

**Original Article****Comparative Effectiveness of Haruan and Salmon Fish Extracts in Preventing Stunting Among Toddlers: A Quasi-Experimental Study**Widya Warastuti<sup>1</sup>, Tri Ratna Ariestini<sup>1</sup>, Fetty Rahmawati<sup>1</sup>, Elisa<sup>1</sup><sup>1</sup> Department of Nursing, Ministry of Health, Health Polytechnic of Palangka Raya, Central Kalimantan, Indonesia**ARTICLE INFO****Article History**

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**ABSTRACT**

**Background:** Stunting, a condition characterized by impaired growth and short stature in toddlers resulting from chronic malnutrition, remains a primary health concern in Indonesia, including Central Kalimantan. A significant contributing factor is the inadequate consumption of animal protein. Fish, such as haruan (*Channa striata*) and salmon, are excellent sources of protein and essential nutrients crucial for growth. However, comparative studies examining the efficacy of the local haruan fish extract and imported salmon fish extract in preventing stunting are scarce. This study aims to compare the effectiveness of these two fish extracts among toddlers in the operational area of the Pahandut Community Health Center, Palangka Raya City.

**Methods:** This quasi-experimental study followed TREND reporting guidelines. The study involved 100 toddlers, selected by purposive sampling based on specific inclusion/exclusion criteria. Participants were divided into two groups: one group receiving haruan fish extract and the other group receiving salmon extract. The intervention was conducted for three months (June to August 2023). Anthropometric measurements of mid-upper arm circumference (MUAC), body length, and body weight were taken monthly. Data were analyzed using the Wilcoxon Signed-Rank Test and the Mann-Whitney U Test.

**Results:** The Wilcoxon Signed-Rank Test showed that both haruan and salmon fish extracts significantly increased MUAC, Body Length, and Body Weight in each group ( $p < 0.001$ ). The average increase in MUAC was 0.8 cm for the haruan group and 0.9 cm for the salmon group. However, the Mann-Whitney U Test did not show a statistically significant difference between the two treatment groups in terms of increases in MUAC ( $p = 0.452$ ) and Body Weight ( $p = 0.387$ ). These findings indicate that both extracts are equally effective in improving the nutritional status of stunted children.

**Conclusion:** Haruan and salmon fish extracts are equally effective in improving the anthropometric status of stunted toddlers, suggesting that locally sourced haruan can serve as a cost-effective, sustainable alternative to imported salmon in stunting prevention programs.

**Keywords:** Fish extract; stunting; toddlers; quasi-experimental study; Indonesia; nutritional intervention.

**Implications for Practice:**

- Implement haruan fish extract supplementation as a sustainable and cost-effective, community-based nutritional intervention for stunting prevention, leveraging local resources.
- Incorporate nutrition education on the benefits of locally available, nutrient-dense fish like haruan into existing maternal and child health programs to promote dietary diversification.

## Implications for Practice:

- Develop standardized guidelines for the formulation and dosage of fish-based nutritional supplements to ensure quality and efficacy in public health interventions across primary health centers.

## Introduction

Stunting is defined as impaired growth and development in children under two years of age due to chronic malnutrition, resulting in a child being excessively short for their age. The nutritional deficiency begins during pregnancy and in the early postnatal period, up to the first two years of life. However, the physical manifestations of stunting typically become apparent only after the child reaches two years of age. A stunted or severely stunted toddler is identified by a Length-for-Age (LAZ) or Height-for-Age (HAZ) measurement that falls below the World Health Organization (WHO) 2006 growth standards (WHO, 2015). According to the Indonesian Ministry of Health (2018), stunting is specifically defined as a child under five with a z-score of less than -2 standard deviations (SD) for stunted and less than -3 SD for severely stunted (Detriani *et al.*, 2023)

The stunting prevalence in Central Kalimantan was recorded at 22.1% in 2024, showing a decrease from 23.5% in 2023. In Palangka Raya City, the capital of Central Kalimantan Province, 19.1% of toddlers were stunted (Kementrian Kesehatan Republik Indonesia, 2025). The city's geographical setting is characterized by large and small rivers and tributaries, with settlements concentrated around watersheds, swamps, and wilderness areas. This environment supports significant potential for freshwater capture fisheries from rivers, lakes, and swamps. (Hamidah *et al.*, 2014).

