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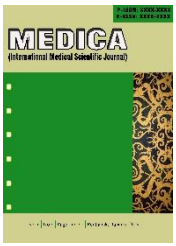

The Effectiveness of Online Nutrition Counseling on Fish and Protein Consumption to Prevent Stunting in Children Aged 4-6 Years

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Abstract

Stunting remains a significant public health problem in Indonesia, and inadequate fish and protein intake among preschool children is a key modifiable risk factor. The use of Zoom- and telephone-based nutritional counseling represents a novel, accessible strategy for community-based dietary education, yet evidence on its effectiveness in the Posyandu setting remains limited. This study aimed to evaluate the effect of nutritional counseling delivered through Zoom meetings and telephone communication on fish consumption and protein intake among children aged 4–6 years. A quasi-experimental one-group pretest–posttest design was employed at Posyandu Rajawali 1 and 2, Tugu Village, Depok, West Java. All 22 eligible children were included using total sampling. Mothers served as respondents. Dietary intake was assessed using 24-hour dietary recall and food frequency questionnaires over three non-consecutive days, administered before and after three educational sessions held in April–May 2025. Paired t-test was used for bivariate analysis. The results of the study show that mean fish consumption increased significantly from 23.91 g to 30.68 g (Δ = 6.77 g; p = 0.0001) and mean protein intake from 30.94 g to 38.45 g (Δ = 7.51 g; p = 0.0001). In conclusions, zoom and telephone-based nutritional counseling was associated with significant short-term improvements in fish and protein intake. However, given the absence of a control group and small sample size, causal inference is limited. Post-intervention intake levels remained below recommendations, suggesting the need for complementary structural and repeated educational interventions. Future studies with larger samples, control groups, and anthropometric outcome measures are strongly recommended.

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1. INTRODUCTION

Stunting, defined as a height-for-age Z-score below −2 standard deviations according to WHO child growth standards, is a chronic manifestation of undernutrition that affects a child's physical stature, cognitive development, and long-term productivity (Picauly & Toy, 2013; Harding et al., 2018). Globally, stunting disproportionately affects children in low- and middle-income countries, and Indonesia remains one of the countries with high stunting prevalence. A preliminary survey at Posyandu Rajawali 1 and 2 in Tugu Village, Depok, revealed that 28.6% of children under five showed signs of stunting, surpassing the 20% threshold that constitutes a public health emergency (Kementerian Kesehatan Republik Indonesia, 2014). Stunting during early childhood is associated with impaired neurosensory integration, reduced school performance, and diminished adult income potential, underscoring the urgency of early preventive action (Bhutta et al., 2013; Prendergast & Humphrey, 2014).

One of the most consistently documented modifiable risk factors for stunting is inadequate intake of animal-source protein, particularly during the first 1,000 days of life (from conception to 24 months) (Black et al., 2013; McKune et al., 2022). Data from the Food and Agriculture Organization (FAO) indicate that per capita animal protein consumption in Indonesia is approximately 20–30 grams per day, substantially below that of neighboring countries such as Thailand, the Philippines, and Malaysia (40–60 g/day) (Al Hasan et al., 2022). Among animal-source foods, fish is of particular strategic importance in the Indonesian context due to its local availability, cultural acceptability, and rich nutrient profile including high-quality protein, omega-3 fatty acids (EPA and DHA), vitamin D, iodine, and zinc all of which are essential for linear growth and brain development in early childhood (Maulu et al., 2021; Hicks et al., 2019; Byrd et al., 2022).

Despite this nutritional value, fish and overall protein consumption among preschool-age children in community settings such as the Posyandu remain suboptimal. Community-based studies in Indonesia consistently report low fish intake among this age group, which has been identified as a key dietary gap linked to elevated stunting risk (Sari et al., 2010; Pardamean et al., 2024; Putra et al., 2025). This gap is attributable not only to food insecurity and limited access, but also to inadequate maternal knowledge and low nutritional literacy, particularly in households where education levels are secondary or below (Bhutta et al., 2013; Silva et al., 2023).

