00	12	30.00
	Tall	1	2.50	1	2.50
	Total	40	100	40	100
	Poor Nutrition	1	2.50	0	0
Weight/Height	Malnutrition	8	20.00	1	2.50
	Good Nutrition	30	75.00	37	92.50
	More Nutritional Risks	1	2.50	2	5.00
	Total	40	100	40	100
	Poor Nutrition	1	2.50	0	0
BMI/Age	Malnutrition	5	12.50	1	2.50
	Good Nutrition	31	77.50	33 3	82.50
	More Nutritional Risks	3	7.50	5	12.50
	Obesity	0	0	1	2.50
	Total	40	100	40	100

Information

Based on table 5, it is known that the average z-score of respondents based on the W / U index before being given the local food-based MTAB (mixed toddler additional food) intervention of bada fish was -2.17 (underweight) while the average value after being given the local food-based MTAB (mixed toddler additional food) intervention of bada fish was -1.84 (normal body weight). The average z-score of respondents based on the Height/Age index before being given the MTAB (mixed toddler additional food) intervention based on local food of bada fish was -2.55 (short) while the average value after being given the MTAB (mixed toddler additional food) intervention based on local food of bada fish was -2.56 (short). The average z-score of respondents based on the W/H index before being given the MTAB (mixed toddler additional food) intervention based on local food of bada fish was -0.95 (good nutrition) while the average value after being given the MTAB (mixed toddler additional food) intervention based on local food of bada fish was -0.42 (good nutrition). The average z-score of respondents based on the BMI/U index before being given the MTAB (mixed toddler additional food) intervention based on local food of bada fish was -0.58 (good nutrition) while the average value after being given the MTAB (mixed toddler additional food) intervention based on local food of bada fish was -0.05 (good nutrition).

The results of the analysis of the t dependent statistical test with a confidence level of 95% in the nutritional status variables (Weight/Age, Height/Age, Weight/Height, BMI/Age) obtained ap value of 0.00 which means that there is a meaningful difference between nutritional status (Weight/Age, Height/Age, Weight/Height, BMI/Age) before and after being given a local food-based MTAB (mixed toddler additional food) intervention of bada fish ($p<0.05$).

Table 5. Average Z-Score Value of Toddler Nutritional Status Index Before and After Intervention

	Before Intervention	After intervention	Differences	
NutritionalStatus	Mean + SD			
	Before Intervention	After intervention	Differences	PValue
Weight/Age	-2.17 ± 1.65	-1.84 ± 1.49	0.33 ± 0.16	0.000
Height/Age	-2.55 ± 2.67	-2.56 ± 2.53	0.01 ± 0.14	0.000
Weight/Height	-0.95 ± 0.98	-0.42 ± 0.94	0.53 ± 0.04	0.000
BMI/Age	-0.58 ± 1.03	-0.05 ± 1.10	0.53 ± 0.07	0.000

Dependent Test of t-Test Sample

The results showed that the intervention of bada fish-based toddler supplementary food products could optimize the intake of nutrients (Energy, Protein, Fat, Carbohydrates, Zinc, Fe, Ca, Vitamin A) in stunted children. This can be seen from the increase in the amount and or category of intake (Energy, Protein, Fat, Carbohydrates, Zinc, Fe, Ca, Vitamin A) of respondents after being given additional food for children under five in the form of Local Food Products bada fish (Rasbora-Argyrotaenia) in a better direction. The findings from various studies underscore the significant impact of fish-based supplementary food products on improving the nutritional status of stunted children, particularly

regarding their intake of key nutrients such as energy, protein, fat, carbohydrates, zinc, iron, calcium, and vitamin A. The introduction of local food products, such as those derived from various fish species, has been shown to optimize nutrient intake for stunted toddlers, leading to improved dietary outcomes post-intervention.

For example, a study by Nugroho et al. demonstrated that a structured program delivering supplementary fish-based foods over a period of 90 days yielded marked improvements in the nutritional status of toddlers in terms of energy and protein intake, indicating a direct correlation between the intervention and positive dietary shifts among the children. Another investigation found that processed fish food serves as an effective additional source of essential nutrients, thus alleviating stunting symptoms observed in affected infants. These findings are consistent with observations reported by Damanik et al., which highlight that inadequate variety and frequency in feeding and low intake of nutrients are prevalent among children with stunting (Damanik et al., 2020).

