



MALAHAYATI INTERNATIONAL JOURNAL
OF NURSING AND HEALTH SCIENCE
ISSN 2620-9152 (Print)
ISSN 2621-4083 (Online)
DOI: 10.33024



ARTICLE INFORMATION

Received: December, 11, 2025

Revised: March, 26, 2026

Available online: March, 27, 2026

at : <https://e-jurnal.iphorr.com/index.php/minh>

Effectiveness of complementary food formulated from soybean seed coat and milkfish flour in supporting weight gain among young children

Lindawati, Yunita Sari, Cucuk Kunang Sari, Bangun Wijanarko, Dewi Indah Sari*

Politeknik Kesehatan Kemenkes Banten, Indonesia

Corresponding author: *E-mail.indah@poltekkesbanten.ac.id

Abstract

Background: Child undernutrition remains a significant concern in Indonesia, particularly during the complementary feeding period when inadequate dietary quality may impair optimal growth.

Purpose: To evaluate the short-term effectiveness of a complementary feeding formulation composed of soybean seed coat flour and milkfish flour in supporting weight gain among children aged 9–12 months.

Method: A quasi-experimental one-group pretest–posttest design was conducted among 20 children, with 16 included in the final analysis after excluding dropouts and outliers. Participants received 125 ml of the formulated complementary food daily for nine consecutive days. Body weight was assessed before and after the intervention.

Results: Due to non-normal data distribution (Shapiro–Wilk $p < 0.05$), the Wilcoxon Signed Rank Test was applied. Seven children demonstrated weight gain, seven showed no change, and two experienced slight weight loss. Despite positive tendencies, the overall change was not statistically significant ($Z = -1.727$; $p = 0.08$). Factors such as short intervention duration, inconsistent caregiver adherence, concurrent intake of ultra-processed foods, and minor illnesses likely contributed to limited measurable changes.

Conclusion: Although not statistically significant, the nutrient-rich formulation shows potential for longer-term application, especially in low-resource settings. Extended duration studies with larger sample sizes are recommended.

Keywords: Child Nutrition; Complementary Feeding; Milkfish Flour; Soybean Seed Coat; Stunting Prevention.

INTRODUCTION

Stunting—defined as impaired linear growth resulting from chronic undernutrition and recurrent infections—is a major public health concern in Indonesia. Children whose height falls below the standards set by the Ministry of Health and the World Health Organization face long-term consequences for health, cognitive development, and productivity. Recognizing this threat to human capital, the Indonesian government has set a target to reduce stunting prevalence to 14% by 2024 through integrated, multisectoral interventions, with improved nutrition among children aged 0–59 months as a primary focus (Tarmizi, 2022).

The complementary feeding period (6–24 months) represents a critical window for growth and development. However, many infants in Indonesia receive diets deficient in protein and micronutrients, particularly from animal-source foods. Evidence shows that inadequate protein intake during this stage is strongly associated with impaired growth trajectories (Wright, Sotres-Alvarez, Mendez, & Adair, 2017). Addressing dietary gaps during this period is therefore essential for stunting prevention.

Local, nutrient-rich food sources offer promising solutions to improve dietary quality while supporting food security. Soybean seed coat, an agro-industrial

Effectiveness of complementary food formulated from soybean seed coat and milkfish flour in supporting weight gain among young children

by-product, is rich in protein and minerals and has potential as a functional complementary food ingredient (Deak, Johnson, Lusas, & Rhee, 2008). In parallel, milkfish—a widely cultivated and culturally accepted source of animal protein in Indonesia—provides high-quality protein and essential micronutrients, making milkfish flour a feasible complementary food component (Parikh, Semba, Manary, Swaminathan, Udomkesmalee, Bos, & Nga, 2022). Leveraging these locally available resources offers an innovative, economical, and sustainable approach to stunting prevention.