A primary cause of stunting is inadequate consumption of a balanced diet, particularly from animal protein sources. This can be understood through the UNICEF Conceptual Framework on the Causes of

Malnutrition (1990), which posits that inadequate dietary intake is an immediate cause of undernutrition (UNICEF, 2021). Within this framework, chronic deficiency of high-quality nutrients, especially protein and essential fatty acids, directly leads to impaired linear growth and development. Animal protein is crucial for cell growth, tissue development, and supports brain and immune system development in children. Research indicates that children with regular access to animal protein tend to have better physical growth and cognitive development compared to those relying solely on plant-based protein. (Kadosh *et al.*, 2021).

Regular fish consumption can help meet the nutritional needs of toddlers, thereby reducing the risk of stunting (Paramata & Mahdang, 2024). Fish is an excellent and affordable source of nutrition, containing 18% protein composed of essential amino acids. It provides unsaturated fatty acids (EPA and DHA), vitamins A, B1, B2, and D, and various minerals (Radjawane *et al.*, 2025). The protein and fatty acids in fish are beneficial for children's health and intelligence (Martins *et al.*, 2020). Supplementary feeding using fish-based ingredients has been shown to significantly improve the nutritional status of stunted toddlers (Nugroho *et al.*, 2023). The biological rationale is that the high-quality protein provides the essential amino acids necessary for synthesizing insulin-like growth factor 1 (IGF-1) and building new tissues, while omega-3 fatty acids reduce inflammation and support neurodevelopment, collectively addressing key pathophysiological pathways in stunting (Calder, 2015).

This is because animal protein has a more complete profile of essential amino acids and is more easily absorbed by the body. In Indonesia, fish is a particularly excellent source of animal protein. Beyond its high protein content, fish is rich in omega-3 fatty acids (DHA and EPA), which are vital for a child's brain development. Other nutrients in fish, such as vitamin D, iodine, iron, and calcium, also contribute to bone formation, nervous system health, and help prevent anemia and metabolic issues ([Tanod et al., 2025](#)).

One of the key potentials of freshwater fisheries is the haruan fish ([Septya & Wanto, 2024](#)). Haruan fish has high albumin content ([Jamal et al., 2022](#)) and is rich in protein ([Mustafa et al., 2022](#)), which can help prevent stunting ([Misnati et al., 2023](#)). In addition to albumin and protein intake, stunting prevention can also be addressed by increasing the intake of vitamin D and omega-3 fatty acids, which are abundant in salmon ([Handeland et al., 2018](#)).

Haruan fish is a nutritionally dense source of protein, essential amino acids, and omega-3/6 fatty acids, vital for child development. Its key advantage over more expensive and less accessible proteins like beef or chicken is its local availability in Kalimantan through wild catch and aquaculture. Nutritional data confirms a 100g portion provides 16.2g of protein and a notably high albumin content of 13,552 mg/100g, significantly exceeding levels in carp or catfish ([Mahmudah & Bahar, 2025](#)).

Salmon, a marine counterpart to the freshwater haruan fish, is renowned for its high-quality protein and exceptional nutritional profile. It is a rich source of B vitamins, vitamin D, niacin, phosphorus, and, most notably, long-chain omega-3 fatty acids (EPA and DHA). These essential fats, which must be obtained through diet, are vital for health; a 100-gram portion provides approximately 2.3 to 2.6 grams of omega-3s ([Tambunan et al., 2025](#)).

While interest in haruan as a local nutritional source in Central Kalimantan is growing ([Sundari et al., 2024](#)). Direct comparative research on the efficacy of local fish-based interventions versus imported ones for stunting prevention remains limited. Few studies have directly compared the effectiveness of nutritional interventions based on local fish like haruan with imported, nutrient-dense fish like salmon in improving anthropometric outcomes in stunted toddlers. Haruan is valued for its albumin and protein content, whereas salmon is distinguished by its vitamin D and omega-3 levels. Therefore, a direct comparison is needed to determine if locally available resources can offer comparable benefits to globally recognized superfoods, which has significant implications for public health policy and program sustainability.

This study aims to compare the effectiveness of haruan fish extract and salmon fish extract in improving anthropometric indicators (Mid-Upper Arm Circumference, Body Length, and Body Weight) among stunted toddlers in the working area of the Pahandut Community Health Center, Palangka Raya City.

## Methods

### Study Design

This quasi-experimental study followed the TREND (Transparent Reporting of Evaluations with Nonrandomized Designs) reporting guidelines ([Jarlais et al., 2004](#)). The study was conducted over a three-month period from June to August 2023. Due to the nature of the public health intervention and the need to administer specific supplements to predefined groups, random assignment was not feasible; therefore, a quasi-experimental design with pre-assigned groups was implemented.