Nutrition education targeting caregivers is a well-established and cost-effective intervention to improve children’s dietary behaviors, as mothers serve as the primary gatekeepers of household food choices (Ruel & Alderman, 2013; Saleh et al., 2021). According to the Health Belief Model and Social Cognitive Theory, behavior change in dietary practices is mediated by improvements in knowledge, perceived benefits, and self-efficacy (Notoatmodjo, 2018). Effective nutrition education must therefore address these behavioral determinants through repeated, engaging, and accessible communication strategies.

The COVID-19 pandemic accelerated the adoption of digital and remote communication platforms in community health services. Zoom Meeting and telephone-based counseling have emerged as viable modalities for delivering nutrition education, particularly in settings where face-to-face interactions are constrained by geographic distance, mobility limitations, or resource constraints (Faiq et al., 2026; Sukmawati et al., 2023). Zoom enables synchronous, group-based interaction with visual aids, while telephone counseling allows personalized, one-on-one follow-up adapted to individual needs a combination that may reinforce behavior change more effectively than either modality alone.

Despite growing evidence on digital nutrition education, few studies have evaluated the combined use of Zoom group sessions and telephone-based follow-up specifically for improving fish and protein intake among preschool children in Indonesian Posyandu settings. This represents a critical research gap, as the Posyandu is the primary community-based nutrition surveillance and education platform in Indonesia. The present study therefore addresses this gap by evaluating the influence of Zoom and telephone-based nutritional counseling on fish consumption and protein intake among children aged 4–6 years at Posyandu Rajawali 1 and 2, Tugu Village, Cimanggis District, Depok, West Java.

2. METHOD

This study employed a quasi-experimental design with a one-group pretest–posttest approach to evaluate the effect of a nutritional education intervention on fish consumption and protein intake among preschool children. This design was selected to assess changes in dietary behavior by comparing outcomes before and after the intervention within the same group of participants. However, the absence of a control group limits the ability to establish causal relationships and increases susceptibility to potential confounding factors, including history effects, maturation effects, and seasonal variations in food availability.

The study was conducted at Posyandu Rajawali 1 and Posyandu Rajawali 2, located in Tugu Village, Cimanggis District, Depok City, West Java, Indonesia. A preliminary survey was undertaken in January 2025, followed by anthropometric screening conducted from January 16 to 22, 2025. The nutritional education intervention was implemented between April and May 2025.

The study population consisted of all children aged 4–6 years registered at the two Posyandu centers (n = 22). A total sampling technique was applied, whereby all eligible children were recruited as study participants. Mothers served as the primary respondents because they were primarily responsible for household food preparation and child feeding practices. Participants were included if their mothers were willing to participate and provided written informed consent, and if they were able to complete dietary assessment instruments throughout the study period.

This study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki. Ethical approval was obtained from the appropriate Institutional Review Board prior to data collection (Ethical Clearance No.: [to be inserted]). Written informed consent was obtained from all participants, and confidentiality of personal information was maintained throughout the research process.

Dietary intake was assessed using two instruments: a 24-hour dietary recall and a semi-quantitative Food Frequency Questionnaire (FFQ). The 24-hour dietary recall was administered on three non-consecutive days, including one weekend day, to capture habitual dietary intake and minimize day-to-day variability. The FFQ was adapted for preschool-aged children and had previously been used in Indonesian community-based nutritional studies. Data collection was conducted through face-to-face interviews by trained researchers using standardized interviewing procedures, visual aids, and household measurement tools to improve the accuracy of portion size estimation.

Fish consumption was quantified in grams per day by converting reported portion sizes using the Indonesian Food Composition Table. Daily protein intake was calculated by summing protein contributions from all foods consumed based on the same reference database. To ensure data quality and consistency, all interviewers followed a standardized data collection protocol, and a random review of completed questionnaires was conducted during the study period.