Despite their nutritional potential, empirical evidence on the combined use of soybean seed coat and milkfish flour in infant feeding remains limited (Manik, Nuryanto, & Afifah, 2020). This study therefore aims to evaluate the short-term effectiveness of a complementary feeding formulation composed of soybean seed coat flour and milkfish flour in supporting weight gain among children aged 9–12 months. We hypothesize that the nutrient-rich formulation will promote positive weight changes, providing preliminary evidence for its potential role in longer-term stunting prevention strategies.

RESEARCH METHOD

A quasi-experimental one-group pretest–posttest design was employed. The study recruited infants aged 9–12 months from Banjar Agung Primary Health Center, Serang City.

Inclusion criteria were: (1) age 9–12 months at enrollment; (2) registered at Banjar Agung Primary Health Center; (3) documented stagnant or insufficient weight gain over the previous two months based on growth monitoring records; (4) currently receiving complementary feeding alongside breastfeeding or formula; and (5) caregiver willingness to provide the intervention food daily

throughout the study period with signed informed consent. Exclusion criteria included: (1) congenital anomalies, chronic diseases, or metabolic disorders affecting growth or nutrient utilization; (2) acute severe illness at baseline requiring hospitalization; (3) participation in other nutritional supplementation or clinical interventions; (4) known allergy or intolerance to soybean or fish products; and (5) incomplete follow-up due to withdrawal, non-adherence, or loss to follow-up.

The intervention was conducted from 1–9 September 2025. Participants received 125 ml/day of a complementary food formulated from soybean seed coat flour and milkfish flour. Body weight was measured before and after the intervention using a calibrated SECA 354 digital infant scale. Data analysis was performed using SPSS version 26.0. Normality was assessed with the Shapiro–Wilk test. As data were not normally distributed, the Wilcoxon Signed Rank Test was applied, with statistical significance set at $p < 0.05$.

A retrospective power analysis was conducted to evaluate the sensitivity of the study design. With a final sample size of $n=16$, statistical power set at 0.80, and $\alpha=0.05$ (two-tailed), the minimum detectable effect size was calculated. Under these parameters, the study was powered to detect a large effect size (Cohen's $d \approx 0.80$). Smaller or moderate effects could not be reliably detected given the limited sample. Because the observed changes in weight did not reach this threshold, the study must be considered underpowered, and all inferential conclusions are constrained by this limitation. The findings should therefore be interpreted as preliminary and exploratory rather than confirmatory.

Ethical approval was granted by the Research Ethics Committee of Yatsi Madani University (No. 485/LPPM-UYM/VII/2025). Written informed consent was obtained from caregivers.

Lindawati, Yunita Sari, Cucuk Kunang Sari, Bangun Wijanarko, Dewi Indah Sari*

Politeknik Kesehatan Kemenkes Banten, Indonesia
Corresponding author: *E-mail.indah@poltekkesbanten.ac.id

DOI: <https://doi.org/10.33024/minh.v9i1.2027>

Effectiveness of complementary food formulated from soybean seed coat and milkfish flour in supporting weight gain among young children

RESEARCH RESULTS

Table 1. Characteristics of the Participants (n=16)

Variable	Values
Age (Mean±SD)(Range)(Month)	(10.4 ± 1.1)(9-12)
Gender (n/%)	
Male	8/50
Female	8/50
History of Stagnant or Insufficient Weight Gain in the Last Two Months (n/%)	
Yes	16/100
No	0/0

Table 1 shows that the mean age was 10.4 ± 1.1 months. Of these, 8 (50%) were male and 8 (50%) were female. All participants had a documented history of stagnant or insufficient weight gain during the preceding two months.

Table 2. Changes Observed During the Intervention Period (n = 16)

Variable	Mean ± SD	Median (IQR)	Minimum	Maximum
Pre-intervention weight (kg)	7.28 ± 0.82	7.20 (6.60–7.90)	5.90	8.80
Post-intervention weight (kg)	7.35 ± 0.84	7.30 (6.70–7.90)	5.80	9.00

Table 2 shows although mean and median values increased slightly after the intervention, variability remained similar across both time points, reflecting individual heterogeneity in response.

