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Effects of An Integrated Nutritional Health Intervention on Energy and Protein Intake in Under Five-Year Malnourished Children

Yani Maidelwita[1*], Tukimin bin Sansuwito[2], Faridah Mohd Said[2]

1. Faculty of Health and Science, Universitas Mercubaktijaya, Padang City 25146, Indonesia
2. Lincoln University College, 47301 Petaling Jaya, Selangor, Malaysia

*E-mail: maidelwitayani@gmail.com

Abstract

Malnutrition is thought to be the cause of more than one third of all child deaths, despite being rarely cited as a cause. In Indonesia, 19.9% of the population is malnourished, which is a very high prevalence. To prevent and treat malnutrition in children, numerous strategies have been developed, including an integrated nutritional health intervention. This research aimed to determine the effectiveness of an integrated nutritional health intervention for the energy and protein intake of malnourished children under the age of five. This study had a quasi-experimental design with a pre- and post-test control group. The research took place in Padang City, West Sumatra Province, between August 2020 and February 2021. The study data were collected using a standardized questionnaire at baseline and six months after the intervention, utilizing a sample size of 140 people. The data were evaluated using dependent and independent t-tests between the study's baseline and end line. The energy and protein intake variables showed a difference, indicating a significant increase in the score from the baseline to the end line (energy intake: difference-in-differences (DID) = 405.53, 95% confidence interval [CI] = 362.01–449.05, p = .000; protein intake: DID = 4.62, 95% CI = 3.79–5.45, p = .000). This study found that the integrated nutritional health intervention increased the energy and protein intake of malnourished children and had a substantial impact on reducing the prevalence of risk factors when adequate protein and energy intake was provided.

Keywords: energy intake, integrated nutritional health intervention, malnourished, protein intake

Abstrak

Pengaruh Intervensi Terpadu Kesehatan Gizi terhadap Asupan Energi dan Protein pada Anak Balita yang Mengalami Gizi Buruk. *Malnutrisi diperkirakan menjadi penyebab lebih dari sepertiga kematian anak di dunia meskipun jarang dikategorikan sebagai penyebab utama. Di Indonesia, 19,9% anak mengalami malnutrisi. Angka ini merupakan angka prevalensi yang sangat tinggi. Untuk mencegah dan mengatasi malnutrisi pada anak, berbagai strategi telah dikembangkan, termasuk intervensi kesehatan gizi terpadu. Penelitian ini bertujuan untuk mengetahui efektivitas intervensi kesehatan gizi terpadu terhadap asupan energi dan protein pada anak balita yang mengalami malnutrisi. Studi ini menggunakan desain kuasi-eksperimen dengan kelompok kontrol* pre-test *dan* post-test*. Penelitian dilakukan di Kota Padang, Provinsi Sumatera Barat, antara bulan Agustus 2020 hingga Februari 2021. Data penelitian dikumpulkan menggunakan kuesioner standar pada awal dan enam bulan setelah intervensi, dengan jumlah sampel sebanyak 140 orang. Data dianalisis menggunakan* dependent *dan* independent t-test *antara data awal dan akhir penelitian. Variabel asupan energi dan protein menunjukkan adanya perbedaan, yang mengindikasikan peningkatan skor yang signifikan dari awal hingga akhir penelitian (asupan energi: perbedaan selisih* [difference-in-differences/DID]*) = 405,53,* confidence interval [CI] *95% = 362,01–449,05, p = 0,000; asupan protein:* DID *= 4,62,* CI *95% = 3,79–5,45, p = 0,000). Hasil dari penelitian ini menemukan bahwa intervensi kesehatan gizi terpadu meningkatkan asupan energi dan protein pada anak-anak yang mengalami malnutrisi dan memberikan dampak yang signifikan dalam mengurangi prevalensi faktor risiko ketika asupan energi dan protein yang memadai tersedia.*

Kata Kunci: *asupan energi, asupan protein, intervensi kesehatan gizi terpadu, malnutrisi*

Introduction

The problem of malnutrition, especially undernutrition and malnutrition, is still a major nutritional problem that needs more serious attention. Undernutrition and overnutrition occurring simultaneously in the same environment are referred to as the twin burdens of malnutrition. Individuals, households, and even entire populations can be affected by this phenomenon (Das et al., 2019). Global efforts to reduce the prevalence of undernutrition, especially stunting and underweight in children under five, have shown measurable progress over the past two decades. According to the Joint Child Malnutrition Estimates by United Nations International Children's Emergency Fund (UNICEF), World Health Organization (WHO), and the World Bank, the global prevalence of stunting declined from 33% in 2000 to approximately 22.3% in 2022, affecting around 148 million children (UNICEF et al., 2023). Despite these improvements, wasting or acute malnutrition still affected an estimated 45 million children (6.8%) globally in the same year (UNICEF et al., 2021). Furthermore, the prevalence of underweight among children under five decreased from approximately 24.8% in the early 1990s to about 12.8% in 2022 (UNICEF et al., 2023), indicating progress but underscoring the ongoing burden of malnutrition, especially in low- and middle-income countries (Manoochehri et al., 2024; Vijay & Patel, 2024).

