Combined WhatsApp and Face-to-Face Intervention Improves Infant and Young Child Feeding (IYCF) Practices in Indonesia: A Longitudinal Quasi-Experimental Study

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Abstract

This study evaluated the effectiveness of a WhatsApp-delivered infant and young child feeding (IYCF) education program for Indonesian women pregnant with their first or second child, and changes in local community health worker ('cadre') knowledge and skills following program implementation. A longitudinal quasi-experimental design was used with 24 trained cadres who delivered three WhatsApp video counselling sessions, three consultations with a nutritionist, and monthly home visits from late pregnancy through seven months postpartum; control participants received standard prenatal care. Knowledge and skills were assessed pre- and post-training, and breastfeeding outcomes among women (n = 113) were examined using logistic regression models adjusted for key sociodemographic and clinical factors. Cadres showed significant increases in IYCF knowledge after training, although skill levels did not change. Early initiation of breastfeeding increased from 7.1% to 54.4% in the intervention group, with intervention participants having higher odds of early initiation than controls (OR = 4.3, p < .05). Exclusive breastfeeding was also more common in the intervention group (80.7% vs. 58.9%) (OR = 3.02, p < .05). Maternal age and type of delivery were significantly associated with early initiation (OR = 4.4, p < .05; OR = 3.0, p < .05). Findings demonstrate the feasibility and potential of mobile IYCF education to strengthen maternal practices and support stunting prevention.

Keywords

Community health cadres; exclusive breastfeeding; infant and young child feeding; Indonesia; WhatsApp-based intervention

Introduction

Indonesia is emerging as an upper-middle-income country, yet it still has one of the highest global prevalences of child stunting (Mulyaningsih et al., 2021; World Bank Group, 2023). Stunting refers to when children under five years of age have a length or height of more than two standard deviations below the World Health Organization's (WHO) (2021b) median child growth standard. This can have detrimental effects on children's cognitive development, leading to long-term challenges in national productivity (World Bank, 2020). According to a 2022 survey, approximately 21.6% of Indonesian children under five are stunted (Ministry of Health of the Republic of Indonesia, 2023a). Therefore, concerted efforts and prioritization of strategies to tackle stunting have been articulated in the Indonesia Medium Development Goals 2015–2019 and 2020–2024 (Ministry of National Development Planning, 2014; Satriawan, 2018).

It is well documented that maternal education plays a crucial role in shaping women's decisions about child health, particularly in South and Southeast Asia (Neves et al., 2021; Sarkar et al., 2023; Tariqujjaman et al., 2022). This pertains to the adoption of appropriate infant and young child feeding (IYCF) practices, including early initiation of breastfeeding, exclusive breastfeeding for the first six months of life, timely and appropriate complementary feeding, and continued breastfeeding up to two years (Dhami et al., 2021). In Indonesia, maternal education is typically delivered through community-based health centers called Posyandu, an acronym for 'Pos Pelayanan Terpadu' ('Integrated Service Post'), which provide a range of services for mothers and young children (Rosiska & Soviarni, 2023; Yani et al., 2023). Posyandu are primarily managed by local community health workers ('cadres') who play a vital role in engaging with and educating mothers and caregivers about prenatal and postnatal care (Muharyani et al., 2023).

Enhancing cadres' knowledge and skills is critical for ensuring effective communication with mothers during Posyandu counselling and aligns well with the Theory of Planned Behavior (TPB) (Ajzen, 1991). The TPB posits that behavioral outcomes are driven by intention, which is shaped by attitudes, subjective norms, and perceived behavioral control. Strengthening cadres' knowledge and skills directly enhances their perceived behavioral control and helps cultivate more positive attitudes toward delivering IYCF counselling. This is important, as evidence indicates that limited capacity among community health workers can diminish the effectiveness of counselling, and the quality of support and guidance strongly influences the quality of the feeding practices mothers receive (Rahman et al., 2023; Syihab et al., 2021).

Mobile health (mHealth) interventions have demonstrated effectiveness in educating both mothers and cadres on strategies to improve IYCF practices, although most prior studies have been conducted in developed countries (Downs et al., 2019; Ferdous et al., 2024). However, several studies have focused on developing regions, including one that found that a mobile-based nutrition education intervention targeting pregnant and nursing mothers increased knowledge and awareness and improved feeding practices (Gebremariam et al., 2023). Conventional IYCF education in Indonesia is primarily delivered through Posyandu group sessions. It is often constrained by limited cadre numbers and varying levels of competency, which reduce the consistency and reach of counselling. These challenges are more pronounced in hard-to-reach areas and were further exacerbated during the COVID-19 pandemic, when mobility restrictions disrupted routine nutrition services (Wenang et al., 2022).