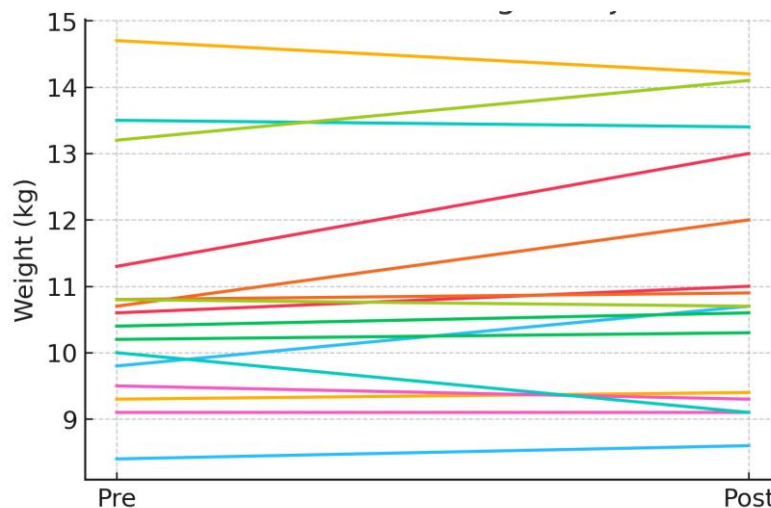


Figure 1. Individual Pre-Post Weight Trajectories of 16 Participants

A line graph (spaghetti plot) illustrates weight change for each participant: 7 upward-sloping lines (indicating weight gain), 7 horizontal lines (no change), and 2 downward-sloping lines (weight loss).

Lindawati, Yunita Sari, Cucuk Kunang Sari, Bangun Wijnarko, Dewi Indah Sari*

Politeknik Kesehatan Kemenkes Banten, Indonesia
Corresponding author: *E-mail.indah@poltekkesbanten.ac.id

DOI: <https://doi.org/10.33024/minh.v9i1.2027>

Effectiveness of complementary food formulated from soybean seed coat and milkfish flour in supporting weight gain among young children

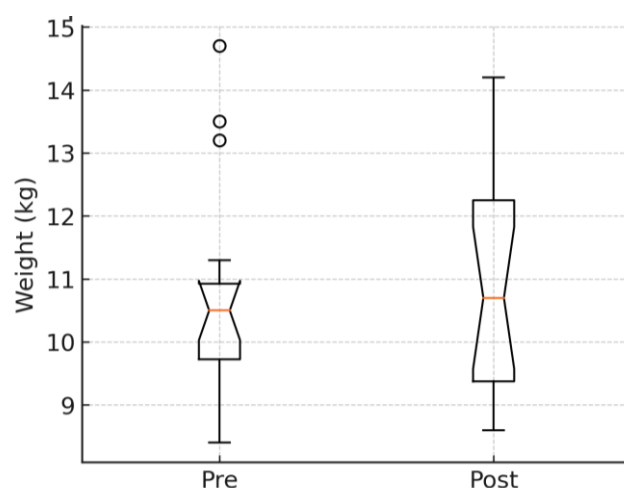


Figure 2. Boxplot of Pre- and Post-Intervention Weight

The boxplot comparison shows a slight upward shift in median, nearly identical interquartile ranges, overlapping notches indicating non-significant median differences, and no new outliers detected.

Table 3. Shapiro–Wilk Normality Test

Variable	W Statistic	p-value
Pre-intervention weight	0.800	0.003
Post-intervention weight	0.856	0.017

Normality of pre- and post-intervention weight values was assessed using the Shapiro–Wilk test due to the small sample size ($n = 16$). Both variables failed to meet normality assumptions ($p < 0.05$), confirming the need for nonparametric analysis.