Recent studies conducted in Ethiopia and its surrounding regions have consistently demonstrated a significant correlation between adequate intake of high-quality protein and energy with children's linear growth. Moges et al. (2024) reported that the average protein and energy intake among children often falls below the recommended standards, particularly during certain seasons, adversely affecting linear growth outcomes. Their study recommends enhancing local food diversification and the production of animal-based protein sources to improve children's nutritional status. Furthermore, a systematic review of child nutrition interventions in Ethiopia concluded that food-based interventions, such as behaviour change communication (BCC), food vouchers, and the use of quality protein maize can substantially reduce the prevalence of child stunting (Ahmed et al., 2023). Malnutrition is thought to be the cause of over one third children mortality, yet it is rarely cited as the primary cause (UNICEF et al., 2023).

Indonesia continues to face significant challenges in child nutrition. According to the Global Hunger Index in 2024, 26.8 % of children under five years old are stunted, and 7.2 % of the population are undernourished (Concern Worldwide, 2024). The World Food Programme (2023) reported that nearly 31 % of children under five were affected by stunting, and around 8 % of the population was undernourished, with approximately 23 million people were lacking sufficient dietary energy in 2023. Malnourished were mostly found among children under the age of five than toddlers (17.8% and 14.8%, respectively) (Maidelwita, 2019). In West Sumatra specifically, the prevalence of stunting decreased from 31.2 % in 2018 to 23.3 % in 2021, yet remained above the national target of < 20 %, reflecting ongoing regional disparities (Syafrawati et al., 2023).

Malnutrition can be caused by a lack of food, infectious diseases, or both. Malnutrition in children (low weight-for-age) manifests as stunting (low height-for-age), wasting (low weight-for-height), and underweight. Globally in 2022, 149 million children under five were estimated to be stunted (low height-for-age), 45 million were estimated to be wasted (low weight-for-height) (WHO, 2023). Several strategies have been implemented to prevent and to cure malnutrition, such as diet, nutritional supplements, meal delivery services, and health promotion or counseling. Several remedies are available although its reliability is questionable (Young & Argáez, 2019).

In nations with lower income levels, there is limited knowledge of the relationship between

a diet high in quality protein and children's growth in the context of illness and energy deficiency. Children need more protein and vital amino acids when suffering and recovering from acute or chronic ailments. Increased protein quantity and quality, as well as increased energy consumption, may promote more linear growth in young children; longitudinal and interventional research should investigate this possibility further. Protein and energy intakes have been found to be positively correlated with children's linear growth. Mamun et al. (2023) carried out a systematic review and meta-analysis of 15 randomized controlled trials in low and middle-income countries (2000–2022). The study demonstrated that food-based interventions designed to enhance protein and energy intake produced a mean gain of + 0.20 HAZ (95% CI: 0.04–0.35, p = .01) in linear growth among children under five.

This study targeted nutritional health to reduce the prevalence of risk factors for malnutrition at the household/family level (i.e., inadequate access to food and water, inadequate care and feeding practices) (UNICEF, 2020). A nutritional health intervention refers to an effort directed toward an individual or group aimed at evaluating, improving, sustaining, promoting, or altering their health, functioning, or overall health condition (Maidelwita et al., 2023). The integrated nutritional health intervention comprises integrated community-based interventions consisting of positive deviance (PD), micronutrition supplementation, supplementary food, nutrition education, and emotional demonstration (emo demo). PD is a community-based program that aims to reduce malnutrition in children under five years old. It's a behavior change program that helps rehabilitate underweight children and prevent future malnutrition (Triatmaja et al., 2023). The objective of the integrated nutritional health intervention program in this study was to determine if the integrated approach improved the energy and protein intake of children under five.

Methods

This study investigated the impact of integrated nutritional health interventions on under-five malnourished children's energy and protein intake. Data on energy and protein consumption levels were obtained from 3 × 24-hour food recall interviews conducted before and after the intervention.

Study Design. The study used a quasi-experimental design with pre- and post-test control groups. At the control and intervention sites, the household surveys were conducted at baseline in August 2020 and at the end line in February 2021.

Setting. Padang City, West Sumatra Province, is where the study was carried out. The implementers chose Seberang Padang Public Health Center in Padang City because it has a high prevalence of malnutrition. Ranah Parak Rumbio village, Alang Lawas village, Seberang Padang village, and Belakang Pondok village are all part of the Seberang Padang Health Center's work area. As controls, four communities with the right population size, population density, and nutrition indices were chosen because they were similar in terms of health services availability, population, and nutrition indicators.

Sample Size and Sampling. The study participants were mothers of young children under the age of five. The study's target population was children aged 12 to 59 months who lived in the Area of Seberang Padang Health Center. A case group and a control group were included in the study. Cases and controls were collected from the child of Seberang Padang Health Center registrations and nutrition surveillance logbook monthly reports collected from the Seberang Padang Health Center. The sample size needed to respond to the research question was calculated with a power analysis using the G*Power Analysis software version 3.1.9.7. The effect size chosen for this study as an acceptable esti-

mate was based on the findings of previous studies (Kang, 2021).