Moreover, studies focused on protein intake reveal its crucial role in catch-up growth within stunted populations. Endrinikapoulos et al. argue that protein supplementation is vital for promoting growth in children experiencing stunting, aligning with the notion that dietary diversity, including the consumption of animal protein such as fish, is beneficial for this demographic (Endrinikapoulos et al., 2023). Research substance that fish contributes essential micronutrients like zinc and iron—factors integral to healthy development—and facilitates better overall dietary quality when integrated into complementary feeding programs. Furthermore, as reported by Krebs et al., integrating animal proteins into the diets of toddlers positively influences their growth metrics, further validating the role of fish as a supplementary food (Krebs et al., 2011). This positioning corresponds to findings from similar interventions that documented an increase in the intake of diverse nutrients following structured nutritional programs (Damanik et al., 2020).

The results indicate that the provision of additional food interventions based on local fish products for stunted children under five did not yield significant improvements in energy and nutrient intake ($p > 0.05$). This aligns with findings from various studies that emphasize the limited impact of brief supplementation periods, highlighting the need for sustained dietary interventions to achieve measurable health outcomes in malnourished populations (Pradhan et al., 2016; Tam et al., 2020). While products like fortified fish-based food provide essential nutrients, their low energy contribution complicates their effectiveness as standalone solutions for nutritional deficiencies, as noted by researchers advocating for comprehensive dietary recovery strategies for malnourished children (Chipili et al., 2022; Ratnawati & Satriani, 2024). Therefore, solutions must be holistic, integrating both quantitative and qualitative dietary improvements over extended periods to support significant nutritional recovery in stunted children (Mayangsari & Rasmiati, 2020; Suksesty et al., 2020).

The study indicates that significant differences in the intake of micronutrients such as Zinc, Iron (Fe), Calcium (Ca), and Vitamin A were observed before and after local food-based interventions, particularly featuring various fish species as a dietary source ($p < 0.05$). This improvement in micronutrient intake is attributed to the rich nutritional profile of these fish, which can commonly contain substantial amounts of protein, Vitamin A, Iron, and Zinc. For example, many small indigenous fish varieties have been documented to provide around 16% of the protein needs and contribute significant levels of essential micronutrients in diets across populations that rely on fish for nutrition (Akinpelu et al., 2021; Akther et al., 2018). Previous studies have documented similar findings, establishing that the protein-rich content of various fish supports improved dietary intake of essential micronutrients. Furthermore, consistent consumption of such nutrient-dense fish can play a crucial role in addressing micronutrient deficiencies within at-risk populations and may improve overall health and nutritional status (Mahmud et al., 2019; Permatasari et al., 2021).

The intervention using fish-based supplementary food products significantly improved the nutritional status of stunted children. Research demonstrates that supplementary feeding, particularly with high-quality animal protein sources like fish, positively influences the growth and nutritional intake of toddlers. For example, a study established that after a 90-day intervention with additional fish-based food, there were notable improvements in the nutritional status of stunted toddlers, supporting the hypothesis that such interventions are effective in mitigating stunting (Nugroho et al., 2023). Moreover, supplementary feeding programs are designed to elevate nutritional intake, and studies confirm that these interventions lead to better health outcomes for children by ensuring that their dietary needs are met during crucial growth phases. Furthermore, the role of maternal nutritional knowledge and proper feeding practices also contributes significantly to the nutritional success of the children (Nadimin, 2022; Wardani et al., 2024).

The nutritional status of respondents improved following the MTAB (mixed toddler additional food) intervention involving bada fish. Initially, 35.0% were classified as having poor nutritional status based on the WEIGHT/AGE index. However, after the intervention,

the proportion of individuals with normal weight rose to 40.5%, highlighting the effectiveness of the dietary intervention. Similarly, based on the W/H index, there was a reported improvement in nutritional status, with a 17.5% increase in individuals categorized as having good nutritional status post-intervention. The WEIGHT/AGE index indicated a 5.0% rise in those classified with good nutritional status following the MTAB (mixed toddler additional food) intervention, reinforcing the positive outcomes linked to dietary changes involving local foods like bada fish. This aligns with existing literature emphasizing the vital role of adequate dietary intake in improving children's nutritional outcomes