Table 4. Wilcoxon Signed Rank Summary

Comparison	N	Mean Rank	Sum Ranks
Post < Pre (Negative Ranks)	2	4.00	8.00
Post > Pre (Positive Ranks)	7	5.29	37.00
Post = Pre (Ties)	7	-	-

Given the non-normal distribution, the Wilcoxon Signed Rank Test was used to compare pre-post weight change. The distribution of ranks indicates a greater number of children experiencing weight gain than weight loss.

The statistical analysis yielded $Z = -1.727$ with $p = 0.08$ (two-tailed). Since p exceeded the 0.05 threshold, the difference in body weight before and after the intervention was not statistically significant. Although nearly half of the participants showed measurable weight gain, the overall effect of the 9-day complementary feeding program did not reach significance.

Lindawati, Yunita Sari, Cucuk Kunang Sari, Bangun Wijanarko, Dewi Indah Sari*

Politeknik Kesehatan Kemenkes Banten, Indonesia

Corresponding author: *E-mail.indah@poltekkesbanten.ac.id

DOI: <https://doi.org/10.33024/minh.v9i1.2027>

Effectiveness of complementary food formulated from soybean seed coat and milkfish flour in supporting weight gain among young children

DISCUSSION

This study examined the short-term effectiveness of a complementary feeding formulation composed of soybean seed coat flour and milkfish flour on the weight gain of young children aged 9–12 months. Although nearly half of the participants experienced an increase in body weight following the 9-day intervention, the change did not reach statistical significance. These findings highlight several important considerations regarding the nutritional efficacy of the intervention, the contextual factors influencing growth outcomes, and the broader implications for complementary feeding strategies in low-resource settings.

The modest and statistically non-significant weight changes observed are consistent with evidence indicating that short-duration nutritional interventions rarely produce measurable anthropometric improvements in young children. Previous systematic reviews demonstrate that complementary feeding interventions typically require a minimum of 30 days to yield detectable weight changes and at least 90 days to influence linear growth (Roberts & Stein, 2017). The 9-day duration in this study driven by budgetary and field constraints was likely insufficient to allow steady physiological adaptation, tissue accretion, and cumulative nutrient deposition. Weight gain in infants is influenced not only by immediate caloric intake but also by the continuity of nutrient provision, metabolic efficiency, and reductions in infection burden. Therefore, short intervention windows may underestimate the true biological potential of nutrient-dense formulations.

Another explanation for the absence of significant statistical effects relates to the variability in caregiver feeding practices. Although participants received standardized complementary food portions, home-based feeding posed challenges in ensuring full adherence. Dietary recall data revealed that many children regularly consumed ultra-processed foods such as sweetened snacks, sausages, and nuggets a pattern consistent with recent findings in Southeast Asia showing increased early exposure to ultra-processed foods, which displaces nutrient-dense foods and contributes to suboptimal growth (Rahmadhani, 2024). Such foods provide low-quality calories with limited micronutrient density, potentially

offsetting the benefits of the intervention (Pries, Filteau, & Ferguson, 2019). Additionally, feeding by alternative caregivers (e.g., grandparents, hired domestic workers) may introduce inconsistency in feeding frequency, quantity, or prioritization of the intervention food.

Health status during the intervention period also appeared to influence weight trajectories. Mild respiratory symptoms were reported among several participants, and even minor infections are known to reduce appetite, impair nutrient absorption, and increase metabolic demands (Thawkar & Taksande, 2024). Inflammation associated with common childhood illnesses can also compromise the utilization of nutrients, especially protein, for growth. Thus, individual-level health conditions likely contributed to the observed heterogeneity in weight response.