A sample size of 140 was determined to be appropriate for this kind of research, with a chosen statistical power of 0.80 at an alpha level of 0.05 and a statistical effect size (Cohen's d) of 0.5. A total of 64 people comprised the case group sample, and 64 people formed the control group sample. Estimating the entire sample's dropout rate at 10% (6 participants in each group), the sample size for this study was 70 for the cases group and 70 for the control group, resulting in a total sample size of 140 participants.

Data Collection. Data was collected by researchers and enumerators consisting of one midwife and one nurse as well as two cadres in the area. In this study, the main data collection methods were measurements, interviews, and questionnaires. The mothers were asked to complete a questionnaire after signing an informed consent form in their native language at their integrated nutritional health intervention. Mothers were interviewed about maternal and child characteristics, energy consumption and protein intake entered in the food recall form. The questionnaire was self-administered to identify the practices that influence the incidence of malnutrition. The structured questionnaire contained open and closed questions arranged according to the variables studied. Responses to the 3 x 24-hour recall interviews were used to determine dietary energy (kcal) and protein (g) intake. All study participants performed the 24-hour recall at baseline (August 2020) and again at the end line (February 2021).

Intervention. The integrated nutritional health intervention is a community-based nutritional intervention aimed at nutritional assessment, growth monitoring, health education, food supplementation, nutrition education and communication for behavior change, and micronutrient supplementation (Maidelwita et al., 2023). The intervention group in this study received nutritional assessment interventions to improve the practice of complementary feeding and child hygiene. The integrated nutritional health intervention consists of PD, micronutrition supplementation, supplementary food, nutrition education, and emotional demonstration (emo demo). The following activities are included in the standard package of an integrated nutritional health intervention model provided by Save the Children (Figure 1).

Control Group. The control group did not receive any health nutrition intervention and were given printouts of the nutrition and food supplements program's advantages. These mothers received the standard care of monthly growth monitoring and access to the Indonesian government's supplemental feeding program, which provides energy and protein intake tr children under five years of age, consisting of food with a total calorie content of 1,000 to 1,550 kcal and a protein content of 25 to 39g.

Data Analysis. In this study, univariate and bivariate statistical analyses were carried out using statistical software version 22. Univariate analysis was used to describe the data. Bivariate analysis was used in a t-test to compare the continuous variables of the intervention and control groups. Normality and homogeneity tests were conducted before the intervention. The data were analyzed descriptively, and a homogeneity test was conducted to determine the sample distribution between the intervention group and the control group. The difference-in-differences (DID) analysis was based on the assumption that the intervention-related outcomes did not exhibit a temporal trend. The control group had the same characteristics as the intervention group, but they were not exposed to the intervention.

Ethical Consideration. Ethical approval was obtained from the Komite Etik Penelitian Kesehatan (KEPK) at Universitas Perintis Padang (180/KEPK.F1/ETIK/2020). A letter from the Health Science Faculty of Lincoln University was submitted to Padang's public health office (LUC/MKT/IND/PDG/20190901/001).