Recently, the widely used mobile communication platform WhatsApp gained increased traction for delivering educational materials during the COVID-19 pandemic (Fan et al., 2022; Nurhayati et al., 2023; Peiris et al., 2023; Rachmah et al., 2023; Wulandari et al., 2022). That said, IYCF interventions have largely retained conventional delivery methods, such as direct or face-to-face meetings, particularly for breastfeeding education (Sabancı Baransel et al., 2023). Importantly, gaps in access to health promotion and education persist for many women and may be attributed to infrastructure and technical barriers that developing countries, such as Indonesia, face in fully implementing m-health approaches. A combination of online (e.g., WhatsApp) and offline (e.g., home visits) intervention strategies to increase IYCF education may be recommended for certain countries transitioning from traditional to mHealth health message delivery.

Therefore, the objective of this study was to examine the effectiveness and feasibility of delivering IYCF nutrition education via WhatsApp, in combination with face-to-face meetings and home visits conducted by cadres in Indonesia. Specifically, we aimed to (a) evaluate the impact of IYCF training on the knowledge and skills of cadres, and (b) assess the influence of combined WhatsApp and face-to-face IYCF education on various practices, including early breastfeeding initiation, exclusive breastfeeding, complementary feeding, and continued breastfeeding (>6 months).

Methods

Research design

This longitudinal quasi-experimental study employed an equivalent-time sampling design, in which the research team collected repeated data on the health outcomes of interest before and after the intervention to compare trends over time. This was conducted as part of a larger investigation (NCT05502978) aimed at assessing the impact of nutrition education delivered through WhatsApp and face-to-face interactions on behavior change, IYCF practices, and infant nutritional status. The present analysis focused specifically on the effects on ICYF practices and cadre psychosocial indicators.

Sampling and allocation procedure

Bantul has been designated a national priority area for stunting management, with 14 of its 17 subdistricts identified as stunting treatment locus areas. During the study period, pregnant women were recruited from four areas within these 14 subdistricts. Two subdistricts served as intervention sites and two as control sites for the eight-month study.

Several contextual and operational considerations guided the assignment of study groups. Randomization was not feasible due to two primary constraints. First, several stunting-locus subdistricts were already receiving exclusive breastfeeding interventions through a university-led IYCF surveillance program, which created a risk of contamination and precluded random allocation. Second, local resource constraints, particularly the limited number of available community health cadres, limited the feasibility of random assignment at the subdistrict level.

To minimize potential selection bias, comparison areas were selected based on the absence of overlapping interventions and sufficient geographic separation from other districts. Strict inclusion criteria were applied to ensure comparability. Homogeneity tests were conducted to assess whether participant characteristics differed between the intervention and control groups.

Cadre recruitment and inclusion criteria

Cadres were recruited from each hamlet research location with pregnant women in the third trimester, based on recommendations from nutritionists at the public health center, who serve as IYCF facilitators. These officers then selected cadres who had attended IYCF refreshment training conducted by the Bantul District Health Department. Cadres were included in the study if they had (1) completed high school, (2) two years of experience as a cadre, (3) attended IYCF training sessions, and (4) owned a smartphone with access to the internet and WhatsApp. A total of 24 eligible cadres agreed to participate.

Participant recruitment and inclusion criteria

Pregnant women were recruited from three subdistricts to serve as the cadre cohort for the intervention. Purposive sampling was used based on respondent data from the Maternal and Child Health Information System, a method also employed in previous studies (Andrade, 2021). Women were deemed eligible to participate if they (1) were in their first (primigravida) or second (multigravida) pregnancy, (2) were between 34 to 45 weeks gestation, (3) did not have any known chronic diseases (e.g., asthma, hypertension, heart disease) or diagnosed mental health disorders, (4) intended to reside in the research area for at least one year; and (5) owned a smartphone with access to the internet and WhatsApp.

Following recruitment, women in one subdistrict were assigned to receive the intervention. In contrast, women in the other two subdistricts were assigned to the control group according to the number of women in each subdistrict. For enrollment, interventions, and assessments, this study followed the Standard Protocol Items: Recommendations for Interventional Trials (SPIRIT) checklist (see Supplementary 1).

Sample size

The sample size for this study was determined using a two-proportion formula, with 80% power, 95% confidence interval (CI), and a margin of error of 5%. Previous research by Saleem et al. (2014) has indicated that the minimum sample size for both the intervention and control groups should be 57 participants, with an additional allowance of 10% (6 participants) for potential loss to follow-up. This was used to determine the minimum required sample size of 63 participants per group, resulting in a total of 126 participants. The final number of participants who completed the intervention and were followed until the end of the study period was 113.

Description of the Intervention

Intervention group

The study intervention was divided into two phases: the first focused on training cadres, and the second on educating pregnant women. More specifically, in the first phase, cadres received targeted education and guidance to enhance their knowledge and skills in IYCF practices. This training was designed to equip them with the necessary expertise to communicate effectively and educate pregnant women and mothers about optimal feeding practices. In the second phase, cadres utilized their training from phase one to deliver tailored education and support to women regarding IYCF practices. This phase of the intervention aimed to empower pregnant women with the knowledge and resources needed to adopt and sustain healthy feeding practices for their infants and young children.

