Received: 24 December 2021 | Revised: 15 March 2022 | Accepted: 30 March 2022

DOI: 10.1111/mcn.13362

ORIGINAL ARTICLE

Maternal & Child Nutrition WILEY

The impact of a package of behaviour change interventions on breastfeeding practices in East Java Province, Indonesia

Christiana Rialine Titaley[1] | Michael J. Dibley[2] | Iwan Ariawan[3] | Anifatun Mu'asyaroh[4] | Bunga Astria Paramashanti[2,5] | Ashraful Alam[2] | Rita Damayanti[6] | Tran Thanh Do[7] | Elaine Ferguson[8] | Min Kyaw Htet[2,9] | Mu Li[2] | Aang Sutrisna[10] | Umi Fahmida[9]

[1]Faculty of Medicine, Pattimura University, Jl. Ir. M. Putuhena, Poka, Ambon, Indonesia

[2]Sydney School of Public Health, Faculty of Medicine and Health, The University of Sydney, New South Wales, Australia

[3]Center for Health Research, Faculty of Public Health, Universitas Indonesia, Depok, Indonesia

[4]Alian Health Center, District Health Office of Kebumen , Central Java, Indonesia

[5]Department of Nutrition, Faculty of Health Sciences, Universitas Alma Ata, Yogyakarta, Indonesia

[6]Center for Health Research, Faculty of Public Health, Universitas Indonesia, Depok, Indonesia

[7]National Institute of Nutrition, Hai Bà Trưng, Hanoi, Vietnam

[8]Department of Population Health, London School of Hygiene and Tropical Medicine, London, UK

[9]South-East Asian Ministers of Education Organization, Regional Center for Food and Nutrition, Pusat Kajian Gizi Regional Universitas Indonesia, Jakarta, Indonesia

[10]Global Alliance for Improved Nutrition (GAIN), Jakarta, Indonesia

Correspondence

Christiana Rialine Titaley, Faculty of Medicine, Pattimura University, Jl. Ir. M. Putuhena, Poka, Ambon, Indonesia.
Email: christiana_rialine@yahoo.com

Funding information

Kingdom of the Netherlands to GAIN, Grant/Award Number: 400000062

Abstract

Suboptimal infant young child feeding practices are frequently reported globally, including in Indonesia. This analysis examined the impact of a package of behaviour change interventions on breastfeeding practices in Malang and Sidoarjo Districts, East Java Province, Indonesia. The BADUTA study (which in the Indonesian Language is an acronym for BAwah DUa TAhun, or children aged less than 2 years) was an impact evaluation using a cluster-randomized controlled trial with two parallel treatment arms. We conducted household surveys in 12 subdistricts from Malang and Sidoarjo. We collected information from 5175 mothers of children aged 0–23 months: 2435 mothers at baseline (February 2015) and 2740 mothers at endline (January to February 2017). This analysis used two indicators for fever and diarrhoea and seven breastfeeding indicators (early initiation of breastfeeding, prelacteal feeding, exclusive breastfeeding under 6 months, predominant breastfeeding, continued breastfeeding, age-appropriate breastfeeding and bottle-feeding). We used multilevel logistic regression analysis to assess the effect of the intervention. After 2 years of implementation of interventions, we observed an increased odds of exclusive breastfeeding under 6 months (adjusted odds ratio [aOR] = 1.85; 95% confidence interval [CI]: 1.35–2.53) and age-appropriate breastfeeding (aOR = 1.39; 95% CI: 1.07–1.79) in the intervention group than in the comparison group, at the endline survey. We found significantly lower odds for prelacteal feeding (aOR = 0.52; 95% CI: 0.41–0.65) in the intervention than in the comparison group. Our findings confirmed the benefits of integrated, multilayer behaviour change interventions to promote breastfeeding practices. Further research is required to develop effective interventions to reduce bottle use and improve other breastfeeding indicators that did not change with the BADUTA intervention.

KEYWORDS

breastfeeding, health promotion, infant feeding, newborn feeding behaviours, nutrition, nutrition education

1 | INTRODUCTION

Infant and young child feeding (IYCF) practices are critical for the health, development, nutritional status and survival of children aged less than 2 years (World Health Organization, 2021). The World Health Organization and UNICEF developed the Global Strategy for IYCF, which aims to improve—through optimal feeding—the nutritional status, growth, development, health and thus the survival of infants and young children (World Health Organization, 2003). The IYCF strategy entails optimum breastfeeding practices, including breastfeeding within 1 h of birth, exclusively breastfed for the first 6 months and continuing breastfeeding up to 2 years of age and beyond (World Health Organization, 2021).