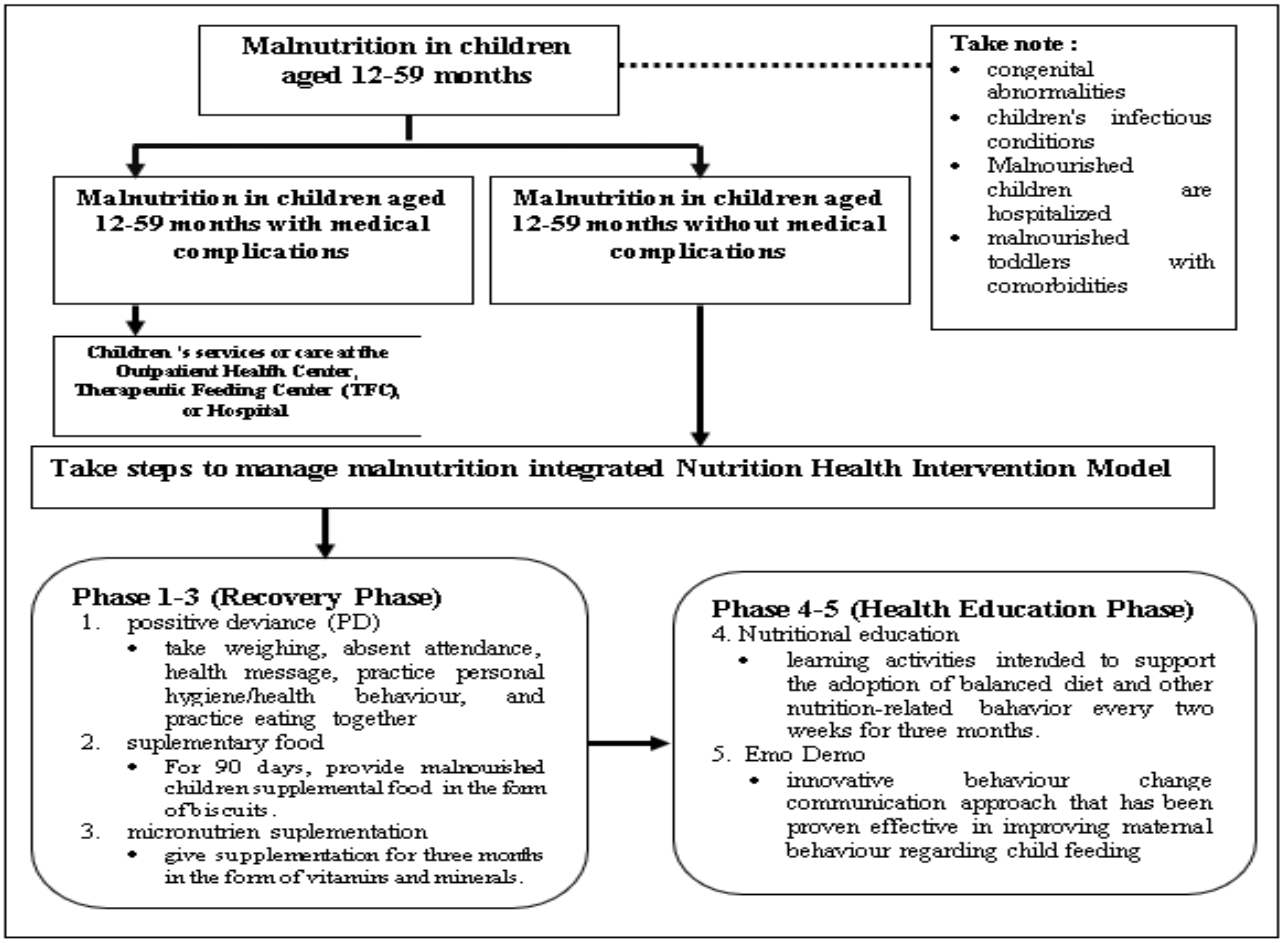

Figure 1. The Integrated Nutritional Health Intervention Model

Permission to conduct the research was obtained from the Padang City Health Office (5/57/SDMK&Jamkes/2019) and the Seberang Padang District (202.13/CPS-Kessos/2019). This research was also registered with the Padang City Government at the National and Political Unity Office (200.09.1916/Kesbangpol/2019).

Results

This study evaluated the effects of an integrated nutritional health intervention on children's energy and protein intake. The study measured energy and protein intake at baseline and at the end line to determine the effects of an integrated nutritional health intervention on energy and protein intake in malnutrition.

Energy and Protein Intake at Baseline. The differences in energy and protein intake of children under five before being given the integrated nutritional health intervention were calculated from the results of the pre-test. Before testing a hypothesis, a prerequisite test is first conducted. This analysis prerequisite test aims to determine the statistical test tool that will be used, namely for parametric or non-parametric statistics. The tests used for the analysis requirements in this study were normality tests and homogeneity tests. The homogeneity test used Levene's test method with the test criterion that if the p-value > .05, then H0 is accepted, meaning that both groups have the same variance, and vice versa, if the p-value < .05, then Ho is rejected and Ha is accepted.

Table 1. Mean Values of Energy and Protein Intake Per Day at Baseline

Variable	Intervention	Control	Overall sample	Min–Max	p
	Mean±SD (n = 70)	Mean±SD (n = 70)	Mean±SD (n = 140)		
Adequate Energy Intake (kcal)	1002.49±102.04	1073.64±115.79	1038.07±114.45	777.46–1503.00	.000*
Adequate Protein Intake (g)	19.96±1.45	21.09±2.11	20.53±1.89	12.67–25.89	.000*

t independent = t-test
*significant p < .05

Table 2. Mean Value for Energy and Protein Intake Per Day at the End Line

Variable	Intervention	Control	Overall sample	Min–Max	p
	Mean±SD (n = 70)	Mean±SD (n = 70)	Mean±SD (n = 140)		
Adequate Energy Intake (kcal)	1371.94±54.47	1037.56±139.31	1204.75±198.14	1200.00–1471.00	.000*
Adequate Protein Intake (g)	24.18±2.32	20.69±1.49	22.44±2.62	17.18–27.89	.000*

t = independent t-test
*significant p < .05

The results of the variance homogeneity test were 0.806, with a p-value of .938. Because the p-value = .371 > .05, then H0 was accepted, which means that the two group variances were the same. The basic assumptions of testing the normality and homogeneity of variance of the sample group data were met so that the data values of the two sample groups were normally distributed with homogeneous variance and were tested using the independent samples t-test to assess differences in adequate energy and protein intake of children under five before being given the integrated nutritional health intervention calculated from the pre-test results. The results can be seen in Table 1.