Phase 1: Training the cadres

The cadres played a crucial role in this study as intervention providers for the participants. In this study, each cadre was assigned to provide IYCF education to 2–3 pregnant mothers. Four 90–120-minute training sessions were conducted at the local community health center, and pre- and post-tests were administered to assess cadres' IYCF knowledge and skills at the beginning and end of each session. Given that cadres were already trained in community health promotion, this training was treated as a refresher with particular emphasis on IYCF. See Table 1 for a description of the topics covered during the four sessions.

Table 1: Cadre Training Session Components

Session	Duration	Topic	Description
First	90 minutes	Informed consent, Introduction to educational media, Understanding the intervention stages	At the beginning of the session, cadres are introduced to the study and asked to provide informed consent. Then, learning materials are distributed as digital booklets and videos. The research team provides additional guidance on successfully delivering education via WhatsApp and on conducting the other intervention stages, such as home visits and standardized anthropometric measurements of infants.
Second	120 minutes	Early breastfeeding initiation and exclusive breastfeeding	Refresher materials on early breastfeeding initiation and exclusive breastfeeding are provided to cadres. A lactation counselor leads this session with a presentation and discussion, followed by a role-play session. The role-play session helps reinforce the education, particularly during the home visit intervention period, and increases the cadres' self-efficacy.
Third	120 minutes	Complementary feeding and continuing breastfeeding	Refresher materials on complementary feeding and continuing breastfeeding after 6 months are provided to cadres. A nutritionist leads this session, providing lectures and discussion, and concluding with another role-play session.
Fourth	120 minutes	Practice using WhatsApp and conducting	Cadres are informed of the intervention protocols before practicing, including the use of WhatsApp and standardized

Session	Duration	Topic	Description
		anthropometric measurements	anthropometric measurements, as outlined in the intervention data collection form.

Phase 2: Delivering the intervention to participants

The intervention designed for pregnant women consisted of both online and face-to-face sessions. The online intervention was delivered three times via WhatsApp, and the face-to-face intervention was conducted seven times (monthly over 7 months) during home visits. Pregnant women recruited were required to meet all inclusion criteria and provide written informed consent before receiving the intervention.

The intervention to be delivered via WhatsApp was structured into three sessions, targeting pregnant women at different stages of gestation and postnatal periods. Each session focused on specific aspects of IYCF, and the cadres provided guidance and support. Additional face-to-face home visits may be conducted to provide more personalized interaction and support. These components are detailed below:

WhatsApp Session I: First, pregnant women at 36–37 weeks' gestation were provided with the IYCF digital booklet and videos from the cadre one week before the intervention. Subsequently, a WhatsApp video call was held to discuss early initiation of breastfeeding and exclusive breastfeeding practices. This session followed four steps: informing participants about the video call, reminding them to review the materials, conducting a pre-test, and allowing participants to ask questions during the session. Those unable to participate in the group video call received a private session with the cadres, and, one month postpartum, a consultation with a nutritionist was arranged based on the IYCF practice evaluation report provided by the cadres.

WhatsApp Session II: At 38–39 weeks of gestation, participating women received educational materials that provided an overview of complementary feeding, structured similarly to Session I.

WhatsApp Session III: At 3 months postpartum, participants received educational materials on complementary feeding. They consulted a nutritionist regarding potential IYCF implementation issues that may arise in the future, and the cadres subsequently submitted another IYCF practice evaluation report.

Face-to-Face Intervention (Home Visit): Home visits were conducted monthly for seven months, beginning after birth, to discuss obstacles to sustained IYCF practices. These visits included anthropometric measurements and nutritional status assessments of infants by the cadres. They were necessary for providing personalized support and interaction between participants and cadres in the comfort of their homes.

Content of IYCF materials

The IYCF materials provided to participants consisted of videos and digital booklets, encompassing various aspects of IYCF education adapted from "Infant and young child feeding guidelines" The content included guiding principles for complementary feeding of breastfed children, strategies for improving young children's diets during complementary

feeding, infant feeding guidelines for health workers, and indicators for assessing infant and young child feeding, including breastfeeding (National Health and Medical Research Council, 2012; UNICEF, 2020; World Health Organization, 2003, 2020, 2021a).

These existing materials were adapted by the research team specifically for use in the intervention, as previously outlined in a study on the development of the preconception education booklet (Nurunniyah et al., 2021). The development process began with a thorough survey of existing standard materials and a needs assessment conducted among third-trimester pregnant women. Subsequently, educational media with content tailored to the research objectives were prepared. The draft booklet and video underwent validity testing among several cadres at community health centers. Feedback from this testing phase was incorporated to enhance the educational materials.