During the first 2 years of life, adequate nutrition is important to prevent growth faltering, undernutrition, micronutrient deficiencies and to reduce children's morbidity and mortality (Rollins et al., 2016; Victora et al., 2016). Studies show that besides being an excellent source of nutrients, breastfeeding also protects infants from different types of viral dan bacterial infections (Horta & Victora, 2013). However, suboptimal breastfeeding practices are frequently reported globally (Victora et al., 2016), including Indonesia (National Institute of Health Research and Development MoH, Republic of Indonesia, 2018; Statistics Indonesia, National Family Planning Coordinating Board, Ministry of Health Republic of Indonesia, 2017). Based on the last two Indonesia Demographic and Health Survey data, the national rate of exclusive breastfeeding among children under 2 years has increased from 32.4% in 2007 (Statistics Indonesia, National Family Planning Coordinating Board, Ministry of Health Republic of Indonesia, 2017) to 41.5% in 2012 (Dibley et al., 2020) and 52.0% in 2017 (National Institute of Health Research and Development MoH, Republic of Indonesia, 2018). Similarly, early initiation of breastfeeding also has increased from 43.9% in 2007 (Statistics Indonesia, National Family Planning Coordinating Board, Ministry of Health Republic of Indonesia, 2017) to 49.3% in 2012 (Dibley et al., 2020) and 56.5% in 2017 (National Institute of Health Research and Development MoH, Republic of Indonesia, 2018). Despite these improvements in breastfeeding practices in Indonesia, there remains a need for effective interventions to promote optimal breastfeeding practices in the first 2 years of life.

The development of effective interventions to improve breastfeeding practices will help the government accelerate optimal breastfeeding practices to improve the health of Indonesia's mothers and children. Although there are reports of the effectiveness of various interventions to promote breastfeeding, not all of them have been successfully adopted at a national level. One of the reasons is the lack of creative behaviour change communication strategies (Dibley et al., 2020). A review of behaviour change interventions to improve breastfeeding practices reported a moderately significant effect on exclusive breastfeeding 4 weeks after delivery (BPS-Statistics of Malang District, 2018). Therefore, developing effective and evidence-based interventions considering the sociocultural barriers and other determinants of health, including feeding practices, will help the government accelerate optimal breastfeeding practices to improve the health of Indonesia's mothers and children.

Key messages

- The integrated package of behaviour change interventions in the BADUTA study (which in the Indonesian Language is an acronym for BAwah DUa TAhun, or children aged less than 2 years) increased exclusive and age-appropriate breastfeeding practices in children under 2 years old in Indonesia.
- The BADUTA study interventions did not significantly affect early breastfeeding initiation, breastfeeding in the last 24 h, ever breastfed, continued breastfeeding, predominant breastfeeding, bottle-feeding practices, fever and diarrhoea 2 weeks before the interview.
- Further research is required to develop effective interventions to improve continued breastfeeding after 12 months of age and reduce predominant breastfeeding for children aged 0–5 months and bottle-feeding practices.

In 2014, the Global Alliance for Improved Nutrition (GAIN), in coordination with the Ministry of Health Republic of Indonesia, implemented the BADUTA study (which in the Indonesian Language is an acronym for BAwah DUa TAhun, or children aged less than 2 years). It compared health system strengthening and behaviour change interventions on maternal and child nutritional status with the standard, integrated village health post services in Malang and Sidoarjo District of East Java Province, Indonesia. The study was a collaborative project with Save the Children, Paramitra Foundation and P. T. Holland for water (Nazava). The University of Sydney, in collaboration with the Centre for Health Research, Universitas Indonesia and the London School Hygiene and Tropical Medicine, conducted a comprehensive evaluation to learn about the factors affecting programme delivery and the impact of the interventions (BPS-Statistics of Malang District, 2018). The study's results will likely help the government and relevant stakeholders improve IYCF practices and prevent stunting in Indonesia.