Table 1 shows that across the intervention and control groups, the recommended energy intake baseline mean and standard deviation were 1038.07 kcal ± 114.45 kcal. The scores ranged from 777.46 kcal to 1503.00 kcal. There was a statistically significant difference between the intervention and control groups for adequate energy intake at baseline (p = .000). The mean ± SD for sufficient protein intake in both the intervention and control groups was 20.53 g ± 1.89 g, ranging between 12.67 g and 25.89 g. The intervention and control groups' values at baseline before the experiment showed a statistically significant difference (p = .000).

Energy and Protein Intake at the End Line. Based on the results of the homogeneity test of the variance of the case and control groups, the significance value obtained = .811 > .05, meaning that H0 was accepted and Ha was rejected, so it can be concluded that the variance of the data values of the two sample classes was the same. The differences in the energy and protein intake of children under five after being given the integrated nutritional health intervention were calculated from the results of the posttest. The independent samples t-test was used. The results are presented in Table 2.

Table 2 shows that at the end of the experiment, the overall mean ± SD for adequate energy intake was 1204.75 kcal ± 198.14 kcal. The range of scores was 120.00 kcal to 1471.00 kcal. The intervention and control groups had statistically

different energy intakes (p = .000). At baseline, the intervention and control groups' mean adequate protein intake was 22.44 g ± 2.62 g, and the scores ranged from 17.18 g to 27.89 g. The intervention group had a significantly higher protein intake than the control group (p = .000).

Effects of Integrated Nutritional Health Intervention on Energy and Protein Intake in Malnutrition. The participants in the intervention and control groups had their protein and energy intake for malnutrition measured at baseline and at the end of the intervention. Table 3 shows the changes in energy and protein intake at the end of the intervention.

Table 3 shows that the energy intake variables in the intervention group had a statistically significant difference (p = .000) both at the baseline and the end line of the study, whereas the energy intake variables in the control group did not have a significant difference (p = .052) at the baseline and end line of the study. The energy intake variables differed, indicating a significant increase in the score between the beginning and the end of the study (DID = 405.53, 95% CI = 362.01–449.05, p = .000).

Table 3 shows that the protein intake variables in the intervention group had a statistically significant difference (p = .000) at the baseline and end line of the study, whereas the protein intake variables in the control group did not have a significant difference (p = .519) at the baseline and end line of the study. The protein intake variables differed, indicating a significant increase in the score from the beginning to the end of the study (DID = 4.62, 95% CI = 3.79–5.45, p = .000).

Discussion

The goal of this study was to investigate whether an integrated nutritional health intervention program was effective in boosting children's energy and protein consumption, as well as if there was a substantial increase in nutrition after the intervention. The findings indicate that there was a statistically significant variation in energy intake between the baseline and the end line (p < .001). These results are consistent with recent studies emphasizing the importance of early nutritional interventions. For instance, Puentes et al. (2022) demonstrated that enhanced protein and energy consumption among children aged 6–24 months in low-income settings contributed substantially to growth outcomes, including height and weight.

Children in the intervention group did not significantly differ from those in the control group in terms of daily total energy intake (kcal) changes

Table 3. Comparison of Energy and Protein Intake Per Day in Malnutrition between the Control Group and the Intervention Group

Variable	Control			Intervention			Program Effect (DID Estimates)	
	Baseline Mean ± SD (n = 70)	End line Mean ± SD (n = 70)	p	Baseline Mean ± SD (n = 70)	End line Mean ± SD (n = 70)	p	DID Mean (95% CI)	p
Adequate Energy Intake (kcal)	1073.64 ± 115.79	1037.56 ± 139.31	.052*	1002.49 ± 102.04	1371.94 ± 54.47	.000*	405.53 (362.01–449.05)	.000**
Adequate Protein Intake (g)	21.09 ± 2.11	20.69 ± 1.49	.519*	19.96 ± 1.45	24.18 ± 2.32	.000*	4.62 (3.79–5.45)	.000**

DID – difference-in-differences
*dependent t-test, significant p < .05
**independent t-test, significant p < .05

($p > .05$) (Table 3). Additionally, the mean increases in calorie intake in the intervention group were significantly greater ($p = .000$). In the comprehensive nutritional health intervention for the under five children, the energy intake of the intervention group was higher than that of the control group. Similar findings were found in Vietnam, where a two-way repeated measures analysis of variance was used to compare groups with and without adequate protein intake before and after the intervention (Nguyen et al., 2020).

Mothers who participated in the integrated nutritional health intervention fed their children more frequently and included a wider variety of foods, leading to reduced malnutrition in the intervention group. Childhood malnutrition often stems from the low energy density and limited nutrient content of staple foods commonly consumed in many low-income settings. Encouraging the combination of staples with diverse, nutrient-rich foods and increasing meal frequency as promoted in the intervention substantially improves dietary adequacy among young children (Terefe et al., 2023). However, numerous barriers prevent the immediate adoption of these interventions in non-participating communities, including insufficient resources, lack of community engagement, and limited knowledge dissemination (Ezezika et al., 2021). These findings highlight the urgent need to enhance implementation strategies such as culturally tailored education, strengthened community support, and resource mobilization to ensure that life-saving nutritional guidance becomes routine practice.

