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Enhancing 'First 1,000 Days' Nutrition Literacy via a Posyandu Kader 'Train-the-Trainer' Model: A Mixed-Methods Impact Evaluation on Child Nutritional Status in Eastern Indonesia

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A B S T R A C T

The 'First 1,000 Days' (HPK) period is critical for preventing stunting, a significant public health challenge in Indonesia, particularly in Eastern provinces. *Posyandu kader* (community health volunteers) are pivotal, but their effectiveness is often hampered by inadequate and unstandardized training. This study evaluates the impact of a structured 'Train-the-Trainer' (ToT) model on *kader* nutrition literacy and, subsequently, on child nutritional status. We conducted a quasi-experimental, convergent parallel mixed-methods study in two districts of East Nusa Tenggara (NTT) province, Indonesia. The intervention district (n=50 *kader*, n=312 mother-child dyads) received the ToT intervention, while the control district (n=50 *kader*, n=309 mother-child dyads) continued standard practices. The ToT model involved training *Puskesmas* (health center) staff as 'Master Trainers' who then cascaded structured training and mentorship to *kader* over 12 months. Quantitative data (kader literacy scores, child anthropometry [Height-for-Age Z-score, HAZ]) were collected at baseline and 12-month follow-up, analyzed using Difference-in-Differences (DiD) and linear mixed-effects models (LMM). Qualitative data (n=24 in-depth interviews, n=6 focus group discussions) explored the intervention's mechanisms, fidelity, and contextual facilitators. At 12 months, *kader* nutrition literacy in the intervention group increased significantly (mean score change: +29.8 points) compared to the control group (+2.1 points, $p < 0.001$). The LMM analysis, controlling for covariates, showed a significant 'time × group' interaction effect on child HAZ ($\beta = 0.28$, 95% CI [0.15, 0.41], $p < 0.001$), indicating a meaningful improvement in child growth attributable to the intervention. Stunting prevalence (HAZ < -2 SD) in the intervention group decreased by 8.7 percentage points, while it remained stagnant in the control group. Qualitative themes revealed that the ToT model enhanced *kader* self-efficacy, shifted their role from passive data collectors to active counselors, and provided mechanisms to address local socio-cultural barriers to nutrition. In conclusion, the 'Train-the-Trainer' model is an effective and scalable strategy for enhancing *kader* nutrition literacy and precipitating measurable improvements in child nutritional status in high-burden settings. This model provides a sustainable framework for strengthening community health systems to combat stunting, aligning with Indonesia's national strategy and Sustainable Development Goal 3.

1. Introduction

The period from conception to a child's second birthday, known as the 'First 1,000 Days' (HPK - *Hari Pertama Kehidupan*), represents a unique and critical window of opportunity for shaping long-term health, cognitive development, and human capital. Nutritional deficiencies and adverse exposures during this time can cause irreversible damage, leading to stunting (low height-for-age), which is a primary indicator of chronic malnutrition.[1] Stunting affects an estimated 149 million children under five globally and is associated with impaired brain development, lower educational attainment, reduced adult economic productivity, and an increased risk of chronic disease in adulthood.

Consequently, addressing stunting is a central pillar of the Sustainable Development Goals (SDGs), particularly SDG 2 (Zero Hunger) and SDG 3 (Good Health and Well-being).[2]

Indonesia, the world's fourth most populous country, faces a formidable challenge with stunting. Despite significant economic progress, the national prevalence of stunting in children under five was 24.4% in 2021, far exceeding the World Health Organization (WHO) threshold of 20% that defines a public health problem of high significance. The burden is not distributed equally; geographic disparities are profound, with provinces in Eastern Indonesia, such as East Nusa Tenggara (NTT), consistently reporting prevalence rates exceeding 35-40%.[3] This disparity highlights deep-rooted issues of food insecurity, poor access to health services, low maternal education, and persistent socio-cultural practices that can negatively impact infant and young child feeding (IYCF).

In response, the Indonesian government has launched a national strategy for stunting reduction (*Strategi Nasional Percepatan Penurunan Stunting*), emphasizing a multi-sectoral approach.[4] Central to this strategy's implementation at the grassroots level is the *Posyandu* (Integrated Health Service Post), a monthly community-based health post run by volunteer community health workers known as *kader*. *Posyandu kader* are typically women from the community who are responsible for monthly child weighing, growth monitoring, providing supplemental feeding, and disseminating health and nutrition information to pregnant women and mothers of young children. They are the frontline interface between the formal health system (the *Puskesmas* or community health center) and the community.[5]

However, the potential of the *Posyandu* system to effectively combat stunting is often undermined by critical gaps in *kader* competency. Studies consistently report that *kader* knowledge of crucial 'First 1,000 Days' nutrition concepts—such as the importance of maternal diet, exclusive breastfeeding, and the principles of timely, adequate, safe, and properly-fed complementary feeding (*MP-ASI*)—is highly variable and often insufficient.[6] Training for *kader* is frequently sporadic, unstandardized, based on outdated materials, and employs passive, didactic teaching methods that fail to build practical counseling skills or self-efficacy. Furthermore, *kader* often lacks the structured support and mentorship from the formal health system needed to translate knowledge into effective practice.[7]

To address this implementation gap, scalable and sustainable training models are urgently required. The 'Train-the-Trainer' (ToT) model presents a promising solution. In this model, a core group of health professionals (such as *Puskesmas* nutritionists and midwives) is intensively trained as 'Master Trainers'. These Master Trainers are then equipped to "cascade" the training to a large number of frontline workers (*kader*) within their catchment areas, providing ongoing mentorship and quality assurance. This approach leverages existing health system structures, promotes local ownership, and is theoretically more cost-effective and scalable than direct training of thousands of *kader* by external experts.[8]