### Participants

The study population consisted of all children aged 6–60 months in the working area of the Pahandut Community Health Center, Palangka Raya City. The sample size was determined using a prevalence survey formula with  $\alpha = 5\%$  ( $Z = 1.96$ ), a precision (d) of 2%, and a stunting proportion in Palangka Raya of 2.6% (2018 data). This calculation yielded a minimum required sample of 50 stunted children as the case group. Subsequently, 50 normal children of comparable age were selected as the control group. Participants were selected using a purposive sampling technique.

The inclusion criteria were toddlers aged 6-60 months, residing in the study area, having parental consent, and having no allergies to haruan or salmon fish extracts. The exclusion criteria were toddlers with special needs, congenital diseases (e.g., heart conditions, thalassemia), or those already receiving regular nutritional supplements. All 100 recruited participants completed the study, with no dropouts or loss to follow-up.

### **Instruments**

Group 1 (Haruan extract) received a daily dose of 1 ml of haruan fish extract for three months. Group 2 (Salmon extract) received 1 ml of salmon extract on the same schedule. The fish extract was prepared under hygienic laboratory conditions, standardized to contain consistent protein concentrations, and packaged in identical capsules to minimize bias. Parents were instructed to administer the extract every morning and record consumption on a daily checklist provided by the research team. Compliance was monitored weekly through this checklist and direct contact. No adverse events were reported during the intervention period.

### **Intervention**

Data were collected using an informed consent form, a respondent characteristics

questionnaire, and monthly anthropometric measurements.

Anthropometric measurements—height, weight, and mid-upper arm circumference (MUAC)—were conducted according to standardized WHO (2006) guidelines. Height/Length was measured using a portable infantometer/stadiometer (Seca 417) to the nearest 0.1 cm. Weight was measured using a calibrated digital scale (Seca 803) to the nearest 0.1 kg. MUAC was measured on the left arm using a non-stretch insertion tape (SECA 212) to the nearest 0.1 cm. All anthropometric tools were calibrated before the study and verified for accuracy on a weekly basis.

### **Data Collection**

Data collection took place over three months (June-August 2023) in the operational area of the Pahandut Community Health Center. Enumerators underwent a two-day training session on standardized anthropometric measurement techniques and ethical data handling. Anthropometric measurements were performed monthly by these trained enumerators under the supervision of the principal investigator. All data forms were checked for completeness on-site before being securely stored. Data were subsequently double-entered into a dedicated database to ensure accuracy.

### **Data Analysis**

Data analysis was performed using SPSS Statistics version 26. The Shapiro-Wilk test was used to assess data normality, which indicated a non-normal distribution for the outcome variables; thus, non-parametric tests were applied. The Wilcoxon Signed-Rank Test was used to analyze pre- and post-intervention differences within each group (paired data). The Mann-Whitney U Test was employed to compare outcomes between the Haruan fish extract group and the Salmon fish extract

group (independent data). A 95% confidence level was used with a significance level ( $\alpha$ ) of 0.05. For significant results, effect sizes were calculated ( $r$  for Wilcoxon, Cohen's  $d$  for Mann-Whitney) to determine the magnitude of the intervention's impact. A  $p$ -value of less than 0.05 was considered statistically significant.

### Ethical Considerations

Ethical approval for this study was obtained from the Health Research Ethics Committee of the Polytechnic of Health, Ministry of Health, Palangka Raya (Number: 270/VIII/KE.PE/2023). The study was conducted in accordance with the principles of the Declaration of Helsinki. Written informed consent was secured from the

parents or guardians of all participating toddlers before data collection commenced. All participant data were anonymized and stored securely to ensure confidentiality and privacy.

### Results

All 100 participants who were recruited completed the three-month study, resulting in a 0% dropout rate. Adherence to the intervention, as monitored through daily checklists, was over 95% for both the Haruan and Salmon extract groups.

**Table 1** presents the baseline demographic characteristics of the respondents. The distribution of gender and age was similar between group 2 (salmon extract) and group 1 (haruan extract).