Further refinement was achieved through a review process conducted by a panel of experts in nutrition, lactation, and health promotion. Their insights and suggestions were utilized to amend the materials as necessary, ensuring accuracy and relevance. Finally, pregnant women in the third trimester were consulted to assess their acceptance of the IYCF educational materials, thereby validating their suitability for use in the proposed study. The full description of IYCF materials is provided in Supplementary File 2.

Control group

In the control group, participants received education in accordance with existing Indonesian government guidelines. This more traditional education is typically initiated during the first prenatal visit, when pregnant women visit their local community health center. During this visit, IYCF materials are usually provided once by either a nutritionist or a midwife. Mothers may receive additional education when referred to the Mother/Child Health (MCH) section of the health center (Ministry of Health of the Republic of Indonesia, 2015). Following childbirth, participants in the control group received three postpartum home visits from village midwives. These visits included education on newborn care, including issues related to exclusive breastfeeding (Ministry of Health of the Republic of Indonesia, 2020).

Outcome measurement

Cadres' knowledge of IYCF was assessed using a 15-item structured questionnaire comprising 11 positively worded and 4 negatively worded items. The questionnaire was adapted from the Infant and Young Child Feeding (IYCF) Counselling Module developed by the Ministry of Health of the Republic of Indonesia (2014). Cadres' IYCF counselling skills were evaluated through direct observation using a structured 26-item skills checklist. Each item was scored during simulated or practice counselling sessions using a three-point scale (0 = not performed, 1 = partially performed, 2 = correctly performed). The checklist was adapted from the Ministry of Health of the Republic of Indonesia's (2014) IYCF Module.

Early initiation of breastfeeding was assessed by determining whether the infant was placed at the breast within the first hour after birth, regardless of suckling or milk transfer. Mothers reported the timing of first breast placement, and responses were classified as ≤1 hour or >1 hour. Exclusive breastfeeding was assessed by determining whether infants aged 0–6 months received only breastmilk, with no additional foods or liquids except vitamins, minerals, or medications (World Health Organization, 2021a). Four WHO-recommended indicators were used to evaluate complementary feeding status:

Minimum Meal Frequency (MMF): Assessed using a 24-hour dietary recall to determine whether children met the age-appropriate number of solid, semi-solid, or soft food feedings. MMF was considered met if breastfed children aged 6–8 months received at least two feedings per day, or if non-breastfed children aged 6–23 months received at least four feedings per day.

Minimum Dietary Diversity (MDD): Calculated based on consumption of at least five of the eight WHO food groups in the past 24 hours. Food groups followed the World Health Organization (WHO) and United Nations Children's Fund (UNICEF) (2021) guideline: (1) breast milk; (2) grains, roots, tubers, and plantains; (3) pulses, nuts, and seeds; (4) dairy products; (5) flesh foods; (6) eggs; (7) vitamin A–rich fruits and vegetables; and (8) other fruits and vegetables.

Minimum Acceptable Diet (MAD): Derived as a composite indicator combining both MMF and MDD criteria.

Introduction of Solid, Semi-Solid, and Soft Foods (ISSF): Assessed by determining whether infants aged 6–8 months had received any solid, semi-solid, or soft foods during the recall period.

Continued breastfeeding was assessed by determining whether infants aged 7 months were receiving breast milk at the time of the interview. All IYCF indicators were adopted from the World Health Organization (WHO) and the United Nations Children's Fund (UNICEF) *Indicators for Assessing Infant and Young Child Feeding Practices* (2021).