Using data from the BADUTA study baseline and endline cross-sectional surveys, this analysis examined the impact of a package of behaviour change interventions on breastfeeding practices in Malang and Sidoarjo Districts of East Java Province. This analysis will help policymakers plan and design effective and evidence-based nutrition behaviour change interventions to improve breastfeeding practices in Indonesia.

2 | METHODS

2.1 | Study design

The BADUTA study was an impact evaluation using a cluster randomized controlled trial with two parallel treatment arms. The

design used a superiority hypothesis, one-to-one allocation of the treatments, cross-sectional and cohort outcome assessments, and a process evaluation. We designed the study of the cross-sectional outcome assessments to examine the impact of the integrated package of nutrition-specific and nutrition-sensitive interventions aimed at women and their families to improve breastfeeding practices. We will present in another manuscript the effect of the interventions on complementary feeding practices, child growth and undernutrition.

2.2 | Study setting

We conducted household surveys in 12 subdistricts of Malang and Sidoarjo Districts in East Java province (Dibley et al., 2020). Malang District is predominantly rural, but has two cities nearby, Malang and Batu, with separate administrations. There are 15 periurban subdistricts in a valley between these cities, but the remaining 17 subdistricts are rural. Sidoarjo District borders Surabaya, the second-largest city in Indonesia, and less than 20% of its population is rural. It is a fishing centre and produces many processed fish products, such as prawn and fish crackers and fermented shrimp paste. It also hosts several manufacturing plants that produce, among other things, household goods and shoes. This setting provides many alternative livelihoods opportunities for households besides farming.

The population in Malang District was 2,450,769 (BPS-Statistics of Malang District, 2018), and in Sidoarjo District, it was 1,955,839 (BPS-Statistics of Sidoarjo District, 2018), which gave a total population across the two districts of 4,406,608. There were 51 rural subdistricts (33 in Malang and 18 in Sidoarjo) eligible for the trial. The average total population per subdistrict was 86,404 (108,658 in Sidoarjo District and 74,266 in Malang District) (BPS-Statistics of Malang District, 2018; BPS-Statistics of Sidoarjo District, 2018).

2.3 | Clusters and randomization

The unit of randomization for the study was subdistricts. We used constrained randomization (Dickinson et al., 2015; Moulton, 2004) to ensure a balanced distribution of covariates in the study treatment groups because of the limited number of subdistrict clusters for which it was feasible to conduct the study. We constructed a database of indicators of household economic status, access to health care, and prevalence of undernutrition in children for all the eligible subdistricts. To select the 12 most similar subdistricts, we employed hierarchical cluster analysis. We constructed a list of the 924 possible combinations of six intervention and six comparison subdistricts using the 12 similar subdistricts. Using the database, we identified the combinations of subdistricts with balanced covariates and randomly selected one of them to allocate the trial interventions. The combination of subdistricts randomly selected were Dampit, Jabung and Turen, as intervention clusters, and Gondanglegi, Tumpang and Poncokusumo, as control cluster in Malang District, and Krian, Tulangan and Wonoayu, as intervention, and Sidoarjo, Taman and Prambon as control clusters in Sidoarjo District. The published study protocol provides more details about the restricted randomization used in the BADUTA study (Dibley et al., 2020).

2.4 | Sampling and eligibility criteria

In each of the subdistricts selected, 10 villages or urban areas (*kelurahan*) were randomly selected using the Probability Proportionate to Size sampling method, which is a self-weighted sampling method (Filmer & Pritchett, 2001). In each village/kelurahan chosen, we then selected two or three hamlets (*Rukun Warga* or RW) using simple random sampling. In the *baseline* survey, we only selected two RW per village; however, we could not achieve the planned sample size with this approach. Thus, in the *endline* survey, we selected three RW per village to ensure adequate children in the targeted age range were involved in the study. We obtained the list of all RWs from the local Village Office, and for each one, the field team prepared a sketch map and conducted a household listing. We randomly selected eight children under 2 years of age and their mothers from the list using simple random sampling to ensure the required sample size. The only eligibility criteria used in this survey was the child's age, that is, 0–23 months. We selected this age range since the first 2 years of life are within a critical window for linear child growth. It is sensitive to environmentally modifiable factors, including nutrition, sanitation, and health care.