The nutrient composition of the intervention food nonetheless suggests substantial potential. Soybean seed coat, despite being a by-product typically treated as waste, contains meaningful levels of protein, minerals, and dietary fiber (Sari, Fadmawaty, & Lindawati, 2024). When combined with milkfish flour, which provides high-quality animal protein with essential amino acids (Headey, Hirvonen, & Hoddinott, 2018), the formulation aligns with recommendations emphasizing the inclusion of both plant-based and animal-source proteins in complementary feeding to support growth (Arnesen, Thorisdottir, Lamberg-Allardt, Bärebring, Nwaru, Dierkes, & Åkesson, 2022; (World Health Organization, 2023; Sunarto, Chaerunnimah, & Irma, 2024). Furthermore, integrating an agro-industrial by-product into infant feeding strategies contributes to sustainable nutrition and circular food systems an approach gaining momentum globally (Gómez-García, Campos, Aguilar, Madureira, & Pintado, 2021; Liu, De Souza, Holland, Dunshea, Barrow, & Suleria, 2023). Although the short-term effect in this study was limited, the nutritional rationale remains robust and warrants longer-term evaluation.

The positive directionality observed where more children gained than lost weight suggests that the formulation may indeed provide biological benefit when given consistently and over extended durations. Several trials from South Asia and Sub-Saharan

Lindawati, Yunita Sari, Cucuk Kunang Sari, Bangun Wijanarko, Dewi Indah Sari*

Politeknik Kesehatan Kemenkes Banten, Indonesia
Corresponding author: *E-mail.indah@poltekkesbanten.ac.id

DOI: <https://doi.org/10.33024/minh.v9i1.2027>

Effectiveness of complementary food formulated from soybean seed coat and milkfish flour in supporting weight gain among young children

Africa show that small-quantity lipid-based or protein-enriched supplementary foods gradually accumulate effects on weight and growth only after sustained administration for ≥ 4 weeks (Babys, Dewi, & Rahardjo, 2022; Mamun, Mahmudiono, Yudhastuti, Triatmaja, & Chen, 2023). Therefore, the intervention used in this study should not be dismissed based on a 9-day evaluation but instead considered promising for future trials with adequate duration and controlled feeding.

An additional layer of interpretation relates to environmental and behavioral factors. Households living in densely populated and resource-limited areas often face constraints in food storage, hygiene, and responsive feeding. Suboptimal sanitation increases infection risk (Luby, Rahman, Arnold, Unicomb, Ashraf, Winch, & Colford, 2018), which indirectly limits growth even in the presence of improved nutrient intake (United Nations Children's Fund, 2015; 2021). Caregiver perceptions also influenced acceptability, initial skepticism toward soybean seed coat commonly perceived as waste may have influenced feeding enthusiasm and child consumption. Educational components accompanying future interventions could address misconceptions and improve acceptability and adherence.

The study's strengths include its use of locally available, affordable, and sustainable food ingredients; standardized preparation procedures; and objective anthropometric measurement methods. Moreover, the study provides early empirical evidence on a novel combination of plant-based and animal-source proteins with potential applicability in community nutrition programs.

However, several limitations must be acknowledged. First, the absence of a control group limits causal inference, although the pre-post design offers useful preliminary insights. Second, the short intervention duration restricts the physiological time window for measurable growth. Third, reliance on caregiver-reported dietary intake introduces risk of recall bias, and variations in daily diet could not be fully controlled. Fourth, the small sample size reduces statistical power and increases sensitivity to variance. Finally, the exclusion of outliers while statistically justified may have removed clinically relevant cases.

Future research should address these limitations through a randomized controlled trial with ≥ 12 weeks of intervention, larger sample sizes, and enhanced monitoring of feeding adherence and health status. Additionally, exploring fortification adjustments, such as varying ratios of soybean seed coat to milkfish flour or incorporating micronutrients, may optimize nutritional outcomes. Behavioural interventions targeting caregiver feeding practices may further enhance program effectiveness.

In conclusion, while the intervention did not produce statistically significant weight gain in the short term, the findings highlight the promise of integrating locally sourced, sustainable ingredients such as soybean seed coat and milkfish flour into complementary feeding strategies. The positive trends observed underscore the potential value of this formulation when applied over longer periods, under conditions of improved dietary control, and alongside supportive caregiver education. This study contributes to emerging evidence supporting sustainable approaches to child nutrition and offers a foundation for expanded research aimed at reducing undernutrition and promoting healthy early growth.