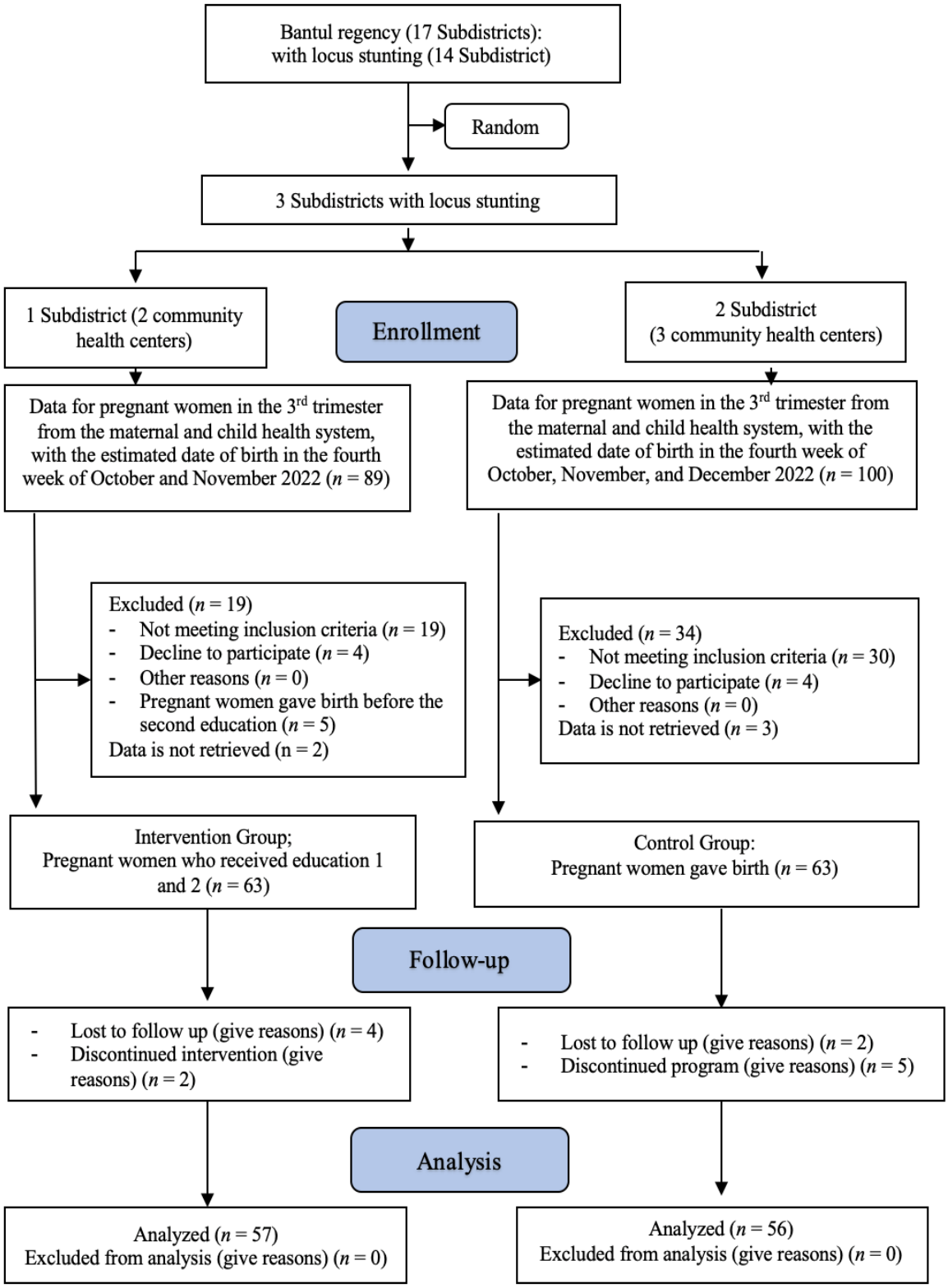
Data collection

Quantitative data were collected to assess the effectiveness of the intervention program. Figure 1 illustrates the flow of participants through the data collection process. Initially, 126 pregnant women were recruited and deemed eligible to participate; 63 were assigned to the intervention group and 63 to the control group. However, at the final phase of the intervention, only 113 participants remained. Thirteen participants were lost to follow-up, either giving birth before receiving the second education session or discontinuing the program. Participant recruitment took place from October 2022 to January 2023, and the intervention period extended until August 2023.

Data management and analysis

The research team verified the completeness and consistency of responses on completed questionnaires, and all data were entered and analyzed using SPSS Statistics version 27. Prior to statistical analyses, normality and homogeneity tests were conducted. For cadre knowledge and skills, the Wilcoxon signed-rank Test was used. To analyze the IYCF data, chi-square tests were used for categorical comparisons, and t-tests for continuous variables. Multiple logistic regression analyses examined the impact of interventions on IYCF practices, adjusting for covariates. The intervention effect was estimated using crude and adjusted odds ratios, with corresponding 95% confidence intervals (CIs) derived from logistic regression models. Below, odds ratios are presented with their 95% CIs, and statistical significance is indicated by $p < .05$.

Figure 1: Participant Recruitment and Data Collection Processes



Results

Participant characteristics

Table 2 presents the baseline characteristics of the participant sample. No significant differences were found between the intervention and control groups. The majority of participants were aged 26–35 years; 61.9% of mothers and 67.2% of fathers had completed high school. Approximately half (50.4%) of mothers were not currently employed, whereas 53.9% of fathers were employed by the government or in the private sector. Moreover, 78.7% of participants earned higher than the district minimum monthly wage. Most mothers (70.7%) gave birth in hospitals, with midwives present in 66.35% of cases, and the majority of newborns were boys (59.2%).