In total, we collected information from 5175 mothers of children aged 0–23 months, that is, 2435 mothers from the baseline and 2740 mothers from the endline surveys. We estimated the sample size to provide 80% power assuming 5% refusal, 10% loss of data, a *z*-score standard deviation of 0.975, and a 5% significance level to detect a 0.15 *z*-score difference in height-for-age *z*-scores between the intervention and comparison groups at the end line survey (Ruel et al., 2008).

2.5 | Recruitment and training of field workers

In the 12 subdistricts, 10 teams collected the baseline data and 12 teams collected the endline data. We recruited 10 field coordinators, 10 field coordinator assistants, and 130 enumerators for the baseline assessment. For the endline assessment, we recruited 12 field coordinators, 24 assistants of field coordinators, and 168 enumerators.

We initially trained all field coordinators in the baseline and endline surveys, including a 1-day try-out, followed by a 7-day training programme for all the enumerators. The training for all enumerators was conducted rigorously, including 2 days of try-out sessions to ensure all field personnel had adequate knowledge of the methodology and sufficient skills and experience in using the CommCare application. Training topics we covered included an

overview of the BADUTA study, a brief overview of the CommCare application, household listing and data collection procedures, study instruments (listing forms, questionnaires using the CommCare application) and quality control methods. Detailed information about the training can be found in the protocol paper (Dibley et al., 2020).

2.6 | Data collection

We conducted the baseline assessment from 1 February 2015 to 25 February 2015, and the endline assessment was carried out from 16 January to 8 February 2017. The field team initially conducted house listings in each subcluster (hamlet). From these lists, in each subcluster, the field coordinator listed all mother–infant pairs who met the inclusion/exclusion criteria and randomly selected eight pairs from this sample frame to participate in the study. The trained interviewers then carried out face-to-face interviews with the selected respondents. The field coordinators managed a team of interviewers and ensured we carried out all data collection as planned. The CommCare programme used in this survey provided real-time information about the number of interviews completed by each interviewer. The data managers and field coordinators used the information to monitor the progress of data collection.

2.7 | The instruments for data collection

In both baseline and endline surveys, data were mainly captured electronically on Android tablets in the field using the CommCare system from Dimagi, but supplemented with paper forms for registration. The current analysis only used information derived from the questionnaires for children under 2 years old.

We adapted the established Demographic and Health Survey Questionnaire to gather information about mothers' and children's sociodemographic characteristics, history of pregnancy and delivery, history of antenatal care services, breastfeeding practices, as well as morbidity, and socioeconomic status (Statistics Indonesia, National Family Planning Coordinating Board, Ministry of Health Republic of Indonesia 2008, 2013, 2017). We developed project-specific questions to gather information about respondents' exposure to the intervention, the use of integrated health posts (Posyandu), and mobile phones. We collected information about the mothers' self-efficacy for breastfeeding using the Breastfeeding Self-Efficacy Scale-Short Form questionnaire developed by Dennis (2003). We recorded information about household food security using the US Household Food Security/Hunger Survey Module (Bickel et al., 2000; Usfar et al., 2007).

2.8 | Intervention

We designed the BADUTA interventions to operate through four intervention pathways. The first pathway traced all the steps to improve nutritional status during pregnancy by enhancing the nutrient adequacy of diets through increased consumption of foods from animal sources and increasing iron and folic acid supplement use. The second pathway traced the steps to improve the nutrient adequacy of infant and young child diets through improved dietary diversity. The third pathway was to reduce infectious diseases and improve nutrient intake through adherence to exclusive breastfeeding in the first 6 months of life. The fourth pathway identified steps to mitigate infectious diseases through improved water and sanitation practices. A detailed explanation of the four intervention pathways has been explained elsewhere (Dibley et al., 2020). Figure 1 illustrates the timeline for the implementation of the interventions (Figure 2).