While the ToT model is widely used in global health, rigorous evidence of its impact on the full causal pathway—from improving *kader* literacy and self-efficacy, to changing *kader* counseling behaviors, and ultimately, to improving child nutritional outcomes—is limited, particularly within the unique Indonesian *Posyandu* context.[9] Most studies focus on immediate post-training knowledge (a low-level outcome) or are purely qualitative, lacking a control group to attribute changes in child health status directly to the intervention.[8] This evidence gap hinders policy-makers from making informed decisions about adopting and scaling such models.[10]

This study aims to fill this critical gap by evaluating the impact of a structured 'Train-the-Trainer' intervention, focused on 'First 1,000 Days' nutrition, in East Nusa Tenggara province. The study's novelty lies in its robust, quasi-experimental mixed-methods design. We move beyond simple knowledge assessment to (1) quantify the intervention's impact on *kader* nutrition literacy (knowledge, attitudes, and

self-efficacy) and (2) measure the subsequent impact on child nutritional status (stunting) using a controlled Difference-in-Differences (DiD) analysis. Concurrently, we use qualitative methods to (3) elucidate the *mechanisms* of change, exploring *how* the ToT model was implemented, perceived, and translated into practice, and identifying the contextual facilitators and barriers that shaped its success.

Therefore, the primary aim of this study was to evaluate the effectiveness of a 'Train-the-Trainer' model in improving *Posyandu kader* nutrition literacy and reducing stunting among children under two years of age in Eastern Indonesia. We hypothesized that *kader* in the intervention group would demonstrate significantly greater improvements in nutrition literacy and that this improvement would be associated with a statistically significant positive change in the Height-for-Age Z-scores (HAZ) of children in their communities, compared to the control group.

2. Methods

This study employed a quasi-experimental, convergent parallel mixed-methods design. (1) Quantitative Component: A controlled pre-post (baseline and 12-month follow-up) design was used to assess the impact of the ToT intervention. We compared changes in *kader* literacy and child anthropometric outcomes between an intervention district and a control district; (2) Qualitative Component: A descriptive qualitative study, involving in-depth interviews (IDIs) and focus group discussions (FGDs), was conducted at the 12-month follow-up point. This component ran concurrently with the quantitative data collection to explore the implementation process, intervention mechanisms, and contextual factors from the perspectives of participants and stakeholders. The convergent design involved collecting and analyzing the quantitative and qualitative data separately, then "mixing" the results during the interpretation and discussion phase to provide a more comprehensive understanding of the intervention's impact.

The study was conducted in East Nusa Tenggara (NTT) province, Eastern Indonesia. NTT was purposively selected due to its high prevalence of child stunting (37.8% in 2021) and its reliance on the *Posyandu* system. Two districts with similar demographic profiles and stunting prevalence but geographically distinct *Puskesmas* catchment areas were selected: one as the intervention site (District A) and one as the control site (District B). Participants were recruited at multiple levels: (1) *Posyandu Kader*: In each district, 50 *kader* were randomly selected from a list of all active *kader* in 10 purposively selected villages (5 *kader* per village) known to have high stunting rates. Inclusion criteria were: being an active *kader* for at least one year and providing services to mothers with children under two; (2) Mother-Child Dyads: In the catchment area of these 100 *kader* (50 per district), we recruited a cohort of mother-child dyads. Inclusion criteria were: child aged 0-12 months at baseline (to ensure they were still within the 'First 1,000 Days' window at follow-up), mother as the primary caregiver, and planning to reside in the village for the next 12 months. We recruited approximately 310 dyads per arm to account for an estimated 15% attrition; (3) Qualitative Participants: A purposive sub-sample of participants was recruited at the 12-month follow-up for IDIs and FGDs. This included: *Posyandu kader* (n=10), mothers (n=10), Master Trainers (n=4, intervention arm only), and *Puskesmas* (health center) midwives/nutritionists (n=4, two per arm). Six FGDs were conducted (three per arm), segregated by *kader* and mothers.

The intervention was designed based on social cognitive theory [20], aiming to improve knowledge, skills, and self-efficacy.

Phase 1: Development and master trainer (ToT) workshop (Month 0)

An evidence-based training module on 'First 1,000 Days' nutrition was developed in *Bahasa Indonesia*. The module was highly practical, skill-based, and used visual aids adapted for a low-literacy context. Key topics included: (1) The concept of stunting and the

'First 1,000 Days', (2) Maternal nutrition during pregnancy and lactation, (3) The "golden standard" of exclusive breastfeeding, (4) Principles of complementary feeding (*MP-ASI:* timely, adequate, safe, and responsive feeding), and (5) Interpersonal counseling (IPC) skills and empathy. In the intervention district (District A), 10 'Master Trainers' (selected *Puskesmas* nutritionists and senior midwives) attended an intensive 3-day ToT workshop facilitated by expert nutritionists from the research team. This workshop focused on mastering the module content and, crucially, on adult education principles, facilitation skills, and how to conduct supportive mentorship.

Phase 2: Cascade training and mentorship (Months 1-12)

The 10 Master Trainers returned to their *Puskesmas* and were responsible for training the 50 selected *kader* in their catchment area. The cascade involved an initial 2-day training workshop for the *kader*. This was followed by monthly structured mentorship and reinforcement sessions (2-3 hours each) for the *kader* over the 12-month intervention period. These sessions, led by the Master Trainers, took place during regular *Posyandu* or *Puskesmas* meetings and involved case-study discussions, role-playing counseling scenarios, and problem-solving local challenges.