**Table 1.** Frequency Distribution of Respondent Characteristics

Variable	Category	Haruan Extract Group (n = 50)	Salmon Extract Group (n = 50)
Gender	Female	22 (44.0 %)	27 (54.0 %)
	Male	28 (56.0 %)	23 (46.0 %)
Age (months)	6 – 36 months	41 (82.0 %)	32 (64.0 %)
	37 – 68 months	9 (18.0 %)	18 (36.0 %)

The effectiveness of the interventions was first assessed by comparing pre- and post-intervention measurements within each group. Table 2 shows that in the Haruan group, all anthropometric parameters significantly

increased after the three-month intervention. The mean Mid-Upper Arm Circumference (MUAC) increased by 0.60 cm, body length by 0.90 cm, and body weight by 0.30 kg (all  $p < 0.001$ ).

**Table 2.** Comparison of Anthropometric Changes Before and After Intervention Between Haruan and Salmon Fish Groups

Variable	Group	Pre-intervention Mean $\pm$ SD	Post-intervention Mean $\pm$ SD	Mean Change $\pm$ SD	Within-Group $p$ -value <sup>1</sup>	Between-Group $p$ -value <sup>2</sup>
Mid-upper arm circumference (cm)	Haruan extract	13.73 $\pm$ 0.85	14.33 $\pm$ 0.81	+0.60 $\pm$ 0.27	< 0.001 *	0.108
	Salmon extract	14.06 $\pm$ 0.82	14.95 $\pm$ 0.88	+0.89 $\pm$ 0.31	< 0.001 *	
Body length (cm)	Haruan extract	81.49 $\pm$ 2.56	82.39 $\pm$ 2.51	+0.90 $\pm$ 0.46	< 0.001 *	0.028 *
	Salmon extract	85.14 $\pm$ 2.64	87.66 $\pm$ 2.60	+2.52 $\pm$ 0.58	< 0.001 *	
Body weight (kg)	Haruan extract	10.48 $\pm$ 0.76	10.78 $\pm$ 0.79	+0.30 $\pm$ 0.15	< 0.001 *	0.129

Variable	Group	Pre-intervention Mean ± SD	Post-intervention Mean ± SD	Mean Change ± SD	Within-Group p-value <sup>1</sup>	Between-Group p-value <sup>2</sup>
	Salmon extract	11.30 ± 0.90	11.82 ± 0.95	+0.52 ± 0.20	< 0.001 *	

**Notes:**

<sup>1</sup> Wilcoxon Signed-Rank Test for within-group comparisons.

<sup>2</sup> Mann-Whitney U Test for between-group comparisons.

Values are expressed as mean ± standard deviation (SD).

p < 0.05 is considered statistically significant.

The analysis of anthropometric outcomes revealed significant improvements following the three-month intervention with both fish extracts. Within-group comparisons using the Wilcoxon Signed-Rank Test demonstrated statistically significant increases (p < 0.001 for all variables) in both the Haruan and Salmon extract groups. Specifically, the Mid-Upper Arm Circumference (MUAC) increased by 0.60 ± 0.27 cm in the Haruan group and by a larger margin of 0.89 ± 0.31 cm in the Salmon group. A similar pattern was observed for Body Weight, which rose by 0.30 ± 0.15 kg in the Haruan group and 0.52 ± 0.20 kg in the Salmon group. However, the between-group analysis using the Mann-Whitney U Test indicated that these differences in MUAC (p = 0.108) and Body Weight (p = 0.129) were not statistically significant. In contrast, a significant between-group difference was observed for Body Length (p = 0.028), where the Salmon extract group exhibited a substantially greater mean increase of 2.52 ± 0.58 cm compared to the 0.90 ± 0.46 cm gain in the Haruan extract group. These findings indicate that while both interventions were effective, salmon extract may have a distinct advantage in promoting linear growth (**Table 2**).

**Discussion**

This study demonstrates that a three-month intervention with both haruan fish (*Channa striata*) extract and salmon fish extract significantly improved key anthropometric indicators—mid-upper

arm circumference (MUAC), body length, and body weight—in stunted toddlers. These findings underscore the critical role of high-quality animal-source proteins in combating chronic malnutrition.

Protein functions as a fundamental building block for new tissue. When energy requirements are unmet, protein is catabolized for energy, thereby impairing its primary growth-promoting role. Adequate energy and protein intake during critical developmental windows, from pregnancy until age two, is therefore essential. All nutrients are vital, but protein and specific micronutrients like zinc, iron, and vitamin A are particularly crucial for linear growth and cellular repair ([Chaerunnimah et al., 2021](#)). The significant improvements observed in both intervention groups align with this physiological principle, as the fish extracts provided a concentrated source of bioavailable nutrients.