2.9 | Study outcomes

We divided the outcomes of this study into two groups: breastfeeding practice and child morbidity indicators. The seven breastfeeding practice indicators used were: (1) early initiation of breastfeeding: defined as women initiating breastfeeding within 1 h of delivery (World Health Organization, 2021); (2) prelacteal feeding: defined as children aged 0–23 months given prelacteal feeds (i.e., liquids or foods other than breast milk during the first 3 days of life) (USAID, Davies U, WHO, UNICEF 2008); (3) exclusive breastfeeding under 6 months: defined as infants aged <6 months who were exclusively breastfed (breast milk and no other water or milk based liquids, or foods) during the previous day (World Health Organization, 2021); (4) predominant breastfeeding: defined as infants aged <6 months whose predominant source of nourishment is breast milk, but also received other fluids such as water-based drinks, fruit juice and ritual fluids, except for nonhuman milk and food-based fluids in the previous day (USAID, Davies U, WHO, UNICEF, 2008); (5) continued breastfeeding at 12–15 months and 20–23 months: defined as children in both age groups who received breast milk during the previous day (USAID, Davies U, WHO, UNICEF 2008); (6) age-appropriate breastfeeding: defined as infants aged 0–5 months receiving only breast milk during the previous day, and children aged 6–23 months receiving breast milk, as well solid, semisolid of soft foods during the previous day (USAID, Davies U, WHO, UNICEF, 2008); and (7) bottle-feeding: defined as children aged 0–23 months fed from a bottle with a nipple during the previous day (World Health Organization, 2021). The two-child morbidity indicators used in this analysis were the history of *fever* and *diarrhoea* within 2 weeks before the interview as reported by mothers of children 0–23 months.

2.10 | Data analysis

We initially performed basic descriptive analyses by treatment group of study to assess the balance across treatment groups of potentially confounding characteristics. For categorical variables,

Knowledge-adoption pathways	2015				2016			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Exclusive Breastfeeding								
% Health facility with maternity services implement BFHI	11%	18%	21%	25%	25%	25%	25%	25%
% of village with village midwife received BF Counseling Training	53%	76%	93%	100%	100%	100%	100%	100%
% of Posyandu deliver 3 emo-demo session for EBF	0%	0%	0%	24%	95%	95%	100%	100%
% of mothers with <2y child attending at least 1 emo-demo session on EBF	0%	0%	0%	19%	74%	76%	76%	76%
% of mothers with <2y child watching EBF TVC on tablet from village facilitator	0%	0%	0%	28%	36%	56%	60%	73%
% of mothers with <2y child & pregnant women registered with SMS Bunda	2%	3%	4%	5%	11%	33%	40%	42%
Clean Water and Handwashing								
% village with at least 1 free distribution of Nazava water filter	0%	1%	1%	12%	14%	14%	29%	65%
% village with at least 1 education session for safe water treatment & storage	2%	12%	29%	35%	65%	75%	82%	89%
% village with at least 1 Nazava water filter sales	1%	3%	6%	17%	32%	50%	72%	75%
% of Posyandu deliver emo-demo session on Handwashing	0%	0%	0%	0%	0%	0%	100%	100%
% of mothers with <2y child attending emo-demo session on handwashing	0%	0%	0%	0%	0%	0%	69%	69%
% of mothers with <2y child shown handwashing TVC by village facilitator on tab	0%	0%	0%	3%	5%	10%	11%	39%
% of mothers with <2y child & pregnant women registered with SMS Bunda	2%	3%	4%	5%	11%	33%	40%	42%
Key, The shading in cells, reflects the extent of coverage with the percentage of **coverage** displayed, but they can be interpreted as	None	Some		Average		Fair		High

TVC- Television Commercials; *EBF* – exclusive breastfeeding; SMS Bunda – text messaging service

FIGURE 1 Timeline for implementation of interventions.

we examined frequency distributions and performed a χ^2 test for independence adjusted for the cluster sampling (svy commands). We used the Wald test adjusted for the cluster sampling to assess for any significant difference between treatment groups for continuous variables. We defined statistically significant differences between the groups as p values <0.05. To determine the effect of the intervention, we applied multilevel logistic regression analysis on the baseline and endline survey data, which adjusted for the complex sample design. A priori, we included the household wealth index in all of our analyses as a proxy of socioeconomic status, an important social determinant of health status (Braveman & Gottlieb, 2014). The Benjamini–Hochberg procedure was employed post hoc to decrease the Type 1 error using a 0.05 false discovery rate (Thissen et al., 2002). We used Stata/M.P. software (version 14.2; StataCorp) for all statistical analysis using the xmelogit routine.