Control group (District B)

Kader and *Puskesmas* staff in the control district received no intervention from the research team. They continued with the "standard of care," which included sporadic, ad-hoc training or information dissemination from the District Health Office, if any.

Quantitative data were collected at baseline (Month 0) and follow-up (Month 12) in both districts by a team of trained enumerators blinded to the group allocation; (1) *Kader* Nutrition Literacy: A structured questionnaire, adapted from previous validated tools and pre-tested in a similar Indonesian context, was administered. It consisted of three domains: (i) Knowledge: 30 multiple-choice questions on 'First 1,000 Days' nutrition (such as breastfeeding benefits, *MP-ASI* texture progression, stunting signs). Score range: 0-100; (ii) Attitudes: 10 items on a 5-point Likert scale (Strongly Disagree to Strongly Agree) about their role and the importance of nutrition counseling (for instance, "My counseling can change a mother's feeding habits"). Score range: 10-50; (iii) Self-Efficacy: 10 items on a 5-point Likert scale (Not at all Confident to Very Confident) about their ability to perform specific tasks (for instance, "How confident are you in helping a mother who is struggling with breastfeeding?"). Score range: 10-50; (2) Child Anthropometry**:** Children's weight and length were measured by trained anthropometrists following WHO standard procedures. Weight was measured to the nearest 0.01 kg using calibrated digital infant scales (SECA 874). Length was measured to the nearest 0.1 cm using portable infantometers (SECA 417). Measurements were taken in duplicate, and the average was used. Age was calculated from the date of birth, verified from birth certificates or child health cards (*Kartu Menuju Sehat*). Height-for-Age (HAZ), Weight-for-Age (WAZ), and Weight-for-Height (WHZ) Z-scores were calculated using the WHO Anthro software (version 3.2.2). Stunting, underweight, and wasting were defined as HAZ, WAZ, and WHZ < -2 Standard Deviations (SD), respectively; (3) Covariates: A baseline household survey collected data on potential confounders: child's gender and age, maternal age, maternal education (none, primary, secondary, tertiary), paternal education, household income (quintiles), and number of children.

For qualitative data, at the 12-month follow-up, semi-structured IDIs and FGDs were conducted in Bahasa Indonesia by trained qualitative researchers. Separate interview guides were developed for each participant group (kader, mothers, Master Trainers, Puskesmas staff). The guides explored: (1) Perceptions and experiences with the ToT model (intervention group) or standard training (control group); (2) Observed changes in *kader* counseling practices and confidence; (3) Mechanisms of change (i.e., *how* the

training led to different behaviors); (4) Contextual facilitators and barriers to implementing nutritional advice (such as cultural beliefs, poverty, food access); (5) Fidelity and quality of the training cascade. All IDIs and FGDs were audio-recorded, transcribed verbatim, and translated into English by professional translators, with back-translation checks for key terms.

Quantitative analyses were conducted using Stata v17.0, following an intention-to-treat (ITT) principle. Baseline characteristics of *kader* and mother-child dyads in both groups were compared using independent t-tests for continuous variables (such as age, baseline HAZ) and Chi-square (X^2) tests for categorical variables (such as maternal education, child gender) to assess for group equivalency. The primary impact of the intervention was assessed using a DiD approach. For *kader* literacy outcomes and child anthropometric Z-scores (HAZ, WAZ, WHZ), we used linear mixed-effects models (LMM) to account for the clustered nature of the data (children nested within *Posyandu*, *kader* nested within villages/Puskesmas). The model was specified as:

$$Y_{ijt} = \beta_0 + \beta_1(Time_t) + \beta_2(Group_j) + \beta_3(Time_t \times Group_j) + \beta_4(X_{ijt}) + u_j + e_{ijt}$$

Where:

- Y_{ijt} is the outcome of interest (such as HAZ score) for child *i* in group *j* at time *t*.
- $Time_t$ is a dummy variable (0 = baseline, 1 = follow-up).
- $Group_j$ is a dummy variable (0 = control, 1 = intervention).
- $Time_t$ x $Group_j$ is the interaction term. The coefficient β_3 is the DiD estimator, representing the average differential change in the outcome in the intervention group compared to the control group. This was our primary coefficient of interest.
- X_{ijt} is a vector of baseline covariates (child gender, baseline child age, maternal education, household income).
- u_j is the random effect for the cluster (such as *Posyandu* or village).
- e_{ijt} is the error term.

A similar DiD model using a logistic link (generalized linear mixed model - GLMM) was used to assess the intervention's impact on the odds of stunting (HAZ < -2 SD).

Qualitative data were analyzed using a reflexive thematic analysis approach in NVivo 12 software; (1) Familiarization: The research team read and re-read the transcripts to immerse themselves in the data; (2) Coding: Two researchers independently coded the first six transcripts (two from each participant type) to develop an initial codebook. Discrepancies were resolved through discussion with a third senior researcher. This codebook was then applied to the remaining transcripts; (3) Theme Generation: Codes were collated and sorted into potential themes and sub-themes. The research team held workshops to review, refine, and name the themes, ensuring they accurately represented the data; (4) Reporting: Themes were finalized, and illustrative quotes were selected to substantiate the analysis. The analysis focused on identifying mechanisms of change and comparing the experiences of the intervention and control groups.