The efficacy of haruan fish extract is consistent with its documented nutritional profile, which is rich in high-quality protein and albumin, substances directly involved in tissue synthesis and cellular repair ([Yunita et al., 2022](#));([Siti Khotijah et al., 2025](#)). Furthermore, haruan is a good source of zinc, a mineral essential for the activation and synthesis of growth hormone and for cellular processes like protein synthesis and gene replication ([Mustafa et al., 2025](#)). This local fish can be innovatively processed into various complementary foods, such as shredded fish, sausages, and flour, enhancing its utility in community-



based nutrition programs ([Mahalia & Ramadhani, 2022](#)).

Similarly, salmon fish extract yielded significant growth improvements, which can be attributed to its renowned composition of long-chain omega-3 fatty acids (EPA and DHA) and vitamin D. These nutrients are well-established for their roles in brain development and bone health ([Nevins et al., 2021](#)). A key finding from our study was that salmon extract led to a significantly greater improvement in body length compared to haruan extract. This suggests a specific advantage for linear growth, which may be mechanistically explained by salmon's higher levels of omega-3s and vitamin D. These nutrients are known to potentiate the activity of Insulin-like Growth Factor-1 (IGF-1), a primary mediator of bone growth at the epiphyseal plates, and to enhance calcium absorption for bone mineralization ([Rozner et al., 2020](#)). This finding is supported by a previous study, which reported that salmon supplementation reduced stunting prevalence by 37% with significant improvements in height-for-age scores ([Pardamean et al., 2024](#)).

Despite the difference in linear growth, the fact that both extracts were equally effective in improving MUAC and body weight carries profound implications for public health policy. While salmon may offer a slight edge for linear growth, haruan fish represents a sustainable, locally available, and cost-effective alternative for broad-based nutritional supplementation. This is particularly relevant in a region like Central Kalimantan, where haruan is abundant. The integration of locally sourced fish like haruan into community stunting intervention programs is a viable and sustainable strategy. Such interventions are most effective when combined with nutrition education for parents and consistent growth monitoring ([Murniati et al., 2024](#)).

When contextualized within broader evidence, our results reinforce the value of fish-based nutrients. Omega-3 fatty acids, particularly DHA, are vital for neurodevelopment, with accumulation being most critical during gestation and infancy ([Nevins et al., 2021](#)). Furthermore, the accessibility and cost-effectiveness of fish-based interventions make them highly suitable for large-scale public health programs ([Rindawati, 2022](#)).

This study has several limitations. Its quasi-experimental design, without randomization, may introduce selection bias. Furthermore, the use of fish extracts, while ensuring standardized dosing, may not fully replicate the benefits of consuming whole fish, which provides a broader matrix of nutrients and dietary fiber. Future research should include randomized controlled trials (RCTs) with longer follow-up periods to confirm these findings and further elucidate the long-term impacts on cognitive development and the precise mechanisms by which different fish nutrients influence growth pathways.

In conclusion, both haruan and salmon fish extracts are effective nutritional interventions for improving the anthropometric status of stunted toddlers. The choice between a locally sourced option like haruan and an imported one like salmon can be informed by specific public health goals, availability, and cost considerations, with both representing valuable tools in the multi-faceted effort to eliminate stunting.

### **Implications and limitations**

This study carries significant conceptual, practical, and policy implications. Conceptually, it challenges the paradigm that expensive, imported solutions are superior, providing a robust evidence base for utilizing local food biodiversity within public health nutrition. It underscores that nutritional efficacy must

be evaluated within a framework of accessibility, sustainability, and cultural relevance. Practically, the findings demonstrate that haruan fish extract is a highly effective, cost-efficient, and readily available nutritional supplement for community-level stunting interventions. This empowers local health workers and communities to leverage indigenous resources. Consequently, at the policy level, these results advocate for a strategic re-evaluation of national nutrition programs, suggesting a shift in resource allocation towards developing and scaling sustainable, local food-based interventions.

The interpretation of these findings must consider several limitations. The study's generalizability is constrained by its relatively small sample size and confinement to a single community health center area. The use of a quasi-experimental design with purposive sampling, rather than randomization, introduces a potential for selection bias. Furthermore, a key limitation is that general dietary intake outside of the administered fish extract was not monitored or controlled, meaning other dietary factors could have acted as confounders and influenced the observed outcomes. The three-month intervention period, while sufficient to show significant anthropometric improvements, is too short to assess the long-term sustainability of these effects or their impact on cognitive development. Future research should employ randomized controlled trials with longer follow-up periods, dietary intake monitoring, and a larger, multi-center sample to verify these promising results.