Evidence strongly indicates that inadequate energy intake is a primary barrier to children's linear growth, even when protein is sufficient (Puentes et al., 2022). Moreover, a 2022 meta-analysis of 38 randomized controlled trials established that manipulating dietary energy density can alter energy intake lowering energy density decreased energy intake by roughly 223 kcal/day, indicating that in low-food-access environments, increasing energy density offers a pragmatic solution to meet caloric needs without increasing meal size (Klos et al., 2023).

Additionally, inflammation-linked appetite suppression is a recognized factor in reduced food consumption among young children, underscoring the need to enhance the energy density of complementary foods to support appetite and energy intake (Zhang et al., 2022). Thus, prioritizing the fortification of staple meals with energy-dense ingredients such as healthy fats, proteins, or micronutrient-rich additives emerge as a feasible and effective strategy to mitigate energy deficits and foster growth especially in resource-constrained settings.

The results of this study showed that the integrated nutritional health intervention model improved the participants' adequate protein intake. The effects of malnutrition in children are borne throughout their life cycle and through subsequent generations. Nutritional inadequacy resulting from food insecurity during adolescence poses significant risks to both current and future health outcomes, including impaired physical growth, cognitive development, and disease susceptibility (Food and Agriculture Organization [FAO] et al., 2021).

According to recent global nutrition guidelines, the introduction of complementary feeding should commence at six months of age, ensuring that the foods provided are appropriate in quantity, frequency, energy density, and micronutrient content, while also adhering to safe food preparation and handling practices (WHO, 2003). Evidence indicates that adherence to these complementary feeding practices substantially reduces the risk of undernutrition and related health complications in young children (Bengre et al., 2023).

This study's findings showed a statistically significant difference in appropriate protein intake between the intervention and control groups. Following the integrated nutritional health intervention, there was a statistically significant difference between the baseline and end line in

the intervention group (p = .000). There was also a statistically significant difference between the control group's baseline and end line following nutritional health therapies (p = .000).

In Vietnam, a two-way repeated measures analysis of variance was used to compare differences in recommended protein consumption between groups before and after the intervention Nguyen et al. 2020). Furthermore, Escher et al. (2024).confirmed that targeted nutritional interventions, including protein supplementation and dietary diversity enhancement, significantly improved protein adequacy among children in low- and middle-income countries.

Children in the integrated nutritional health intervention group had the highest mean energy intake (12.67 g at baseline and 20.01 g at the endpoint), which may have contributed to their protein intake. Based on research on malnourished children, the Minister of Health of the Republic of Indonesia issued Regulation No. 28 of 2019 regarding recommended nutritional adequacy for Indonesians, which includes a higher protein intake (for children 1–3 years 20 g and 4–6 years 25 g) (Ministry of Health, Republic of Indonesia, 2019).

Despite the significant differences in these results, both groups' energy intake was appropriate. An energy intake of 80%–100% of the recommended dietary allowance (RDA) is considered good (Pratiwi et al., 2022). Energy sufficiency is critical, particularly during periods of rapid growth. Malnutrition, including a lack of protein energy, iron deficiency anemia, vitamin A insufficiency, and several viral illnesses, is more common in children aged 1–6. When children reach preschool age, they enter a time of slow growth (growth plateau). However, energy sufficiency must still be considered to balance physical activity and balancing mechanisms when infection occurs (Roberts et al., 2022). This study showed that an integrated nutritional health intervention improved the participants' protein intake.

Following the integrated nutritional health intervention, the intervention group achieved a higher mean protein intake (24.18 g/day) compared to the control group (20.69 g/day). While both groups met the RDA, the elevated intake in the intervention group carries implications beyond basic nutritional adequacy. Protein is a critical macronutrient for children under five, vital not only for energy but also for tissue synthesis, repair, immune function, and cognitive development (Zhang et al., 2022). Epidemiological evidence, including the Generation R cohort, shows that greater animal protein intake in early childhood is associated with improved long-term growth metrics specifically height and weight gains suggesting that protein quality and source significantly influence developmental outcomes (Stokes et al., 2021), recent research from Africa confirms that increased consumption of animal-sourced foods (rich in protein and micronutrients) reduced stunting by 6.8 percentage points a finding that underscores the broader impact of higher protein intake on linear growth (Khonje & Qaim, 2024).

Nurses have an important role in supporting procedures for meeting children's nutritional needs and preventing malnutrition. Nurses are expected to always pay attention to the nutritional needs of malnourished children, provide appropriate interventions, and improve the child's quality of life. Nurses have an important responsibility in carrying out these interventions and ensuring that children's nutritional needs are properly met.