The study protocol was approved by the Health Research Ethics Committee of CMHC Research Center, Indonesia. Written informed consent (or a thumbprint for non-literate participants, witnessed by an impartial third party) was obtained from all participants prior to any data collection. Participants were informed of their right to withdraw at any time without penalty. All data were anonymized to ensure confidentiality. The intervention was provided to the control group at the conclusion of the study, following ethical principles of beneficence.

3. Results and Discussion

A total of 100 *Posyandu kader* (50 intervention, 50 control) were enrolled and completed the study. For the mother-child dyads, 621 were recruited at baseline (312 intervention, 309 control). At the 12-month follow-up, 574 dyads remained (92.4% retention), with 288 in the intervention group (7.7% attrition) and 286 in the control group (7.4% attrition). Attrition was

primarily due to families moving out of the study villages and was not significantly different between groups.

Table 1 presents the baseline characteristics of the mother-child dyads and *kader*. The two groups were well-matched at baseline. There were no statistically significant differences in children's mean age, gender distribution, or baseline anthropometric measures (HAZ, WAZ, WHZ). Similarly, maternal and household characteristics, such as maternal age, education, and household income quintiles, were comparable. Among *kader*, there were no significant differences in age, years of experience, or educational attainment. This baseline equivalence strengthens the quasi-experimental design, suggesting that observed differences at follow-up are less likely to be due to pre-existing group disparities.[11]

Table 1. Baseline characteristics of mother-child dyads and *Posyandu kader.*

CHARACTERISTIC	INTERVENTION GROUP	CONTROL GROUP	P-VALUE
Mother-Child Dyads (n)	**312**	**309**	
Child Characteristics			
Child Age (months), mean (SD)	6.1 (3.2)	6.3 (3.1)	0.451[a]
Child Sex (Male), n (%)	160 (51.3)	151 (48.9)	0.548[b]
Baseline Anthropometry			
Height-for-Age Z-score (HAZ), mean (SD)	-2.12 (1.05)	-2.10 (1.11)	0.864[a]
Weight-for-Age Z-score (WAZ), mean (SD)	-1.98 (0.96)	-1.95 (1.02)	0.723[a]
Weight-for-Height Z-score (WHZ), mean (SD)	-0.75 (0.88)	-0.71 (0.90)	0.591[a]
Maternal & Household			
Maternal Age (years), mean (SD)	28.4 (5.5)	28.9 (5.8)	0.317[a]
Maternal Education, n (%)			0.611[b]
No Schooling / Incomplete Primary	48 (15.4)	42 (13.6)	
Primary School Graduate	111 (35.6)	115 (37.2)	
Junior High School Graduate	98 (31.4)	94 (30.4)	
Senior High School / Tertiary	55 (17.6)	58 (18.8)	
Household Income (Lowest Quintile), n (%)	88 (28.2)	81 (26.2)	0.589[b]
Parity (≥3 children), n (%)	102 (32.7)	109 (35.3)	0.527[b]
***Posyandu Kader* (n)**	**50**	**50**	
Kader Age (years), mean (SD)	41.2 (8.1)	42.5 (8.9)	0.466[a]
Years as Kader, mean (SD)	7.8 (4.2)	8.3 (4.5)	0.530[a]
Kader Education, n (%)			0.792[b]
Primary School or less	14 (28.0)	16 (32.0)	
Junior High School	22 (44.0)	20 (40.0)	
Senior High School or more	14 (28.0)	14 (28.0)	

Notes:

[a] *p-value from independent t-test for continuous variables.*

[b] *p-value from Chi-square (χ^2) test for categorical variables.*

Table 2 shows the impact of the ToT intervention on *kader* nutrition literacy scores. At baseline, knowledge, attitude, and self-efficacy scores were low and statistically indistinguishable between the two groups.[12] After 12 months, the intervention group demonstrated dramatic and statistically significant improvements across all three domains. The mean knowledge score (out of 100) increased from 54.8 to 84.6 (a 29.8-point increase). In contrast, the control group's knowledge score showed a negligible increase from 54.1 to 56.2 (a 2.1-point increase). The Difference-in-Differences (DiD) estimator, representing the net effect of the intervention, was 27.7 points (95% CI [23.1, 32.3], $p < 0.001$). Similar patterns were observed for attitudes and self-efficacy. The intervention group's self-efficacy score (out of 50) increased by 16.1 points, compared to only 1.3 points in the control group (DiD = 14.8, $p < 0.001$). This indicates the intervention was highly successful in not only transferring knowledge but also in building the *kader*'s confidence to perform counseling tasks.

Table 2. Impact of Intervention on *Kader* Nutrition Literacy Scores (n=100)

OUTCOME DOMAIN (SCALE)	GROUP	BASELINE MEAN (SD)	12-MONTH FOLLOW-UP MEAN (SD)	WITHIN-GROUP CHANGE	DIFFERENCE-IN-DIFFERENCES (DID) (95% CI)
Knowledge (0-100)	Intervention (n=50)	54.8 (8.2)	84.6 (6.1)	+29.8	27.7 (23.1, 32.3)
	Control (n=50)	54.1 (8.9)	56.2 (9.3)	+2.1	
Attitude (10-50)	Intervention (n=50)	36.1 (4.4)	44.8 (3.0)	+8.7	7.9 (6.1, 9.7)
	Control (n=50)	35.8 (4.1)	36.6 (4.0)	+0.8	
Self-Efficacy (10-50)	Intervention (n=50)	27.2 (5.1)	43.3 (3.8)	+16.1	14.8 (12.7, 16.9)
	Control (n=50)	27.2 (5.1)	28.5 (5.3)	+1.3	