The results of the analysis of the t dependent statistical test with a confidence level of 95% in the nutritional status variables (Weight/Age, Height/Age, Weight/Height, BMI/Age) obtained ap value of 0.00 which means that there is a meaningful difference between nutritional status (Weight/Age, Height/Age, Weight/Height, BMI/Age) before and after being given a local food-based MTAB (mixed toddler additional food) intervention of bada fish ($p<0.05$). Research demonstrates the efficacy of local food interventions, such as the use of Bada fish (Rasbora argyrotaenia), in improving nutritional indices among stunted children. Notably, Bada fish is rich in protein and essential micronutrients, with a protein content of approximately 33.4 grams per 100 grams, alongside significant amounts of vitamin A, iron, and zinc, which collectively contribute to better dietary intake and nutritional status in children (Gelli et al., 2018). These findings align with studies indicating that consumption of diverse animal-source foods significantly impacts dietary quality and stunting rates (Asna & Syah, 2023; Horiuchi et al., 2018).

Moreover, interventions focusing on optimizing nutritional intake through local foods have shown promising results in enhancing children's health and reducing stunting prevalence (Prayitno et al., 2025). Subsequently, consistent nutritional education regarding dietary diversity and maternal awareness plays a crucial role in mitigating stunting among children (Astuti et al., 2022). Evidence suggests that improving maternal knowledge directly influences child nutritional outcomes, emphasizing the need for educational programs aimed at enhancing knowledge of food supplementation (Atamou et al., 2023). Supported by Rezaeizadeh et al. (2024), that optimal height growth in stunted children can be achieved by accelerating bone growth above normal growth according to the age of the child, for this it is necessary to increase the quantity and quality of food by providing essential (special) nutrients such as protein, zinc, Fe and vitamins that have the potential and are needed in higher quantities for bone tissue growth.

Conclusion

The conclusion of this study is that providing Bada fish-based supplementary food to stunted children in West Pasaman Regency increased micronutrient intake (such as iron, zinc, and vitamin A) and improved several indicators of nutritional status (weight-for-age and weight-for-height). However, this product did not significantly increase protein intake or height, likely due to the short duration of the intervention, which was only one month.

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The authors declare no conflict of interest.

References

Adjepong, M., Yakah, W., Harris, W. S., Colecraft, E., Marquis, G. S., & Fenton, J. I. (2018). Association of Whole Blood Fatty Acids and Growth in Southern Ghanaian Children 2–6 Years of Age. *Nutrients*, *10*(8), 954. https://doi.org/10.3390/nu10080954

Akinpelu, A. T., Akinloye, O. M., Olumuyiwa, A. O., Afolabi, O. O., & Stephen, O. A. (2021). Comparative Assessment of the Nutritional Fitness of Wild and Cultured African Catfish (Clarias gariepinus). *Annual Research & Review in Biology*, 96–106. https://doi.org/10.9734/arrb/2021/v36i230345

Akther, S., Islam, M. B., Rahman, H., & Bhuiyan, A. S. (2018). Proximate composition and nutritional value of fish powder composition (FPC) from different dried SIS fishes in Bangladesh. *Research Journal of Food Science and Nutrition*, *3*(1), 9–14. https://doi.org/10.31248/RJFSN2017.030

Asna, A. F., & Syah, Muh. N. H. (2023). Chronic Energy Malnutrition in Mothers Associated with Stunting. *Jurnal Gizi Dan Dietetik Indonesia (Indonesian Journal of Nutrition and Dietetics)*, *11*(2), 77. https://doi.org/10.21927/ijnd.2023.11(2).77-84

Astuti, R. D. W., Hudaya, I., & Surani, E. (2022). Literatur Review: Reviewing Kadarzi Behavior to Reduce the Incidence of Stunting in Children. *International Journal of Nursing and Midwifery Science (IJNMS)*, *5*(3), 157–163. https://doi.org/10.29082/IJNMS/2021/Vol5/Iss3/371