### Relevance to Practice

For healthcare practitioners at community health centers (Puskesmas), these findings validate the integration of haruan fish-based supplementation into routine stunting prevention programs. Incorporating haruan extract into existing

Puskesmas initiatives, such as supplementary feeding and nutrition counseling, is a highly feasible and sustainable strategy due to its local availability and cost-effectiveness. Community health workers can confidently promote their use in various forms, including extract, flour, or shredded fish during counseling sessions with mothers of at-risk toddlers. This provides a scientifically supported, locally sourced intervention to improve child growth. For public health policymakers, these results support the development of standardized guidelines that include haruan fish in the formulary of local therapeutic foods and foster community-based initiatives for its sustainable production and distribution.

### Conclusion

In conclusion, both haruan and salmon fish extracts were effective in significantly improving key anthropometric indicators among stunted toddlers. While salmon extract demonstrated a marginally greater effect on linear growth, haruan extract proved to be a highly viable, cost-effective, and sustainable alternative for comprehensive nutritional improvement. These findings highlight the substantial potential of leveraging local, nutrient-dense fish like haruan in community-based nutrition programs as a practical and accessible strategy for stunting prevention in Indonesia.

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### CrediT Authorship Contributions Statement

**Widya Warastuti:** Conceptualization, Methodology, Supervision, Writing – Original Draft

**Tri Ratna Ariestini:** Software, Validation, Formal Analysis, Writing – Review & Editing

**Fetty Rahmawati:** Investigation, Resources, Data Curation, Project Administration

**Elisa:** Writing – Original Draft, Writing – Review & Editing, Visualization, Funding Acquisition

## Conflicts of Interest

There is no conflict of interest.

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## References

- Adarme-Vega, T. C., Thomas-Hall, S. R., & Schenk, P. M. (2014). Towards sustainable sources for omega-3 fatty acids production. *Current Opinion in Biotechnology*, 26, 14–18. <https://doi.org/10.1016/j.copbio.2013.08.003>
- Calder, P. C. (2015). Marine omega-3 fatty acids and inflammatory processes: Effects, mechanisms and clinical relevance. *Biochimica et Biophysica Acta*, 1851(4), 469–484. <https://doi.org/10.1016/j.bbali.2014.08.010>
- Chaerunnimah, Aswita Amir, Retno Sri Lestari, & Adriyani Adam. (2021). Analisis Zat Gizi Dan Organoleptik Olahan Sosis Ikan Gabus Sebagai Pangan Alternatif Mencegah Stunting. *Jurnal Kesehatan Manarang*, 7(2), 130–134. <https://doi.org/https://doi.org/10.33490/jkm.v7i2.552>
- Detriani, H., Khairi, I., Rizal, M., Zuraidah, S., Syahputra, F., Hermi, R., Ukhty, N., Rozi, A., & Faisi Ikhwal, M. (2023). Gemarikan and Fishery Product Diversification Training as Effort of Reduce Stunting Prevalence. *EUMPANG BREUH*, 2(2), 26. <https://doi.org/https://doi.org/10.33059/ebjpm.v2i2.8870>
- Fitriahadi, E., & Herfanda, E. (2023). Education and training on preparing complementary feeding (MP-ASI) from local ingredients to prevent stunting. *Community Empowerment*, 8(12), 2050–2057. <https://doi.org/10.31603/ce.10278>
- Hamidah, N., Rijanta, R., Setiawan, B., & Aris Marfai, M. (2014). Urban Riverside Settlement Model Case: Kahayan Riverside Settlement, Palangkaraya. *Jurnal Permukiman*, 9(1), 17–27. <https://doi.org/https://doi.org/10.31815/jp.2014.9.17-27>
- Handeland, K., Skotheim, S., Baste, V., Graff, I. E., Frøyland, L., Lie, Ø., Kjellevoid, M., Markhus, M. W., Stormark, K. M., Øyen, J., & Dahl, L. (2018). The effects of fatty fish intake on adolescents' nutritional status and associations with attention performance: results from the FINS-TEENS randomized controlled trial. *Nutrition Journal*, 17(1), 30. <https://doi.org/10.1186/s12937-018-0328-z>
- Jamal, B. F., Umar, N. A., & Budi, S. (2022). Analisis Kandungan Albumin Ikan Gabus *Channa Striata* Pada Habitat Sungai Dan Rawa Di Kabupaten Marowali. *Journal of Aquaculture and Environment*, 5(1), 14–20. <https://doi.org/10.35965/jae.v5i1.1951>
- Jarlais, D. C. Des, Lyles, C., Crepaz, N., & TREND Group. (2004). Standards for reporting non-randomized evaluations of behavioral and public health interventions: The TREND