The intervention consisted of three structured nutritional education sessions delivered through Zoom Meetings, complemented by individualized telephone counseling. Each Zoom session lasted approximately 20 minutes and was facilitated by the same trained researcher using a standardized educational module. The educational content included: (1) the role of fish consumption in stunting prevention, (2) the nutritional benefits of fish for child growth and cognitive development, and (3) practical strategies for incorporating fish into children's daily diets, including affordable and easy-to-prepare recipes. Educational materials, including presentation slides and recipe guides, were distributed electronically to participants. The sessions were conducted on April 29, May 7, and May 13, 2025.

Telephone counseling was provided between Zoom sessions to reinforce key educational messages, address participants' questions, and assist mothers in overcoming barriers to implementing dietary changes at home. This combined educational approach was intended to maximize learning through both group-based visual instruction and individualized support. Attendance at each educational session was recorded, and telephone counseling activities were documented to monitor participant engagement.

Data were analyzed using computer software. Descriptive statistics were used to summarize participant characteristics and study variables, including frequencies, percentages, means, and standard deviations. The normality of continuous variables was assessed using the Shapiro–Wilk test. Differences in fish consumption and protein intake before and after the intervention were analyzed using the paired t-test. Statistical significance was established at a p-value of less than 0.05.

3. RESULTS AND DISCUSSION

Table 1. Distribution of Maternal and Child Characteristics (n = 22).

Characteristic	Category	n	%
Maternal Age	29–34 years	10	45.5
	35–40 years	12	54.5
Maternal Education	SMP–SMA (Secondary)	17	77.3
	D3–S1 (Tertiary)	5	22.7
Maternal Occupation	Housewife	19	86.4
	Private sector	1	4.5
	Civil servant	1	4.5
	Entrepreneur	1	4.5
Child Gender	Male	12	54.5
	Female	10	45.5
Child Age	4 years	6	27.3
	5 years	9	40.9
	6 years	7	31.8

Table 1 shows that the majority of mothers were aged 35–40 years (54.5%), had secondary-level education (SMP–SMA; 77.3%), and were predominantly housewives (86.4%). The predominance of secondary education may limit the depth of comprehension of complex nutrition-related messages, as educational level is a well-established determinant of nutritional literacy and health behavior (Bhutta et al., 2013; Silva et al., 2023; Mohammadi-Nasrabadi & Doustmohammadian, 2025). Nevertheless, this also implies that educational content must be designed with appropriate language accessibility and visual support a design principle incorporated into the present intervention.

The dominance of housewives is an enabling factor: Southeast Asian studies consistently show that mothers with dedicated caregiving time are more responsive to

nutrition behavioral change interventions, given their direct and frequent involvement in daily food preparation and feeding practices (Kundu et al., 2024; Pardamean et al., 2024). This may have contributed positively to the observed dietary changes.

Most child participants were male (54.5%), with 5-year-olds comprising the largest subgroup (40.9%). Boys in this age group face a higher biological susceptibility to stunting due to greater metabolic demands and infection vulnerability (Wamani et al., 2007; Thompson et al., 2024). The 4–6 year age range also falls within a critical "catch-up" window where dietary improvements can still support linear growth and cognitive development (Bhutta et al., 2013; Sudfeld et al., 2015). The sample therefore represents a high-risk group for whom targeted nutritional intervention is particularly warranted.

Table 2. Fish Consumption and Protein Intake Before and After Nutrition Education: Descriptive and Inferential Statistics (n = 22).

Variable	Min	Max	Mean ± SD (g/day)	Mean Difference	p-value
Fish Consumption – Before	10.00	31.00	23.91	—	—
Fish Consumption – After	20.00	37.00	30.68	+6.77	0.0001*
Protein Intake – Before	20.00	51.10	30.94	—	—
Protein Intake – After	25.15	59.20	38.45	+7.51	0.0001*

** Statistically significant at p < 0.05 (paired t-test). Note: SD data to be reported by authors; confidence intervals were not calculated in this study, which is acknowledged as a limitation.*

Table 2 presents combined descriptive and inferential findings for both outcomes. Mean fish consumption increased by 6.77 g/day (from 23.91 to 30.68 g) and mean protein intake by 7.51 g/day (from 30.94 to 38.45 g), both statistically significant by paired t-test (p = 0.0001). These findings are consistent with prior evidence demonstrating that caregiver-focused nutrition education can improve children's dietary intake, particularly in community-based settings (Sukmawati et al., 2023; Nafista et al., 2023; Ruel & Alderman, 2013).