Notes: *DiD (Difference-in-Differences) calculated from the linear model, adjusted for baseline score.*

Table 3 details the changes in child anthropometric outcomes. At baseline, the mean HAZ, WAZ, and WHZ scores were extremely low in both groups, indicative of the severe nutritional challenges in the region. At the 12-month follow-up, the cohort in the intervention group showed clinically and statistically significant improvements in linear growth (HAZ). The mean HAZ score in the intervention group improved from -2.12 to -1.82 (a gain of +0.30 SD). In the control group, the mean HAZ score deteriorated slightly, from -2.10 to -2.14 (a change of -0.04 SD). The resulting DiD estimator for HAZ was 0.34 (95% CI [0.22, 0.46], $p < 0.001$). This demonstrates a clear positive impact of the intervention on child stunting. Concomitantly, the prevalence of stunting (HAZ < -2 SD) in the intervention group decreased from 51.4% to 42.7% (an 8.7 percentage point reduction). In the control group, stunting prevalence effectively remained unchanged (50.5% vs. 51.0%). The DiD analysis for the odds of stunting (from the GLMM) showed that children in the intervention group had a significantly lower odds of being stunted at follow-up compared to the control group (DiD Odds Ratio = 0.68, 95% CI [0.51, 0.91], $p = 0.009$). Significant, though smaller, intervention effects were also observed for WAZ (DiD = 0.21, $p = 0.002$). No significant effect was found for WHZ (wasting), which is expected, as the intervention was primarily focused on chronic malnutrition (stunting) and feeding practices rather than acute illness and short-term weight loss.

Table 3. Impact of Intervention on Child Anthropometric Outcomes (n=574)

OUTCOME	GROUP	BASELINE (N=621) MEAN (SD)	12-MONTH FOLLOW-UP (N=574) MEAN (SD)	WITHIN-GROUP CHANGE	DIFFERENCE-IN-DIFFERENCE (DID) (95% CI)
HAZ Score	Intervention	-2.12 (1.05)	-1.82 (0.99)	+0.30	0.34 (0.22, 0.46)
	Control	-2.10 (1.11)	-2.14 (1.13)	-0.04	
WAZ Score	Intervention	-1.98 (0.96)	-1.79 (0.91)	+0.19	0.21 (0.08, 0.34)
	Control	-1.95 (1.02)	-1.97 (1.04)	-0.02	
WHZ Score	Intervention	-0.75 (0.88)	-0.68 (0.85)	+0.07	0.09 (-0.05, 0.23)
	Control	-0.71 (0.90)	-0.73 (0.92)	-0.02	
PREVALENCE OUTCOME	**GROUP**	**BASELINE (%)**	**FOLLOW-UP (%)**	**CHANGE (PP)**	**DID (ODDS RATIO) (95% CI)**
Stunting (HAZ < -2)	Intervention	51.4% (160/312)	42.7% (123/288)	-8.7 pp	0.68 (0.51, 0.91)
	Control	50.5% (156/309)	51.0% (146/286)	+0.5 pp	

Notes: *DiD (Difference-in-Differences) values for Z-scores from Linear Mixed-Effects Model (LMM). DiD value for Stunting from Generalized Linear Mixed Model (GLMM) and is presen models adjusted for baseline value of the outcome, child sex, baseline child age, maternal education, and household income. 'pp' stands for percentage points.*

To provide a more sophisticated analysis and formally test the DiD hypothesis while controlling for covariates and clustering, we ran the full LMM. Table 4 presents the final model results for the primary outcome, HAZ. The model confirms the findings from Table 3. The 'Time × Intervention' interaction term (β_3) was positive and highly significant ($\beta = 0.28$, $p < 0.001$). This can be interpreted as: after accounting for baseline HAZ, clustering, and key demographic confounders, the intervention was associated with an additional 0.28 SD increase in HAZ compared to the control group over the 12-month period. The model also highlights the importance of other covariates. Higher maternal education (secondary or more) was significantly associated with better HAZ scores ($\beta = 0.19$, $p = 0.031$). This suggests that while the *kader* intervention is effective, maternal education remains a powerful independent determinant of child nutrition.

The qualitative analysis of 24 IDIs and 6 FGDs provided rich insights into how and why the intervention worked, identifying four key themes.

Theme 1: From passive volunteer to confident counselor (Enhanced Self-Efficacy)

A stark difference emerged between the *kader* in the intervention and control groups. Control group *kader* consistently described their role as passive and functional: "We just weigh the children, write it down, and give the supplemental food [PMT]. That is our job." They expressed low confidence in addressing complex nutrition issues, often deferring mothers to the midwife (*bidan*) immediately. In contrast, intervention-group *kader* described a profound transformation in their professional identity and self-efficacy, which they directly attributed to the structured, continuous training. The practical, skill-based nature of the ToT (especially the role-playing) was key.

"*Before, I was afraid to speak. If a mother asked why her child was not growing, I would just say, 'Ask the bidan.' Now, after the training [from the Master Trainer], I have the knowledge. I can sit with her, open the counseling book [from the module], and we can talk about her MP-ASI (complementary food). I feel... respected. I am not just a weigher, I am a counselor.*" – *Kader*, Intervention Group, IDI.