Atamou, L., Rahmadiyah, D. C., Hassan, H., & Setiawan, A. (2023). Analysis of the Determinants of Stunting among Children Aged below Five Years in Stunting Locus Villages in Indonesia. *Healthcare*, *11*(6), 810. https://doi.org/10.3390/healthcare11060810

Cartmill, M. K., Blackmore, I., Sarange, C., Mbeyu, R., Cheupe, C., Cheupe, J., Kamau-Mbuthia, E., Iannotti, L., Wamukota, A., Humphries, A., & Lesorogol, C. (2022). Fish and complementary feeding practices for young children: Qualitative research findings from coastal Kenya. *PLOS ONE*, *17*(3), e0265310. https://doi.org/10.1371/journal.pone.0265310

Chipili, G., Van Graan, A., Lombard, C. J., & Van Niekerk, E. (2022). The Efficacy of Fish as an Early Complementary Food on the Linear Growth of Infants Aged 6–7 Months: A Randomised Controlled Trial. *Nutrients*, *14*(11), 2191. https://doi.org/10.3390/nu14112191

Cunha, M. P. L., Marques, R. C., & Dórea, J. G. (2018). Influence of Maternal Fish Intake on the Anthropometric Indices of Children in the Western Amazon. *Nutrients*, *10*(9), 1146. https://doi.org/10.3390/nu10091146

Damanik, S. M., Wanda, D., & Hayati, H. (2020a). Feeding Practices for Toddlers with Stunting in Jakarta: A Case Study. *Pediatric Reports*, *12*(11), 8695. https://doi.org/10.4081/pr.2020.8695

Damanik, S. M., Wanda, D., & Hayati, H. (2020b). Feeding Practices for Toddlers with Stunting in Jakarta: A Case Study. *Pediatric Reports*, *12*(11), 8695. https://doi.org/10.4081/pr.2020.8695

Elisanti, A. D., Jayanti, R. D., Amareta, D. I., Ardianto, E. T., & Wikurendra, E. A. (2023). Macronutrient intake in stunted and non-stunted toddlers in Jember, Indonesia. *Journal of Public Health Research*, *12*(3), 22799036231197178. https://doi.org/10.1177/22799036231197178

Endrinikapoulos, A., Afifah, D. N., Mexitalia, M., Andoyo, R., Hatimah, I., & Nuryanto, N. (2023). Study of the importance of protein needs for catch-up growth in Indonesian stunted children: A narrative review. *SAGE Open Medicine*, *11*, 20503121231165562. https://doi.org/10.1177/20503121231165562

Gelli, A., Margolies, A., Santacroce, M., Roschnik, N., Twalibu, A., Katundu, M., Moestue, H., Alderman, H., & Ruel, M. (2018). Using a Community-Based Early Childhood Development Center as a Platform to Promote Production and Consumption Diversity Increases Children's Dietary Intake and Reduces Stunting in Malawi: A Cluster-Randomized Trial. *The Journal of Nutrition*, *148*(10), 1587–1597. https://doi.org/10.1093/jn/nxy148

Horiuchi, Y., Kusama, K., Kanha, S., Yoshiike, N., & The FIDR research team. (2018). Urban-Rural Differences in Nutritional Status and Dietary Intakes of School-Aged Children in Cambodia. *Nutrients*, *11*(1), 14. https://doi.org/10.3390/nu11010014

Kawanto, F. H., Fong, B., Cannan, R., Fatima Alatas, S., Mulyadi, S., Marlisa, Y., Nur Rahman, M., & Firmasyah, A. (2019). Dietary Ganglioside Intake and Serum Ganglioside Concentration among Indonesian Toddlers. *Journal of Food and Nutrition Research*, *7*(3), 191–200. https://doi.org/10.12691/jfnr-7-3-3

Krebs, N. F., Mazariegos, M., Tshefu, A., Bose, C., Sami, N., Chomba, E., Carlo, W., Goco, N., Kindem, M., Wright, L. L., Hambidge, K. M., & Complementary Feeding Study Group. (2011). Meat Consumption is Associated with Less Stunting among Toddlers in Four Diverse Low-Income Settings. *Food and Nutrition Bulletin*, *32*(3), 185–191. https://doi.org/10.1177/156482651103200301