However, several important limitations bear on the interpretation of these results. First, the study lacked a control group, making it impossible to exclude alternative explanations for the observed changes. External factors such as concurrent health initiatives in the Posyandu, seasonal increases in fish availability during the intervention period, or natural improvements in household economic conditions may have independently influenced dietary intake. Second, the study did not calculate effect sizes or confidence intervals, which would provide a more complete picture of the magnitude and precision of the intervention effect. Third, the small sample (n = 22) limits statistical power and increases the risk of both Type I and Type II errors. These constraints mean the results should be interpreted as preliminary and hypothesis-generating rather than conclusive.

Despite these limitations, the observed improvements in fish consumption are clinically meaningful when viewed in the context of prior literature. Interventions promoting fish consumption have been associated with reductions in stunting prevalence in settings where fish is locally available and culturally accepted (Byrd et al., 2022; Headey et al., 2018; Tilley et al., 2026). The increase in protein intake of 7.51 g/day represents a

nutritionally relevant improvement given that inadequate protein is a principal driver of impaired linear growth (Dewey & Begum, 2011; Lamina et al., 2024).

Critically, however, post-intervention fish consumption (30.68 g/day) and protein intake (38.45 g/day) remained below recommended dietary standards for children aged 4–6 years. This indicates that a three-session remote education program, while effective in the short term, is insufficient to fully close existing nutritional gaps. Some studies in comparable settings have reported that knowledge-based interventions produce only modest, transient dietary changes unless reinforced by structural supports such as improved food access, economic subsidies, or community food security programs (Akombi et al., 2017; Kinderknecht et al., 2023; Escher et al., 2024). The present findings are consistent with this pattern.

The findings of this study indicate that nutrition education delivered through a combination of Zoom meetings and telephone counseling was associated with significant improvements in fish consumption and protein intake among preschool children. These results suggest that caregiver-focused educational interventions can positively influence dietary behaviors by increasing awareness of the nutritional importance of fish and protein-rich foods for child growth and development.

From a behavioral perspective, the effectiveness of the intervention may be explained through established behavior change theories. According to Notoatmodjo (2018), health education promotes behavioral modification through the Knowledge Attitude Practice (KAP) pathway, whereby increased knowledge leads to changes in attitudes and subsequently influences health-related practices. Repeated exposure to nutrition messages across multiple educational sessions likely enhanced mothers' understanding of the role of fish in supporting child growth, increased perceived benefits, and strengthened motivation to provide fish more regularly in household meals. As mothers are the primary decision-makers regarding food preparation and feeding practices, improvements in maternal knowledge may have directly contributed to the observed dietary changes among children.

The delivery strategy employed in this study may also have contributed to the positive outcomes. The Zoom sessions provided structured, visually supported, and interactive learning opportunities that enabled participants to receive standardized information and engage in real-time discussions. In contrast, telephone counseling offered individualized reinforcement by allowing participants to discuss personal challenges related to child feeding practices, including food preferences, household budget constraints, and practical meal preparation concerns. The integration of these two modalities may have enhanced both the educational and motivational aspects of behavior change, thereby increasing the likelihood of adopting recommended dietary practices. Similar findings have been reported in previous nutrition education studies, which emphasize the importance of combining information delivery with personalized support to facilitate sustainable behavioral change.

Despite these positive findings, it should be acknowledged that the study design does not allow determination of the independent contribution of each counseling modality. Because Zoom-based education and telephone counseling were delivered simultaneously, it is not possible to ascertain whether the observed improvements were primarily attributable to the group-based educational sessions, the individualized counseling component, or the synergistic effect of both approaches. Future studies employing comparative or factorial designs are therefore needed to identify the most effective and efficient modality for improving dietary behaviors in community settings.