CONCLUSION

This short-term intervention did not produce statistically significant weight gain. However, positive directional trends indicate potential benefits if implemented over longer duration with improved dietary control. The formulation represents a sustainable, locally sourced strategy for improving complementary feeding.

Future research should employ a priori power calculations to determine adequate sample sizes before study initiation. Based on conventional thresholds for detecting small-to-moderate effects in child growth outcomes, substantially larger cohorts will be required. Longer intervention durations and improved caregiver adherence should also be incorporated to enhance the likelihood of detecting clinically meaningful changes.

ACKNOWLEDGEMENTS

The authors thank the participating families, the Banjar Agung Primary Health Center staff, and Politeknik Kesehatan Kemenkes Banten for their support.

Lindawati, Yunita Sari, Cucuk Kunang Sari, Bangun Wijanarko, Dewi Indah Sari*

Politeknik Kesehatan Kemenkes Banten, Indonesia
Corresponding author: *E-mail.indah@poltekkesbanten.ac.id

DOI: <https://doi.org/10.33024/minh.v9i1.2027>

Effectiveness of complementary food formulated from soybean seed coat and milkfish flour in supporting weight gain among young children

REFERENCES

- Arnesen, E. K., Thorisdottir, B., Lamberg-Allardt, C., Bärebring, L., Nwaru, B., Dierkes, J., & Åkesson, A. (2022). Protein intake in children and growth and risk of overweight or obesity: A systematic review and meta-analysis. *Food & nutrition research*, 66, 10-29219.
- Babys, I. Y., Dewi, Y. L. R., & Rahardjo, S. S. (2022). Meta-analysis the effect of complementary feeding practice on stunting in children aged 6-59 months. *Journal of Maternal and Child Health*, 7(4). 465-478
- Deak, N. A., Johnson, L. A., Lusas, E. W., & Rhee, K. C. (2008). Soy protein products, processing, and utilization. In *Soybeans* (pp. 661-724). AOCSS Press.
- Gómez-García, R., Campos, D. A., Aguilar, C. N., Madureira, A. R., & Pintado, M. (2021). Valorisation of food agro-industrial by-products: From the past to the present and perspectives. *Journal of Environmental Management*, 299, 113571.
- Headey, D., Hirvonen, K., & Hoddinott, J. (2018). Animal sourced foods and child stunting. *American Journal of Agricultural Economics*, 100(5), 1302-1319.
- Liu, Z., De Souza, T. S., Holland, B., Dunshea, F., Barrow, C., & Suleria, H. A. (2023). Valorization of food waste to produce value-added products based on its bioactive compounds. *Processes*, 11(3), 840.
- Luby, S. P., Rahman, M., Arnold, B. F., Unicom, L., Ashraf, S., Winch, P. J., & Colford, J. M. (2018). Effects of water quality, sanitation, handwashing, and nutritional interventions on diarrhoea and child growth in rural Bangladesh: a cluster randomised controlled trial. *The Lancet Global Health*, 6(3), e302-e315.
- Mamun, A. A., Mahmudiono, T., Yudhastuti, R., Triatmaja, N. T., & Chen, H. L. (2023). Effectiveness of food-based intervention to improve the linear growth of children under five: a systematic review and meta-analysis. *Nutrients*, 15(11), 2430.
- Manik, D. I. B., Nuryanto, B. P., & Afifah, D.N. (2020). Formulation of complementary feeding biscuits with yellowfin fish flour (*Thunnus albacares*) and terubuk flour (*Saccharum edule Hasskarl*) to improve nutritional status of children in Papua. *Food Research*, 4(2), 31-37.
- Parikh, P., Semba, R., Manary, M., Swaminathan, S., Udomkesmalee, E., Bos, R., & Nga, T. T. (2022). Animal source foods, rich in essential amino acids, are important for linear growth and development of young children in low-and middle-income countries. *Maternal & Child Nutrition*, 18(1), e13264.
- Pries, A. M., Filteau, S., & Ferguson, E. L. (2019). Snack food and beverage consumption and young child nutrition in low-and middle-income countries: A systematic review. *Maternal & child nutrition*, 15, e12729.
- Rahmadhani, E. P. (2024). Dampak Makanan Ultra-Proses Pada Balita: Analisis Gizi dan Resiko Kesehatan.
- Roberts, J. L., & Stein, A. D. (2017). The impact of nutritional interventions beyond the first 2 years of life on linear growth: a systematic review and meta-analysis. *Advances in Nutrition*, 8(2), 323-336.
- Sari, D. I., Fadmawaty, A., & Lindawati, L. (2024). Sistik Kulit Ari Kedelai untuk Peningkatan Haemoglobin Ibu Hamil. *Madani: Jural Ilmiah Multidisiplin* 2(10), 202–208. Retrieved from: <https://jurnal.penerbitdaarulhuda.my.id/index.php/MAJIM/article/view/3165/0>