Table 2: Participant Characteristics (n = 113)

Variable	Intervention (n = 57)	Control (n = 56)	p value*
Age			
17–25 years	18 (31.6%)	17 (30.4%)	
26–35 years	34 (59.6%)	35 (62.5%)	.930
36–45 years	5 (8.8%)	4 (7.1%)	
Mother's education level			
Completed elementary school	0 (0.0%)	2 (3.6%)	
Completed junior high school	6 (10.5%)	4 (7.1%)	.330
Completed senior high school	33 (57.9%)	37 (66.1%)	
Completed a diploma/bachelor's degree and above	18 (31.6%)	13 (23.2%)	
Father's education level			
Completed elementary school/ no school	2 (3.5%)	0 (0.0%)	
Completed junior high school	5 (8.7%)	7 (12.5%)	.530
Completed senior high school	35 (61.5%)	41 (73.2%)	
Completed diploma/bachelor's degree and above	15 (26.3%)	8 (14.3%)	
Mother's occupation			
Housewife	30 (52.6%)	27 (48.2%)	
Merchant/business	6 (10.5%)	7 (12.5%)	.236
Government employees/private employees	20 (35.1%)	16 (28.6%)	
Others	1 (1.8%)	6 (10.7%)	
Father's occupation			
Merchant/business	16 (18.1%)	17 (30.4%)	
Government employees/private employees	30 (52.6%)	31 (55.4%)	.774
Others	11 (19.3%)	8 (14.3%)	
Household income (IDR)[a]			
< District minimum monthly wage	16 (28.1%)	8 (14.3%)	.107
≥ District minimum monthly wage	41 (71.9%)	48 (85.7%)	
Birthing location			

Variable	Intervention (n = 57)	Control (n = 56)	p value*
Government hospital/private hospital/Hospital for mothers and children	39 (68.4%)	41 (73.2%)	.680
Pratama clinic/Public health center/Independent practicing midwife	18 (31.6%)	15 (26.8%)	
Type of birth delivery			
Caesarean section	13 (22.8%)	14 (25.0%)	.828
Normal	44 (77.2%)	42 (75.0%)	
Birth attendant			
Midwife	35 (61.4%)	40 (71.4%)	.321
Obstetrician	22 (38.6%)	16 (30.2%)	
Sex of the child			
Boys	33 (57.9%)	34 (60.7%)	.849
Girls	24 (42.1%)	22 (39.3%)	

Note: [a] Minimum monthly wage of Bantul District in 2022 was IDR 1.9 million (113 USD), based on the governor's decree

Descriptive analysis of IYCF practices indicated that the intervention group had higher rates of early initiation of breastfeeding, exclusive breastfeeding, and continued breastfeeding for more than 6 months than the control group. Regarding complementary feeding practices, the intervention group demonstrated greater adherence to the Minimum Dietary Diversity (MDD) and Minimum Acceptable Diet (MAD) components. However, the control group was more likely to initiate complementary feeding at the recommended age (6 months) than the intervention group.

Knowledge and skills change following the training of cadres

Table 3 illustrates the knowledge and skills of cadres regarding IYCF. There was a notable increase in knowledge scores before and after the four training sessions ($p < .001$). Skills also increased following the training, although the increase did not reach statistical significance.

Table 3: Cadre Knowledge and Skills Before and After Training (n = 24)

Variable	Mean rank	Ties	Sum of rank	Z-value	p value
Knowledge (n = 24)					
Pretest-Posttest	11.50	2	253	-4.15	.00
Skills (n = 24)					
Pretest-Posttest	2.50	20	10	-1.85	.63

Effects of the intervention on IYCF practices

Table 4 presents the multivariate analysis conducted using logistic regression, which revealed significant associations between the WhatsApp and face-to-face education intervention components and the practices of early initiation of breastfeeding (OR = 3.2, $p < .001$) and exclusive breastfeeding (OR = 2.9, $p < .05$). In other words, participants in the intervention group were considerably more likely to practice early initiation of breastfeeding and exclusive

breastfeeding compared to those in the control group. However, breastfeeding duration over 6 months and complementary feeding practices did not differ significantly between the intervention and control groups.

Table 4: WhatsApp and Face-To-Face Intervention Impacts On Participants' IYCF Practices

Variable	Intervention (n = 57)	Control (n = 56)	p value[1]	OR (95%CI)
Early initiation of breastfeeding				
Yes	31 (54.4%)	4 (7.1%)	.00**	3.2 (1.94, 5.59)
No	26 (45.6%)	52 (92.9%)		
Exclusive breastfeeding practice				
Yes	46 (80.7%)	33(58.9%)	.013*	2.9 (1.25, 6.79)
No	11 (19.3%)	23 (41.1%)		
Continued breastfeeding > 6 months				
Yes	55 (96.5%)	52 (92.9%)	.398	2.1 (0.37, 12.04)
No	3 (3.5%)	4 (7.1%)		
Timely initiation of complementary feeding				
< 6 months and > 6 months	9 (15.8%)	7 (12.5%)	.59	0.7 (0.25, 2.16)
6 months	48 (84.2%)	49 (87.5%)		
Minimum Dietary Diversity				
Met	25 (43.9%)	18(32.1%)	.226	1.6 (0.73, 3.60)
Unmet	32 (56.1%)	38(67.9%)		
Minimum Meal Frequency				
Met	57 (100%)	56 (100%)	N/A	N/A
Unmet	0 (0.0%)	0 (0.0%)		
Minimum Acceptable Diet				
Met	42 (73.7%)	38 (67.9%)	.638	1.32 (0.47, 2.89)
Unmet	15 (26.3%)	18 (32.1%)		