Kusumawardani, H. D., & Ashar, H. (2022). Food Consumption Patterns for Children Under Two Years (Toddler) in Areas with High Stunting Prevalence. *IOP Conference Series: Earth and Environmental Science*, *1024*(1), 012071. https://doi.org/10.1088/1755-1315/1024/1/012071

Mahmud, N., Al-Fuad, S., Satya, S. I., Mamun, A. A., Ahmed, S., Karim, A., Islam, M., Ferdaus, J., Islam, S., Sakib, N., & Yeasmin, J. (2019). Development and Biochemical Composition Assessment of Fish Powders from Bangladeshi Indigenous Fish Species and Shelf-Life Characteristics Evaluation During 90 Days of Room Temperature Storage. *Food and Nutrition Sciences*, *10*(08), 963–984. https://doi.org/10.4236/fns.2019.108069

Maulu, S., Nawanzi, K., Abdel-Tawwab, M., & Khalil, H. S. (2021). Fish Nutritional Value as an Approach to Children's Nutrition. *Frontiers in Nutrition*, *8*, 780844. https://doi.org/10.3389/fnut.2021.780844

Mayangsari, R., & Rasmiati, K. (2020). Effect of Supplementation of F100 Biscuits Modified with Moringa Oleifera Flour Substitution On Nutritional Status Of Under-Five Children With Malnutrition in Kendari City Indonesia. *Public Health of Indonesia*, *6*(1), 28–34. https://doi.org/10.36685/phi.v6i1.318

Nadimin, N. (2022). Pemberian makanan tambahan subtitusi tepung ikan gabus (PMT-tibus) dalam meningkatkan status gizi anak balita. *AcTion: Aceh Nutrition Journal*, *7*(1), 61. https://doi.org/10.30867/action.v7i1.613

Normayanti, N., Suparyatmo, J. B., & Prayitno, A. (2020). The Effect of Nutrition Education on Body Mass Index, Waist Circumference, Mid-upper Arm Circumference and Blood Pressure in Obese Adolescents. *Electronic Journal of General Medicine*, *17*(5), em221. https://doi.org/10.29333/ejgm/7884

Nshimyiryo, A., Hedt-Gauthier, B., Mutaganzwa, C., Kirk, C. M., Beck, K., Ndayisaba, A., Mubiligi, J., Kateera, F., & El-Khatib, Z. (2019). Risk factors for stunting among children under five years: A cross-sectional population-based study in Rwanda using the 2015 Demographic and Health Survey. *BMC Public Health*, *19*(1), 175. https://doi.org/10.1186/s12889-019-6504-z

Nugroho, M. R., Yansyah, D., Rhedo, U., Armeidi, E., & Erawani, F. H. (2023). The Efficiency of Providing Animal Protein from Fish as Supplementary Feeding for Toddlers with Stunting. *Jurnal Ilmiah Pengabdian Masyarakat Bidang Kesehatan (Abdigermas)*, *1*(2), 66–72. https://doi.org/10.58723/abdigermas.v1i2.24

Permatasari, T. A. E., Ernirita, E., Kurniaty, I., & Widakdo, G. (2021). Nutritional and Microbiological Characteristics of Snakehead Fish Flour (Channa Striata) and Its Modification as Weight Enhancing Supplements for Children with Tuberculosis. *Food Science and Technology*, *9*(3), 45–57. https://doi.org/10.13189/fst.2021.090301

Pradhan, P. M. S., Dhital, R., & Subhani, H. (2016). Nutrition interventions for children aged less than 5 years following natural disasters: A systematic review. *BMJ Open*, *6*(9), e011238. https://doi.org/10.1136/bmjopen-2016-011238

Prayitno, G., Auliah, A., Zuhriyah, L., Efendi, A., Arifin, S., Rahmawati, R., Nugraha, A. T., & Siankwilimba, E. (2025). Exploring the Role of Food Security in Stunting Prevention Efforts in the Bondowoso Community, Indonesia. *Societies*, *15*(5), 135. https://doi.org/10.3390/soc15050135

Putra, D. P., Riantina, A., Nurindalia, B., Kirana, T. A., Mayang, I., Idris, H., & Hasyim, H. (2023). The Role of Food Security in the Incident of Stunting in Toddlers. *Community Medicine and Education Journal*, *4*(3), 367–372. https://doi.org/10.37275/cmej.v4i3.405