- statement. *Addiction*, 99(9), 1075–1080.  
<https://doi.org/10.1111/j.1360-0443.2004.00785.x>
- Kadosh, K. C., Muhardi, L., Parikh, P., Basso, M., Mohamed, H. J. J., Prawitasari, T., Samuel, F., Ma, G., & Geurts, J. M. W. (2021). Nutritional support of neurodevelopment and cognitive function in infants and young children—an update and novel insights. *Nutrients*, 13(1), 1–26.  
<https://doi.org/10.3390/nu13010199>
- Kemntrian Kesehatan Republik Indonesia. (2025). SSGI 2024 dalam angka.
- Mahalia, L. D., & Ramadhani, J. (2022). utilization of shredded snakehead fish in an effort to prevent stunting in children in Palangka Raya. *Linguistics and Culture Review*, 6(May), 174–181.  
<https://doi.org/10.21744/lingcure.v6ns5.2182>
- Mahmudah, I. F., & Bahar, A. (2025). Daya Terima Siomay dengan Substitusi Ikan Gabus dan Penambahan Daun Kelor sebagai Snack Tinggi Albumin dan Zat Besi.  
<https://doi.org/10.55606/jikg.v3i1.3432>
- Martins, B. P., Bandarra, N. M., & Figueiredo-Braga, M. (2020). The role of marine omega-3 in human neurodevelopment, including Autism Spectrum Disorders and Attention-Deficit/Hyperactivity Disorder - a review. *Critical Reviews in Food Science and Nutrition*, 60(9), 1431–1446.  
<https://doi.org/10.1080/10408398.2019.1573800>
- Misnati, Pomalingo, A. Y., Ranti, I. N., & Nuryani. (2023). the Effect of Substitution of Snakehead Fish and Purple Eggplant Flour on the Acceptability of Biscuits for Stunting Prevention. *Media Gizi Indonesia*, 18(2SP), 37–42.  
<https://doi.org/10.20473/mgi.v18i2SP.37-42>
- Murniati, Dedy Suhendra, Erin Ryantin Gunawan, Dhony Hermanto, Sri Seno Handayani, Alya Hadranita Utami, Baiq Anggi Yustika Leni, & Amida Rischia Ulfa. (2024). Edukasi Manfaat Minyak Ikan Sebagai Upaya Pencegahan Stunting Masyarakat Desa Kuripan Kabupaten Lombok Barat, Nusa Tenggara Barat. *AL HAYAT: Jurnal Pengabdian Masyarakat*, 2(2), 97–103.  
<https://doi.org/10.62588/ahjpm.2024.v2i2.0174>
- Mustafa, A., Khoirunnisa, A. A., & Rahman, N. (2022). Effect of Giving Snakehead Fish Extract (*Channa striata*) on Albumin, Neutrophil, and Lymphocyte Levels in Hypoalbuminemia Patients. *Journal of Local Therapy*, 1(2), 56.  
<https://doi.org/10.31290/jlt.v1i2.3457>
- Mustafa, A., Soelistyorini, D., Pudjirahaju, A., Kristianto, Y., Wardhani, S. A., & Safitri, P. D. (2025). The effect of snakehead fish (*Channa striata*) snacks on nutrition outcomes of adolescence female at risk of chronic energy deficiency. *Jurnal Gizi Klinik Indonesia*, 21(3), 114.  
<https://doi.org/10.22146/ijcn.88973>
- Nevins, J. E. H., Donovan, S. M., Snetselaar, L., Dewey, K. G., Novotny, R., Stang, J., Taveras, E. M., Kleinman, R. E., Bailey, R. L., Raghavan, R., Scinto-Madonich, S. R., Venkatramanan, S., Butera, G., Terry, N., Altman, J., Adler, M., Obbagy, J. E., Stoody, E. E., & De Jesus, J. (2021). Omega-3 Fatty Acid Dietary Supplements Consumed during Pregnancy and Lactation and Child Neurodevelopment: A Systematic Review. *Journal of Nutrition*, 151(11), 3483–3494.  
<https://doi.org/10.1093/jn/nxab238>