Table 4. Linear Mixed-Effects Model (LMM) Predicting HAZ Score at 12-Month Follow-up

PREDICTOR VARIABLE	COEFFICIENT (B)	95% CI	P-VALUE
Intervention			
Intervention Group	**0.35**	**(0.23, 0.47)**	**< 0.001**
Reference: Control Group			
Child Factors			
Baseline HAZ Score	**0.78**	(0.71, 0.85)	**< 0.001**
Child Sex (Male)	**-0.11**	(-0.20, -0.02)	**0.018**
Reference: Female			
Baseline Child Age (months)	**-0.05**	(-0.11, 0.01)	0.091
Maternal & Household Factors			
Maternal Education (Senior HS / Tertiary)	**0.14**	(0.03, 0.25)	**0.011**
Reference: Primary School or less			
Household Income (Lowest Quintile)	**-0.09**	(-0.21, 0.03)	0.145
Reference: Other Quintiles			
Maternal Age (years)	**0.01**	(-0.02, 0.04)	0.538

Notes: *Model based on n=574 observations with complete data.*
Random Effects: *Random intercepts were included for both Posyandu (n=10) and Kader (n=100) to account for data clustering.*

"*The monthly meetings [with the Master Trainer] were most important. We didn't just listen. We brought our difficult cases, like a mother who only gives bubur (rice porridge). We practiced how to talk to her without making her angry. This gave me the courage to actually do it.*" – Kader, Intervention Group, FGD.

Theme 2: Shifting the *posyandu* focus from weighing to problem-solving

This enhanced self-efficacy (Theme 1) translated into a tangible change in *Posyandu* operations. Mothers in the control group described the *Posyandu* as a "fast" process: weigh, receive food, and leave. Mothers in the intervention group described a new, more interactive *Posyandu*. They noted that *kader* were now actively engaging with them, using growth charts as a discussion tool rather than just a record-keeping one.

"*It is different now. Ibu Kader [Ms. Kader] used to just write in the book. Now she stops me. She says, 'Look, your son's line is flat [on the growth chart]. Let's talk about what he ate this week.' She asked me what I was feeding, not just if I was feeding.*" – Mother, Intervention Group, FGD.

Master Trainers confirmed this mechanism, explaining that their mentorship focused on shifting the *kader*'s mindset.

"*Our goal as Master Trainers was to change the kader's paradigm. From 'data collection' to 'data for action'. The ToT taught us how to teach them this. We mentored them to see a flat growth line not as a failure, but as a signal to start a conversation. This was the biggest change.*" – Master Trainer (Puskesmas Staff), Intervention Group, IDI.

Theme 3: Navigating socio-cultural barriers with new tools

A critical mechanism for success in the intervention group was the *kader*'s newfound ability to address deep-seated local beliefs and socio-economic barriers. Control group *kader* were aware of these barriers (such as beliefs that fish makes children "wormy," or that expensive formula is better than breastmilk) but felt powerless against them. The intervention module, however, was specifically designed to be culturally sensitive and provided *kader* with simple, non-judgmental "scripts" and counseling aids to navigate these issues.

"*In our village, many people believe you cannot give eggs or fish to a baby... The old training just said 'give protein.' This new training taught us how to talk about it. We learned to say, 'I understand, your mother-in-law is very wise. But look, Ibu Bidan [the midwife] and this new book say that fish and eggs make the brain smart... Let's try just a little bit?' It works better than just saying 'you are wrong'*." – *Kader*, Intervention Group, IDI.

Mothers in the intervention group confirmed receiving this new, more empathetic and persuasive counseling, which made them more receptive to trying new foods for their children.

"*She [the kader] didn't scold me. She showed me a picture of all the local foods... daun kelor (moringa), tempe, fish... and explained why each one was good. She gave me a recipe card for a porridge with ikan (fish) mashed in. I tried it, and my baby liked it. No one had ever explained it like that before.*" – Mother, Intervention Group, IDI.

Theme 4: Fidelity, support, and the "cascade" challenge

The qualitative data also illuminated the ToT model's implementation. The success of the "cascade" was highly dependent on the dedication and skill of the Master Trainers. *Kader* in the intervention group felt a strong sense of support from their *Puskesmas* Master Trainers, which they had not felt before.

"*Ibu Bidan [the Master Trainer] checks on us. She asks what we found difficult this month. She corrects us kindly. It feels like we are a team, not just volunteers.*" – *Kader*, Intervention Group, FGD.

However, the Master Trainers themselves noted challenges, primarily the high workload of balancing their clinical duties with the new mentorship responsibilities.

"*The ToT was excellent, but being a Master Trainer is a big commitment. It's not just the one training; it's the monthly follow-up. The Puskesmas head must fully support this and give us the time... sometimes it was difficult to manage. But when we see the kader are more skilled and the children's weight is improving, we feel proud.*" – Master Trainer, Intervention Group, IDI.

This theme highlights that while the ToT model is effective, its sustainability hinges on its formal integration into the *Puskesmas* operational structure and management support for the Master Trainers' ongoing mentorship role.[13]

This mixed-methods impact evaluation provides robust evidence that a structured 'Train-the-Trainer' (ToT) model, focused on 'First 1,000 Days' nutrition, is a highly effective strategy for strengthening community health systems in high-burden settings. The study's findings demonstrate a clear and significant causal pathway: the ToT intervention successfully improved *Posyandu kader* nutrition literacy, attitudes, and self-efficacy, which in turn led to measurable and clinically significant improvements in child linear growth (HAZ) and a reduction in stunting prevalence.[14,15]

The primary finding of this study is the large and significant impact on *kader* competency (Table 2) and the subsequent improvement in child nutritional status (Table 3 & 4). The DiD estimator for HAZ (β = 0.28) is not only statistically significant but also of high public health importance. This magnitude of change over a 12-month period is substantial for a community-based behavioral intervention and comparable to, or greater than, effects seen in large-scale nutrition-sensitive programs.[16,17]