*Note: *Statistically significant p < .05; ** < .01; N/A = due to outlier data; statistical results are not available for this variable*

Table 5 presents further analysis of the intervention's influence on IYCF using multiple logistic regression, controlling for potential confounders. This analysis revealed that after adjusting for other variables, the odds ratio for the intervention effect on early breastfeeding initiation practices increased to 4.3 (p < .05), indicating a substantial impact. Additionally, the adjusted odds ratio for exclusive breastfeeding was 3.02 (95% CI [1.17, 7.75]), suggesting a significant association with receiving the intervention compared to the control. Furthermore, mothers in the early adulthood age group (26–35 years) had higher odds of both early breastfeeding initiation (OR = 4.4, p = .016) and exclusive breastfeeding (OR = 3.89, p = .007) than mothers in other age groups. Mothers who delivered vaginally had higher odds of practicing early breastfeeding initiation (OR = 3.0, p = .009) compared to those who delivered via cesarean section.

Table 5: Multivariate Analysis on the Intervention Impact (*n* = 113)

Variable	EIBP		EBP	
	COR	AOR Final model	COR	AOR Final model
Group				
Intervention	3.2 (1.94, 5.59)	4.3 (2.2, 7.16)**	2.9 (1.25, 6.79)	3.0 (1.17, 7.75)*
Control	1	1	1	1
Mother's Age				
17–25 years		1		1
26–35 years		4.4 (1.32, 14.9)*		3.9 (1.44, 10.4)**
36–45 years		4.4 (0.57, 34.5)		0.6 (0.11, 2.66)
Mother's occupation				
Housewife				6.7 (0.96, 46.8)
Merchant/business				2.6 (0.30, 22.1)
Government employees/private employees				1
Others				4.2 (0.66, 25.8)
Birth type				
Caesarean Section		1		
Normal		3.0 (1.63, 6.20)**		

*Note: EIBP, Early Initiation Breastfeeding practice; EBP, Exclusive Breastfeeding Practice; COR, Crude Odds Ratio; AOR, Adjusted Odds Ratio; CI, Confidence Interval; *statistically significant $p < .05$; ** $p < .01$*

Discussion

Overall, this blended online and in-person educational intervention delivered via WhatsApp and during home visits appears to be a feasible approach for strengthening mothers' IYCF practices. This approach aligns with previous research in Malaysia, which shows that interventions integrating WhatsApp with face-to-face strategies can enhance breastfeeding self-efficacy and knowledge (Mohamad Pilus et al., 2022). The extended timing of support from the third trimester through seven months postpartum, as well as the use of multiple strategies including discussion sessions and demonstration videos, likely contributed to its acceptability and utility (Fan et al., 2022; Wulandari et al., 2022). WhatsApp may have been particularly valuable for facilitating communication among researchers, cadres, and participants by enabling rapid responses to concerns. In contrast, face-to-face assistance provided additional opportunities for problem-solving when issues could not be resolved online. Given the widespread familiarity with WhatsApp, its use may be preferable to introducing new technologies in similar future programs.

Stunting remains a persistent challenge in Bantul District, where gaps in dietary quality and child-feeding practices continue to shape growth faltering (Ministry of Health of the Republic of Indonesia, 2023b). Local evidence shows that inappropriate complementary feeding, suboptimal dietary diversity, and household IYCF behaviors are key determinants of poor growth outcomes (Santika et al., 2015). These contextual conditions align with broader research demonstrating that combined educational interventions, particularly those strengthening cadres' capacity while offering direct maternal support, can improve IYCF practices and positively influence child growth outcomes (Baqui et al., 2008; Gusnedi et al., 2023).

Educational interventions also play an essential role in raising awareness of the benefits of early breastfeeding initiation, thereby motivating mothers to adopt these practices. The higher likelihood of early initiation among intervention participants mirrors findings from Ethiopia, where mothers receiving guidance on early initiation were substantially more likely to practice it (Admasu et al., 2022). Maternal age and type of delivery similarly influenced early initiation. Mothers aged 26–35 years were more likely to initiate breastfeeding early, consistent with Ethiopian research suggesting that greater maturity and decision-making capacity may support this behavior (Gedefaw et al., 2020; Notoatmodjo, 2010). Vaginal delivery was also associated with early initiation, aligning with studies showing that caesarean delivery often delays breastfeeding due to physical and procedural barriers (Mekonen et al., 2018).

Exclusive breastfeeding was also more likely among mothers who received the intervention; they were 2.9 times as likely to engage in exclusive breastfeeding as those who did not. This finding is consistent with evidence from Ethiopia and Iran, where women in Bahir Dar, West Ethiopia who received infant feeding counselling or advice were 5.20 times more likely to breastfeed exclusively, and women among a systematic review sample in Iran who received breastfeeding education were 1.13 times more likely to breastfeed exclusively (Behzadifar et al., 2019; Seid et al., 2013).