2.11 | Ethics and informed consent

We obtained ethics approval for the study from the Faculty of Public Health, University of Indonesia, and the Human Research Ethics Committee of the University of Sydney. We obtained written informed consent from all respondents who agreed to participate in the study.

3 | RESULTS

This analysis used information collected from 5175 mothers of children under 2 years old (i.e., 2435 mothers from baseline and 2740 mothers from endline surveys). Table 1 presents household-level characteristics of respondents at baseline and endline by the treatment group. There was balance across treatment groups for

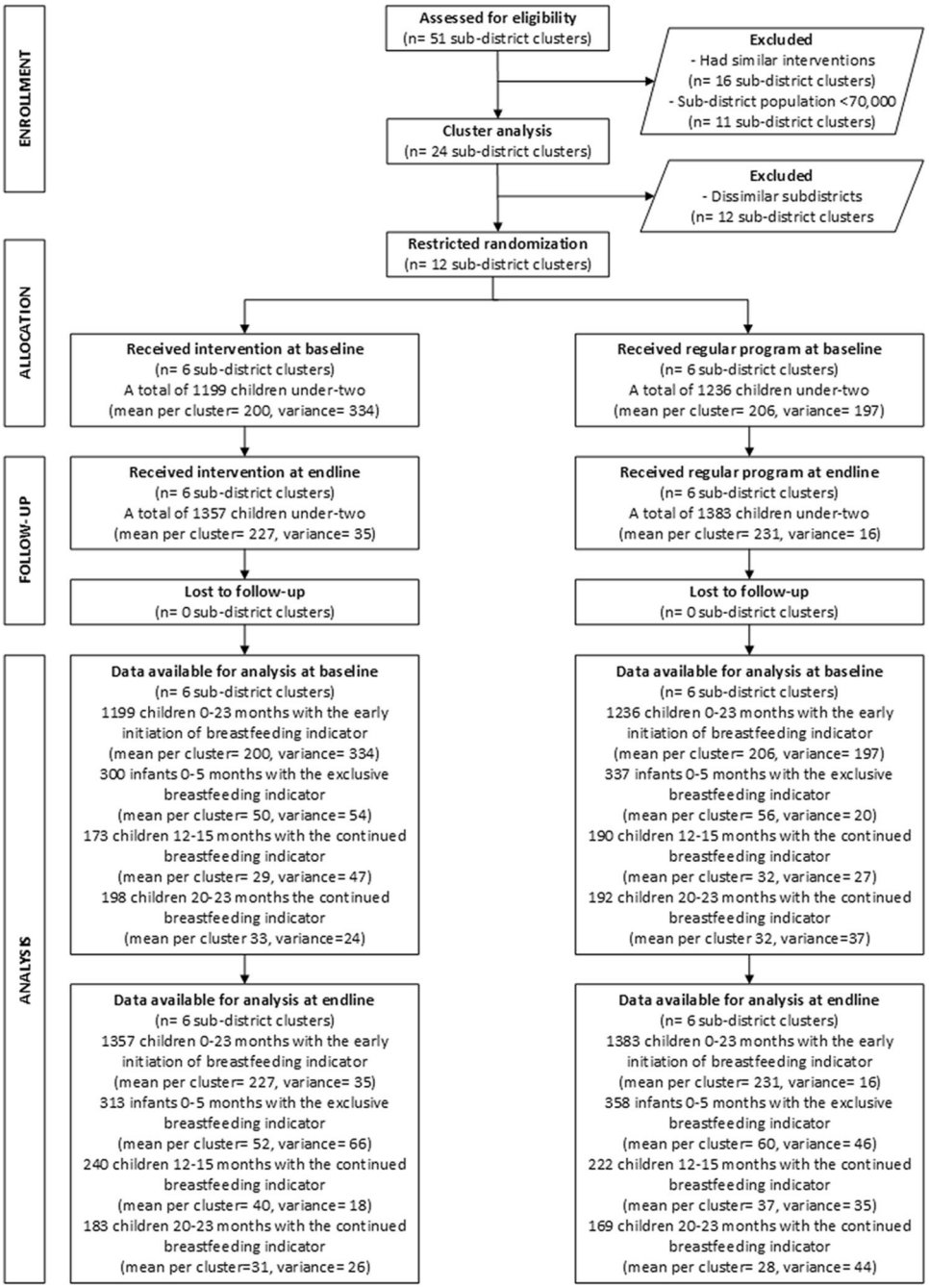


FIGURE 2 Consort flow diagram.

nearly all factors, except for "source of drinking water", which showed a small difference. At baseline, all individual, maternal and child-level characteristics were balanced by treatment group, except for birth weight, which was significantly higher in the intervention group than in the comparison group (Table 1). The majority of health service factors were also balanced, although there was a slight imbalance in the type of delivery attendants. At the endline, more boys and women were attending post-natal services in the comparison group than in the intervention group (Table 1). These differences, however, were not considered important for the analyses.