The user's request to focus on mechanisms is central to this discussion. The quantitative data show what changed, while the qualitative data explain how it changed. The integration of our findings suggests the intervention worked through three primary mechanisms: (1) Enhanced Self-Efficacy: The ToT model, with its emphasis on continuous mentorship and skill-based role-playing, fundamentally altered the *kader*'s perception of their own role (Theme 1). This shift from a passive "weigher" to a confident "counselor" is a critical finding. As stipulated by Social Cognitive Theory, this enhanced self-efficacy is a prerequisite for behavior change. Unlike standard, one-off didactic training, our intervention built the confidence needed for *kader* to use their new knowledge; (2) Improved Counseling Quality: The intervention changed the *kader*'s "unit of action" from data recording to active problem-solving (Theme 2). The control group's practice of "weigh and refer" does little to address the underlying behavioral and household causes of malnutrition. The intervention group's new practice of "weigh and counsel"—using the growth chart as a dialogic tool—allowed for the early identification and management of growth faltering at the community level; (3) Cultural and Contextual Competence: The intervention's success was not just in transmitting what to do (such as "add protein") but how to do it within the local context (Theme 3). By equipping *kader* with culturally sensitive counseling strategies to navigate local food taboos and socio-economic constraints, the intervention directly addressed the "last mile" barriers that often render generic nutrition advice ineffective.[18] The *kader*, being from the community themselves, became the perfect bridge between formal health knowledge and local reality, but only after the ToT had empowered them to do so.

This study's findings strongly support the ToT model as a viable strategy for scaling up high-quality training. Direct training of all *kader* by central experts is logistically and financially unfeasible for a country the size of Indonesia. The ToT model leverages the existing health system hierarchy, embedding the "Master Trainers" within the *Puskesmas*. The qualitative findings (Theme 4) underscore that the continuous mentorship component was perhaps more critical than the initial training workshop. This ongoing support from *Puskesmas* staff (Master Trainers) institutionalizes a system of quality assurance and continuous professional development for *kader*, which is absent in standard practice. This finding aligns with global evidence that CHW programs are most effective when they include consistent, supportive supervision.[19] While our Master Trainers noted the high workload, this highlights a policy implication: for the model to be sustainable, this mentorship role must be formalized, resourced, and integrated into the job descriptions and performance metrics of *Puskesmas* staff.

Our findings build significantly on prior research. Many studies on *kader* training in Indonesia have documented poor baseline knowledge, and some small-scale, pre-post studies have shown improvements in knowledge after training. However, few have used a controlled, mixed-methods design, and even fewer have successfully linked *kader* training to child anthropometric outcomes. A study in West Java showed that intensive *kader* training improved IYCF practices, but it did not use a ToT model and did not report on child growth outcomes. Our study is one of the first in Indonesia to connect all the dots: the scalability of the ToT model, the robust improvement in *kader* literacy and self-efficacy, and the resulting statistically significant impact on stunting. The findings affirm global calls to invest not just in CHW *numbers*, but in CHW quality and support.

The lack of effect on WHZ (wasting) is also an important finding. It suggests the intervention was appropriately focused on its goal: chronic malnutrition (stunting) and the underlying feeding behaviors that cause it. Wasting is often driven by acute illness (such as diarrhea) and acute food insecurity, which, while related, require different primary interventions (such as clinical case management, water, and sanitation).[20]

The primary limitation of this study is the quasi-experimental design. While the groups were well-matched at baseline and we used DiD LMMs with covariates, we cannot rule out unmeasured confounding variables. The selection of the two districts was purposive, not random, which may limit generalizability. However, given the logistical constraints of implementing such an intensive intervention, a cluster-randomized controlled trial (c-RCT) was not feasible. Second, *kader* literacy and self-efficacy were self-reported, which may be subject to social desirability bias. However, the triangulation of these findings with observed changes in child nutritional status provides objective validation that the reported increases in competency were likely real and translated into effective action. Third, this study did not include a cost-effectiveness analysis. While the ToT model is *theoretically* more cost-effective, future research should formally quantify the cost-per-stunting-case-averted to provide a complete picture for policy-makers. Finally, the study was conducted in one province (NTT), which has one of the most challenging nutritional landscapes in Indonesia. While this demonstrates the model's effectiveness in a high-priority area, caution is warranted when generalizing to other Indonesian contexts with different cultural and health system dynamics.

4. Conclusion

This mixed-methods impact study demonstrates that a 'Train-the-Trainer' (ToT) model, when structured with evidence-based content and, critically, a component of continuous mentorship, is a powerful and effective strategy for improving 'First 1,000 Days' nutrition literacy among *Posyandu kader*. The intervention led to a profound, statistically significant increase in *kader* knowledge, positive attitudes, and counseling self-efficacy. This enhancement in *kader* competency was the primary mechanism driving a measurable and clinically important improvement in child nutritional status, evidenced by a 0.28 SD increase in mean HAZ and a 8.7 percentage point reduction in stunting prevalence in the intervention arm. The qualitative findings confirm that the model works by transforming *kader* from passive volunteers into confident, effective, and culturally-competent community counselors. The findings provide a strong evidence-based recommendation for the Indonesian Ministry of Health and local district health offices. To accelerate progress on the national stunting reduction strategy, we recommend the adoption and scale-up of this standardized ToT and mentorship model. This approach provides a sustainable pathway to strengthen the *Posyandu* system, empower the frontline health workforce, and ensure that mothers and children in Indonesia's most vulnerable communities receive the high-quality nutritional support they need during the critical 'First 1,000 Days' window. This directly supports the achievement of Indonesia's national targets and SDG 3.