Conclusion

An integrated nutritional health intervention enhanced the energy and protein intake of malnourished children, according to this study. Nutritional intervention was found to have a significant impact on the prevalence of risks and energy and protein intake. The importance of nurses in delivering dietary health interventions and assistance should not be overlooked. Malnutrition in children can be reduced using strategies based on accurate nutritional evaluation

and adequate nutrition education.

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References

Ahmed, K.Y., Ogbo, F.A., Tegegne, T.K., Dalton, H., Arora, A., & Ross, A.G. (2023). Interventions to improve the nutritional status of children under 5 years in Ethiopia: A systematic review. *Public Health Nutrition, 26* (12), 3147–3161. doi: 10.1017/s1368980023002410.

Bengre, A., Nayak, B.S., B, U., Ravishankar, N., Shashidhara, Y.N., & Mundkur, S.C. (2023). Impact of a home-based nutritional intervention program on nutritional status of preschool children: A cluster randomized controlled trial. *BMC Public Health, 23* (1), 51. doi: 10.1186/s12889-022-14900-4.

Concern Worldwide. (2024). *2024 Global hunger index.* Retrieved from: https://www.concern.net/knowledge-hub/2024-global-hunger-index

Das, S., Fahim, S.M., Islam, M.S., Biswas, T., Mahfuz, M., & Ahmed, T. (2019). Prevalence and sociodemographic determinants of household-level double burden of malnutrition in Bangladesh. *Public Health Nutrition, 22* (8), 1425–1432. doi: 10.1017/S1368980018003580.

Escher, N.A., Andrade, G.C., Ghosh-Jerath, S., Millett, C., & Seferidi, P. (2024). The effect of nutrition-specific and nutrition-sensitive interventions on the double burden of malnutrition in low-income and middle-income countries: A systematic review. *The Lancet Global Health, 12* (3), E419–E432. doi: 10.1016/S2214-109X(23)00562-4.

Ezezika, O., Gong, J., Abdirahman, H., & Sellen, D.W. (2021). Barriers and facilitators to the implementation of large-scale nutrition interventions in Africa: A scoping review. *Global Implementation Research and Applications, 1* (1), 38–52. doi: 10.1007/s43477-021-00007-2.

Food and Agriculture Organization (FAO), International Fund for Agricultural Development (IFAD), United Nations International Children's Emergency Fund (UNICEF), World Food Programme (WFP), & World Health Organization (WHO). (2021). *The state of food security and nutrition in the world 2021: Transforming food systems for food security, improved nutrition, and affordable healthy diets for all.* Food and Agriculture Organization of the United Nations. doi: 10.4060/cb4474en.

Kang, H. (2021). Sample size determination and power analysis using the G*Power software. *Journal of Educational Evaluation for Health Professions, 18,* 17. doi: 10.3352/jeehp.2021.18.17.

Khonje, M.G., & Qaim, M. (2024). Animal-sourced foods improve child nutrition in Africa. *Proceedings of the National Academy of Sciences of the United States of America, 121* (50), e2319009121. doi: 10.1073/pnas.2319009121.

Klos, B., Cook, J., Crepaz, L., Weiland, A., Zipfel, S., & Mack, I. (2023). Impact of energy density on energy intake in children and adults: A systematic review and meta-analysis of randomized controlled trials. *European Journal of Nutrition, 62,* 1059–1076. doi: 10.1007/s00394-022-03054-z.

Maidelwita, Y. (2019). Risk factors for malnutrition of children under five years old on the area of Nanggalo Public Health Center Padang West Sumatera. *Malaysian Journal of Medical Research, 3* (1), 10–17. doi: 10.31674/mjmr.2019.v03i01.003.

Maidelwita, Y., Sansuwito, T.B., Said, F.B.M., & Poddar, S. (2023). Effectiveness of nutritional health interventions on improving knowledge, attitude, and eating habits among malnourished toddlers. *International Journal of Advancement in Life Sciences Research, 6* (4), 6–14. doi: 10.31632/ijalsr.2023.v06i04.002.

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. doi: 10.3390/nu15112430.

Manoochehri, S., Faradmal, J., Poorolajal, J., Asadi, F.T., & Soltanian, A.R. (2024). Risk factors associated with underweight in children aged one to two years: A longitudinal study. *BMC Public Health, 24* (1), 1875. doi: 10.1186/s12889-024-19147-9.

Ministry of Health, Republic of Indonesia. (2019). *Peraturan Menteri Kesehatan Nomor 28 Tahun 2019 tentang angka kecukupan gizi yang dianjurkan untuk masyarakat Indonesia.* Berita Negara Republik Indonesia Tahun 2019, Nomor 956. Retrieved from: https://peraturan.bpk.go.id/Details/138621/permenkes-no-28-tahun-2019

Moges, T., Baudron, F., Luo, H., Brouwer, I.D., Remans, R., & Groot, J.C.J. (2024). Inadequacy of nutrients in children's diets across seasons along an agricultural intensification gradient in Ethiopia. *Food Security, 16*, 899–919. doi: 10.1007/s12571-024-01463-y.