- 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>
- Paramata, N. R., & Mahdang, P. A. (2024). *Jurnal Pengabdian Masyarakat Farmasi: Pharmacare Society Pencegahan Stunting Melalui Penyuluhan dan Pelatihan Pembuatan Bakso Ikan pada Masyarakat*. Vol. 2, 120–125. <https://doi.org/https://doi.org/10.37905/phar.soc.v2i3.20816>
- Pardamean, B., Nirwantono, R., Hidayat, A. A., Trinugroho, J. P., Isnani, M., Rahutomo, R., Sudigyo, D., Asadi, F., Elwireharja, G. N., Ariansyah, D., Sari, R., Pasaribu, R. D. U., Berlian, G., Ichwan, M., & Lumbanraja, S. N. (2024). Monitoring and evaluation of childhood stunting reduction program based on fish supplement product in North Sumatera, Indonesia. *Scientific Reports*, 14(1), 1–10. <https://doi.org/10.1038/s41598-024-61462-z>
- Rindawati, R. (2022). Decreasing Stunting Rate through the Community Eating Fish Movement. *Proceedings of International Conference in Social Science*, 3(1), 45–51. <https://jurnal.unmer.ac.id/index.php/iconiss/article/view/9038>
- Rozner, R., Vernikov, J., Griess-Fishheimer, S., Travinsky, T., Penn, S., Schwartz, B., Mesilati-Stahy, R., Argov-Argaman, N., Shahar, R., & Monsonego-Ornan, E. (2020). The role of omega-3 polyunsaturated fatty acids from different sources in bone development. *Nutrients*, 12(11), 1–22. <https://doi.org/10.3390/nu12113494>
- Septya, L., & Wanto, W. A. (2024). An Inventory and Analysis of Conservation Status of Freshwater Fish Species in Palangka Raya City Traditional Markets. *Jurnal Biologi Tropis*, 24(2), 623–629. <http://dx.doi.org/10.29303/jbt.v24i2.6930>
- Setyawan, F. E. B., Purnamasari, L., & Hidayat, M. K. S. (2023). Literature Review: Peran Salmon Ovary Peptide pada Tata Laksana Komprehensif (Vol. 4, Issue 3).
- Siti Khotijah, Ika Permanasari, Dilgu Meri, & Tino Suhendro. (2025). Giving Additional Food Snakehead Fish On The Weight Of Stunting Children At The Sadar Jaya Health Center UPT. *Corona: Jurnal Ilmu Kesehatan Umum, Psikolog, Keperawatan Dan Kebidanan*, 3(2), 202–210. <https://doi.org/10.61132/corona.v3i2.1262>
- Sundari, U. Y., Maryani, M., Sandriya, A., Norhayani, N., & Nursiah, N. (2024). Diversifikasi Olahan Ikan Haruan Dalam Upaya Program Zero Stunting Dan Peningkatan Ekonomi. *Lambung Inovasi: Jurnal Pengabdian Kepada Masyarakat*, 9(4), 930–942. <https://doi.org/10.36312/linov.v9i4.2306>
- Tambunan, F. R., Aryani, N., & Heltonika, B. (2025). Evaluation of omega-3 enrichment in commercial feed for gourami (*Osphronemus gouramy L.*) fingerlings. *Acta Aquatica: Aquatic Sciences Journal*, 1(1), 100–105. <https://doi.org/10.29103/aa.v1i1.16154>
- Tanod, W. A., Rieuwpassa, F. J., Mahihody, A. J., Sambeka, Y., Cahyono, E., Ansar, N. M. S., Kasaluhe, M. D., Ijong, F. G., Karimela, E. J., Makisake, N. A., Somba, V. V., & Biahimo, S. (2025). Upaya

Pencegahan Stunting Melalui Edukasi Produk Olahan Ikan Kepada Ibu Pkk Kecamatan Tahuna. Jurnal Pengabdian Pendidikan Masyarakat (JPPM), 6(1), 67-77. <https://doi.org/10.52060/jppm.v6i1.2779>

UNICEF. (2021). UNICEF Conceptual Framework on Maternal and Child Nutrition. Nutrition and Child Development Section, Programme Group 3 United Nations Plaza New York, NY 10017, USA, 2-3.

Yunita, Y., Kusdalina, K., & Natan, O. (2022). The Effect Of Moringa Leaves And Snakehead Fish Biscuit Supplementation On The Nutritional Status Of Malnourished And Underweight Toddlers. Proceeding B-ICON, 1, 363-370. <https://doi.org/10.33088/bicon.v1i1.65>.