Contrary to expectations, the intervention did not significantly improve complementary feeding practices. Although most mothers in both groups initiated complementary feeding at six months, household decision-making dynamics, including the influence of husbands and older female relatives, may contribute to variation in the timing of early food introduction (Rakotomanana et al., 2020). Differences between exclusive breastfeeding rates and complementary feeding timing likely reflect the definition of exclusive breastfeeding, which permits formula feeding but prohibits solid or semi-solid foods before six months (WHO & UNICEF, 2021). Despite a nutritionist consultation at seven months, no differences in the timing of complementary feeding were observed, and the absence of a culturally specific food-recall tool may have limited the assessment of dietary diversity.

Although the intervention did not significantly affect Minimum Dietary Diversity (MDD), proportions were slightly higher in the intervention group, consistent with previous studies that reported improvements but did not reach statistical significance (Downs et al., 2019; Kim et al., 2016; Muluye et al., 2020). The absence of variation in Minimum Meal Frequency (MMF) at baseline prevented further analysis. Minimum Acceptable Diet (MAD) also showed slightly higher proportions in the intervention group, consistent with findings from Nairobi, where video-based education modestly improved proportions without achieving statistical significance (Kiprono et al., 2023).

The lack of effect on continued breastfeeding beyond six months may reflect the short follow-up period; assessment at only seven months postpartum provides limited insight into longer-term continuation. Nationally, breastfeeding duration is relatively long in Indonesia (median 21.8 months), suggesting that extended follow-up up to 24 months may be needed to adequately capture this behavior (Bhutta & Black, 2013; Black et al., 2013).

Limited improvements in some indicators may be due to insufficient intensity or timing of complementary feeding components. Complementary feeding is a skills-based behavior that often requires repeated cooking demonstrations and hands-on practice rather than a single counselling session (Dewey & Brown, 2003; Santika et al., 2015). In addition, strong family norms, especially the influential role of grandmothers in feeding decisions, can diminish the

impact of counselling if key family members are omitted. Broader contextual barriers in Indonesia, including digital literacy challenges, inconsistent smartphone and internet access, and sociocultural norms limiting women's autonomy, may also have reduced engagement with mHealth content (Knop et al., 2024; Siswati et al., 2024; Widiasih et al., 2025). These factors underscore the importance of maintaining in-person components to ensure equitable access to IYCF support.

Cadres played a vital role in the intervention, and the increases in their knowledge and skills following training carry long-term benefits. Trained cadres can continue to share IYCF information with additional mothers in their communities, thereby reinforcing the intervention's sustainability (Yenit et al., 2017). Their central role in health promotion is well established both in Indonesia and globally.

A key strength of this intervention was the tailoring of strategies to local circumstances, which enhanced acceptability and suggests potential for scalability in communities where access to IYCF education is limited. At the same time, the study's limited follow-up period restricted the ability to capture longer-term outcomes. Complementary feeding practices and continued breastfeeding beyond six months, both critical for preventing growth faltering through the first 24 months of life, require extended observation to fully understand the intervention's impact. Despite this limitation, the findings provide meaningful evidence that a blended approach combining mHealth and in-person support can strengthen the skills of community health cadres and improve early breastfeeding practices. These results underscore the value of integrating digital tools into existing community health systems and highlight the importance of future research that follows children through the full complementary feeding period to assess sustained effects on IYCF and child growth.

Conclusion

This study demonstrated that a blended mHealth educational intervention using WhatsApp, paired with in-person support from trained cadres, effectively improved early initiation of breastfeeding and exclusive breastfeeding practices among mothers in their first or second pregnancy. Maternal age and type of delivery significantly influenced early initiation, with older mothers and those delivering vaginally more likely to begin breastfeeding soon after birth. Although complementary feeding practices and continued breastfeeding beyond six months improved slightly in the intervention group, these changes were not statistically significant, likely due to the short follow-up period. Continued monitoring beyond seven months is needed to fully assess complementary feeding behaviors and sustained breastfeeding practices through the child's second year of life. Overall, the findings contribute to a growing evidence base indicating that WhatsApp-based education can be a practical and feasible strategy for supporting cadres in delivering IYCF guidance to pregnant women and mothers, particularly in settings with limited access to traditional health education. This approach holds promise for strengthening community health systems and supporting efforts to prevent stunting in resource-limited contexts.

Ethics statement

The authors assert that all procedures involving human subjects/patients were approved by the Institutional Review Board of the Medical and Health Research Ethics Committee (MHREC), Faculty of Medicine, Public Health and Nursing, Universitas Gajah Mada-Dr. Sardjito General Hospital (KE/FK/0995/EC/2022). Written informed consent was obtained from all participants before the interview. A 100,000 IDR (6 USD) shopping voucher was offered to thank participating mothers and cadres and to support their recruitment.

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