Ratnawati, R., & Satriani, S. (2024). The Effect of Giving Biscuits Made from Haruan Fish Flour and Yellow Pumpkin on the Nutritional Status of Toddlers. *Journal of Health and Nutrition Research*, *3*(2), 144–148. https://doi.org/10.56303/jhnresearch.v3i2.261

Rezaeizadeh, G., Mansournia, M. A., Keshtkar, A., Farahani, Z., Zarepour, F., Sharafkhah, M., Kelishadi, R., & Poustchi, H. (2024). Maternal education and its influence on child growth and nutritional status during the first two years of life: A systematic review and meta-analysis. *Clinical Medicine*, *71*, 102574. https://doi.org/10.1016/j.eclinm.2024.102574

Sari, F., Murti, B., Sutisna, E., & Kusnandar, K. (2021). Family's Support, Partnership and Nutrition Status of Children Under the Age of Five in the Special Region of Yogyakarta. *Malaysian Journal of Public Health Medicine*, *21*(2), 95–102. https://doi.org/10.37268/mjphm/vol.21/no.2/art.777

Semba, R. D., Trehan, I., Li, X., Salem, N., Moaddel, R., Ordiz, M. I., Maleta, K. M., Kraemer, K., & Manary, M. J. (2017). Low serum ω-3 and ω-6 polyunsaturated fatty acids and other metabolites are associated with poor linear growth in young children from rural Malawi. *The American Journal of Clinical Nutrition*, *106*(6), 1490–1499. https://doi.org/10.3945/ajcn.117.164384

Shapiro, M. J., Downs, S. M., Swartz, H. J., Parker, M., Quelhas, D., Kreis, K., Kraemer, K., West, K. P., & Fanzo, J. (2019). A Systematic Review Investigating the Relation Between Animal-Source Food Consumption and Stunting in Children Aged 6–60 Months in Low and Middle-Income Countries. *Advances in Nutrition*, *10*(5), 827–847. https://doi.org/10.1093/advances/nmz018

Suksesty, C. E., Hikmah, & Afrilia, E. M. (2020). Effectiveness of the Additional Feeding Program Using Combination of Green Bean Juice and Boiled Chicken Egg Toward Changes in Nutritional Status of Toddler Stunting in Pandeglang Regency. *Proceedings of the 1st International Conference on Community Health (ICCH 2019)*. https://doi.org/10.2991/ahsr.k.200204.053

Suratri, M. A. L., Edwin, V. A., Indriasih, E., & Yulianti, A. (2023). Factors Associated with the Occurence of Stunting in Children Aged 12-35 Month in the DIY Province. *Muhammadiyah International Public Health and Medicine Proceeding*, *3*(1), 137–148. https://doi.org/10.61811/miphmp.v3i1.562

Tam, E., Keats, E. C., Rind, F., Das, J. K., & Bhutta, Z. A. (2020). Micronutrient Supplementation and Fortification Interventions on Health and Development Outcomes among Children Under-Five in Low- and Middle-Income Countries: A Systematic Review and Meta-Analysis. *Nutrients*, *12*(2), 289. https://doi.org/10.3390/nu12020289

Taufiqurrahman, Buanasita, A., & Mundiastuti, L. (2021). The Three Months Balanced Diet Recommendation Education Could Improve Mother's Knowledge and Compliance in Better Diet and Nutrient Intake for Stunted Children in Surabaya, Indonesia. *Indian Journal of Forensic Medicine & Toxicology*, *15*(3), 4488–4494. https://doi.org/10.37506/ijfmt.v15i3.15998

Utri-Khodadady, Z., & Głąbska, D. (2023). Analysis of Fish-Consumption Benefits and Safety Knowledge in a Population-Based Sample of Polish Adolescents. *Nutrients*, *15*(23), 4902. https://doi.org/10.3390/nu15234902

Wardani, K. A., Rambung, E., Wartiningsih, M., & Wirjatmadi, B. (2024). The Relationship Between Maternal Nutritional Knowledge And Feeding Patterns In Stunted Toddlers. *E-Jurnal Medika Udayana*, *13*(3), 122. https://doi.org/10.24843/MU.2024.V13.i03.P18