Lindawati, Yunita Sari, Cucuk Kunang Sari, Bangun Wijanarko, Dewi Indah Sari*

Politeknik Kesehatan Kemenkes Banten, Indonesia
Corresponding author: *E-mail.indah@poltekkesbanten.ac.id

DOI: <https://doi.org/10.33024/minh.v9i1.2027>

Effectiveness of complementary food formulated from soybean seed coat and milkfish flour in supporting weight gain among young children

- Sunarto, S., Chaerunnimah, C., & Irma, R. (2024). Analisis Kandungan Gizi dan Daya Terima Panelis Terhadap Kudapan Gyobas Berbasis Ikan Bandeng Sebagai Upaya Pencegahan Anemia dan Stunting pada Remaja. *Media Kesehatan Politeknik Kesehatan Makassar. Poltekkes Kemenkes Makassar*, 19(2), 265-272.
- Tarmizi, S. N. (2022). Kejar Target Stunting Turun Hingga 14%, Kemenkes Lakukan Pendekatan Gizi Spesifik. Kementerian Kesehatan Republik Indonesia. Retrieved from: <https://kemkes.go.id/id/kejar-target-stunting-turun-hingga-14-kemenkes-lakukan-pendekatan-gizi-spesifik>
- Thawkar, V. N., & Taksande, K. (2024). Navigating nutritional strategies: permissive underfeeding in critically ill patients. *Cureus*, 16(4).
- United Nations Children's Fund. (2015). *The Impact of Poor Sanitation on Nutrition*. SHARE Research Consortium (London School of Hygiene & Tropical Medicine) in collaboration with the WASH and Nutrition Sections of UNICEF India. Retrieved from: <https://thousanddays.org/wp-content/uploads/The-Impact-of-Poor-Sanitation-on-Nutrition-1.pdf>
- United Nations Children's Fund. (2021). *The State of the World's Children 2021 On My Mind: Promoting, protecting and caring for children's mental health*. Retrieved from: <https://www.unicef.org/reports/state-worlds-children-2021>
- World Health Organization. (2023). *The State of Food Security and Nutrition in the World 2023: Urbanization, agrifood systems transformation and healthy diets across the rural-urban continuum* (Vol. 2023). Food & Agriculture Org.
- Wright, M., Sotres-Alvarez, D., Mendez, M. A., & Adair, L. (2017). The association of trajectories of protein intake and age-specific protein intakes from 2 to 22 years with BMI in early adulthood. *British Journal of Nutrition*, 117(5), 750-758.

Lindawati, Yunita Sari, Cucuk Kunang Sari, Bangun Wijanarko, Dewi Indah Sari*

Politeknik Kesehatan Kemenkes Banten, Indonesia
Corresponding author: *E-mail.indah@poltekkesbanten.ac.id

DOI: <https://doi.org/10.33024/minh.v9i1.2027>