The findings also highlight that nutrition education alone may not be sufficient to achieve optimal dietary intake. Although fish consumption and protein intake increased significantly following the intervention, intake levels remained below recommended levels for some participants. This observation suggests that structural and environmental determinants continue to influence food choices and dietary practices. Factors such as food affordability, household purchasing power, local fish availability, intra-household food distribution patterns, and cultural food preferences have been recognized as important determinants of dietary behavior (Headey et al., 2018; Constantinides et al., 2021). Consequently, educational interventions should be complemented by broader community and policy-level strategies that improve access to affordable, nutritious foods and create supportive food environments.

The increase in protein intake observed in this study represents an important step toward improving nutritional adequacy among preschool children. Adequate protein intake is essential for tissue growth, immune function, and overall child development, making dietary improvement a critical component of child nutrition programs. Nevertheless, caution is warranted when interpreting these findings in relation to stunting prevention. The present study focused exclusively on dietary outcomes and did not assess post-intervention anthropometric indicators such as height-for-age z-scores. Therefore, no direct conclusions can be drawn regarding the effectiveness of the intervention in reducing stunting prevalence or improving linear growth. Improvements in dietary intake may contribute to better growth outcomes over time; however, anthropometric changes generally require longer observation periods and are influenced by multiple biological, environmental, and socioeconomic factors.

These findings reinforce the current understanding that effective stunting prevention requires a comprehensive and multisectoral approach. In addition to nutrition education, interventions addressing food security, healthcare access, maternal and child health services, water and sanitation conditions, and socioeconomic support are essential for achieving sustainable reductions in stunting (Sharn et al., 2025; Mulyani et al., 2025). Within this broader framework, caregiver-focused nutrition education remains an important strategy for improving feeding practices and enhancing dietary quality among young children.

Several limitations should be considered when interpreting the findings of this study. First, the one-group pretest–posttest design lacked a control group, limiting the ability to establish causal relationships and increasing susceptibility to potential confounding factors such as history, maturation, and seasonal effects. Second, the relatively small sample size reduced statistical power and limited the generalizability of the findings to broader populations. Third, dietary intake data were obtained through maternal self-report using 24-hour dietary recalls and food frequency questionnaires, which may be subject to recall bias and reporting inaccuracies. Fourth, the intervention combined Zoom-based education and telephone counseling, making it impossible to determine the individual effectiveness of each modality. Finally, the study evaluated only short-term changes in dietary intake and did not assess long-term behavioral sustainability or anthropometric outcomes related to child growth and stunting. Future research should employ larger controlled studies with longer follow-up periods and direct growth measurements to better evaluate the effectiveness of nutrition education interventions on child nutritional status.

4. CONCLUSION

This study found statistically significant short-term improvements in fish consumption and protein intake among children aged 4–6 years following nutritional

education delivered through Zoom meetings and telephone-based counseling at Posyandu Rajawali 1 and 2, Tugu Village, Depok. These findings suggest that remote, technology-assisted nutrition counseling is a feasible and potentially useful strategy for improving dietary behaviors in community-based settings, particularly in contexts where face-to-face counseling is limited.

However, several important caveats must temper this conclusion. The quasi-experimental one-group design without a control group prevents causal attribution of the observed dietary changes to the intervention alone. The small sample size limits statistical power and generalizability. Confidence intervals and effect sizes were not reported. No anthropometric outcomes were measured, and therefore the study cannot confirm any direct impact on stunting prevention. The improvements observed, while statistically significant, represent short-term dietary changes, and it remains unknown whether these gains were sustained after the intervention period.

To build on these preliminary findings, future research should employ randomized controlled or at minimum quasi-experimental designs with a control group and adequate sample sizes determined by a priori power analysis. Longer follow-up periods are needed to assess the sustainability of behavioral changes. Anthropometric measurements should be incorporated as primary outcomes to establish linkage to stunting prevention. Comparative evaluation of Zoom versus telephone modalities in isolation would also advance understanding of their relative contributions. Finally, complementary structural interventions such as subsidized fish programs, local food security initiatives, and community empowerment approaches should be tested alongside educational programs to address both behavioral and structural barriers to nutritional improvement.

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