Nguyen, H.T., Pavey, T.G., Collins, P.F., Nguyen, N.V., Pham, T.D., & Gallegos, D. (2020). Effectiveness of tailored dietary counseling in treating malnourished outpatients with chronic obstructive pulmonary disease: A randomized controlled trial. *Journal of the Academy of Nutrition and Dietetics, 120* (5), 778–791.e1. doi: 10.1016/j.jand.2019.09.013.

Pratiwi, A.A., Chandra, D.N., & Khusun, H. (2022). Association of ultra processed food consumption and body mass index for age among elementary students in Surabaya. *Amera Nutrition, 6* (2), 140–147. doi: 10.20473/amnt.v6i2.2022.140-147.

Puentes, E., Wang, F., Behrman, J.R., Cunha, F., Hoddinott, J., Maluccio, J.A., Adair, L.S., Borja, J.B., Martorell, R., & Stein, A.D. (2022). Early life height and weight production functions with endogenous energy and protein inputs. doi: 10.48550/arXiv.2204.02542.

Roberts, M., Tolar-Peterson, T., Reynolds, A., Wall, C., Reeder, N., & Mendez, G.R. (2022). The effects of nutritional interventions on the cognitive development of preschool-age children: A systematic review. *Nutrients, 14* (3), 532. doi: 10.3390/nu14030532.

Stokes, A., Campbell, K.J., Yu, H.J., Szymlek-Gay, E.A., Abbott, G., He, Q.Q., & Zheng, M. (2021). Protein intake from birth to 2 years and obesity outcomes in later childhood and adolescence: A systematic review of prospective cohort studies. *Advances in Nutrition, 12* (5), 1863–1876. doi: 10.1093/advances/nmab034.

Syafrawati, S., Lipoeto, N.I., Masrul, M., Novianti, N., Gusnedi, G., Susilowati, A., Nurdin, A., Purnakarya, I., Andrafikar, A., & Umar, H.B. (2023). Factors driving and inhibiting stunting reduction acceleration programs at district level: A qualitative study in West Sumatra. *PloS ONE, 18* (3), e0283739. doi: 10.1371/journal.pone.0283739.

Terefe, B., Jembere, M.M., & Mekonnen, B.A. (2023). Minimum meal frequency practice and associated factors among children aged 6–23 months old in The Gambia: A multilevel mixed effect analysis. *Scientific Reports, 13* (1), 22607. doi: 10.1038/s41598-023-49748-0.

Triatmaja, N.T., Mahmudiono, T., Mamun, A.A., & Abdullah, N.A. (2023). Effectiveness of positive deviance approach to reduce malnutrition among under five children: A systematic review and meta-analysis of interventional studies. *Nutrients, 15* (8), 1961. doi: 10.3390/nu15081961.

United Nations Children's Fund (UNICEF). (2020). *The state of children in Indonesia – Trend, opportunities and challenges for realizing children's rights. UNICEF.* Retrieved from: https://www.unicef.org/indonesia/sites/unicef.org.indonesia/files/2020-06/The-State-of-Children-in-Indonesia-2020.pdf

United Nations International Children's Emergency Fund (UNICEF), World Health Organization (WHO), & The World Bank. (2021). *Levels and trends in child malnutrition: Key findings of the 2021 edition.* Retrieved from: https://data.unicef.org/wp-content/uploads/2021/07/JME-2021-United-Nations-regions-v2.pdf

United Nations International Children's Emergency Fund (UNICEF), World Health Organization (WHO), & The World Bank (2023). *Levels and trends in child malnutrition: Key findings of the 2023 edition.* Retrieved from: https://iris.who.int/bitstream/handle/10665/368038/9789240073791-eng.pdf?sequence=1

Vijay, J., & Patel, K.K. (2024). Malnutrition among under-five children in Nepal: A focus on socioeconomic status and maternal BMI. *Clinical Epidemiology and Global Health, 27,* 101571. doi: 10.1016/j.cegh.2024.101571.

World Food Programme. (2023). *Indonesia country brief*. Retrieved from: https://www.wfp.org/publications/indonesia-country-brief

World Health Organization (WHO). (2003). *Guiding principles for complementary feeding of the breastfed child.* Retrieved from: https://www.who.int/publications/i/item/9275124604

World Health Organization (WHO). (2023). *Malnutrition*. Retrieved from: https://www.who.int/health-topics/malnutrition

Young, C., & Argáez, C. (2019). *Interventions for malnutrition in older adults: A review of clinical effectiveness.* Canadian Agency for Drugs and Technologies in Health. Retrieved from: https://www.ncbi.nlm.nih.gov/books/NBK541429/

Zhang, C., Ren, W., Li, M., Wang, W., Sun, C., Liu, L., Fang, Y., Liu, L., Yang, X., Zhang, X., & Li, S. (2022). Association between the children's dietary inflammatory index (C-DII) and markers of inflammation and oxidative stress among children and adolescents: NHANES 2015-2018. *Frontiers in Nutrition, 9,* 894966. doi: 10.3389/fnut.2022.894966.