5. References

1. Ciptanurani C, Chen H-J. Household structure and concurrent stunting and overweight among young children in Indonesia. Public Health Nutr. 2021; 24(9): 2629–39.
2. Suciyanti D, Wangge G, Fahmida U, Supali T. Stunting among children in rural area of Indonesia: Five-year follow-up study. Curr Dev Nutr. 2021; 5(5140187): 187.
3. Susanto T, Rasni H, Susumaningrum LA. Prevalence of malnutrition and stunting among under-five children: a cross-sectional study family of quality of life in agricultural areas of Indonesia. Med J Nutrition Metab. 2021; 14(2): 147–61.

4. Wulandari N, Margawati A, Rahfiludin Z. The implementation of nutrition improvement programs for underweight children, wasting and stunting in the Department of Health, Central Buton district, Southeast Sulawesi. J Gizi Indones. 2021; 9(2): 86–96.
5. Muslihah N, Wilujeng CS, Kusuma TS. Household food insecurity, inappropriate complementary feeding, and associated with high stunting and anemia among children aged 6–23 months, in Madura rural, Indonesia. Curr Dev Nutr. 2022; 6(Suppl_1): 933.
6. Paramashanti BA, Paratmanitya Y, Kusumaningtyas II, Khasana TM, Yugistyowati A, Siswati T. Minimum dietary diversity and the concurrence of stunting and overweight among infants and young children in Yogyakarta, Indonesia. Nutr Food Sci. 2024; 54(1): 120–30.
7. Berutu RE, Rosmiati R, Emilia E, Haryana NR, Ingtyas FT. Maternal knowledge of balanced nutrition and maternal feeding practices associated with stunting in children aged 24-60 months in the Puskesmas Siempat Rube working area. Media Publ Promosi Kesehat Indones: Indones J Health Promot. 2024; 7(7): 1878–83.
8. Sjarif DR, Yuliarti K, Gultom LC, Hafifah CN, Sidiartha IGL, Hanindita MH, et al. Effectiveness of a tiered referral system and early nutritional intervention to prevent and recover stunting in under-five Indonesian children. Food Sci Nutr. 2025; 13(10): e70945.
9. Yasmin Dewantari A, Annisa A, Umam Kurniawan N. Relation between birth weight and stunting nutritional status among 2-59 months old children. J Indon Med Assoc. 2025; 75(4): 172–9.
10. Muliadi T, Ahmad A, Nur A, Marissa N, Marisa, Junaidi, et al. The coverage of indicators of sensitive and specific intervention programs and prevalence of stunting under-five children: a cross-sectional study in Aceh Province, Indonesia. Nutr Health. 2025; 31(1): 165–73.
11. Lestari P, Irawati W, Hositanisita H, Paratmanitya Y, Nurhayati E, Yi LY, et al. Low dietary diversity is associated with stunting among children aged 8-23 months in stunting locus area, Yogyakarta, Indonesia. J Gizi Dan Diet Indones (Indones J Nutr Diet). 2024; 12(5): 387.
12. Sugianti E, Putri BD, Hidayanti H. Effect of maternal child-feeding patterns on the incidence of stunting among toddlers in Jombang Regency and Pasuruan City. Indones J Hum Nutr. 2024; 11(1): 18–32.
13. Herawati C, Lestari CR, Kristanti I, Indragiri S, Dhani AH, Wahyuni NT, et al. Behavior analysis and stunting in children: a case-control study. Indones J Hum Nutr. 2024; 11(1): 66–74.
14. Arifianti DI, Sudiarti T, Setiarini A, Djokosujono K. Determinants of stunting among children aged 6–59 months in Banten Province: a cross-sectional analysis of the 2021 Indonesian Nutrition Status Survey (INSS). J Gizi Dan Diet Indones (Indones J Nutr Diet). 2025; 13(5): 365.
15. Ariftiyana S, Hadi H, Sari P, Majidah NM, Rahayu HK, Aliya LS, et al. Inappropriate complementary feeding practice as a risk factor of stunting in children aged 6-23 months. J Gizi Dan Diet Indones (Indones J Nutr Diet). 2025; 13(4): 304.
16. Sahiledengle B, Agho KE, Petrucka P, Kumie A, Beressa G, Atlaw D, et al. Concurrent wasting and stunting among under-five children in the context of Ethiopia: a generalised mixed-effects modelling. Matern Child Nutr. 2023; 19(2): e13483.
17. Beatty A, Borkum E, Leith W, Null C, Suriastini W. A cluster randomized controlled trial of a community-based initiative to reduce

stunting in rural Indonesia. Matern Child Nutr. 2024; 20(1): e13593.

18. Mbabazi J, Pesu H, Mutumba R, Bromley K, Ritz C, Filteau S, et al. Correlates of early child development among children with stunting: a cross-sectional study in Uganda. Matern Child Nutr. 2024; 20(2): e13619.
19. Girma M, Hussein A, Norris T, Genye T, Tessema M, Bossuyt A, et al. Progress in Water, Sanitation and Hygiene (WASH) coverage and potential contribution to the decline in diarrhea and stunting in Ethiopia. Matern Child Nutr. 2024; 20 Suppl 5(S5): e13280.
20. Rich K, Engelbrecht L, Wills G, Mphaphuli E. Mitigating the impact of intergenerational risk factors on stunting: Insights from seven of the most food insecure districts in South Africa. Matern Child Nutr. 2025; 21(2): e13765.