3.1 | Breastfeeding indicators

Table 3 presents the prevalence and odds of breastfeeding indicators by age group at baseline and endline. At baseline, there were no significant intergroup differences for any breastfeeding indicator. Similarly, at endline, there were no significant differences between the intervention and comparison groups in the odds of ever breastfeeding across the 0–23 months age range (adjusted odds ratio [aOR] = 1.54; 95% confidence interval [CI]: 0.77–3.08; $p = 0.220$). However, there were increased odds of putting the child to the breast within 1 h of birth (aOR = 1.34;

TABLE 1 Household and individual characteristics of trial participants at baseline and endline.

	Baseline				Endline			
	Intervention (*N* = 1199)		Comparison (*N* = 1236)		Intervention (*N* = 1357)		Comparison (*N* = 1383)	
Characteristics	***n***	**%**	***n***	**%**	***n***	**%**	***n***	**%**
District of household								
Sidoarjo	570	47.5	604	49.0	676	49.8	681	49.2
Malang	629	52.5	632	51.1	681	50.2	702	50.8
Sources and treatment of drinking water								
Source of drinking water								
Piped water	216	18.0	197	15.9	228	16.8	237	17.1
Well pump	104	8.7	146	11.8	88	6.5	194	14.0
Protected well	304	25.4	247	20.0	331	24.4	238	17.2
Protected spring	65	5.4	133	10.8	146	10.8	212	15.3
Refilled water	101	8.4	175	14.2	122	9.0	152	11.0
Branded mineral water	224	18.7	254	20.6	284	20.9	312	22.6
Nonprotected source	185	15.4	84	6.8	158	11.6	38	2.7
Water treatment before drinking								
Boiled	864	72.1	791	64.0	926	68.2	851	61.5
Filtered/chlorinated/other	4	0.3	4	0.3	18	1.3	6	0.4
Refilled/branded water	325	27.1	429	34.7	406	29.9	464	33.6
Household wealth index quintiles								
Lowest	218	18.2	269	21.8	259	19.1	327	23.6
Second	256	21.4	249	20.2	304	22.4	340	24.6
Middle	240	20.0	270	21.8	202	14.9	221	16.0
Fourth	266	22.2	268	21.7	328	24.2	291	21.0
Highest	219	18.3	180	14.6	264	19.5	204	14.8
Level of food security								
Food secure	922	76.9	898	72.7	1102	81.2	1077	77.9
Food insecure without hunger	220	18.4	277	22.4	208	15.3	233	16.9
Food insecure with hunger	57	4.8	61	4.9	47	3.5	73	5.3
Maternal characteristics								
Age (years)								
15–19	56	4.7	67	5.4	56	4.1	57	4.1
20–24	287	23.9	316	25.6	282	20.8	318	23.0
25–29	310	25.9	300	24.3	349	25.7	345	25.0
30–34	301	25.1	302	24.4	365	26.9	360	26.0
35–39	163	13.6	164	13.3	211	15.6	212	15.3
40–44	50	4.2	51	4.1	64	4.7	60	4.3
45–49	17	1.4	12	1.0	9	0.7	14	1.0
Marital status								
Single	8	0.7	2	0.2	0	0.0	0	0.0
Married	1161	96.8	1201	97.2	1315	96.9	1350	97.6
Living together	10	0.8	8	0.6	0	0.0	0	0.0

(Continues)

TABLE 1 (Continued)

Characteristics	Baseline				Endline			
	Intervention (*N* = 1199)		Comparison (*N* = 1236)		Intervention (*N* = 1357)		Comparison (*N* = 1383)	
	n	%	*n*	%	*n*	%	*n*	%
Divorced/separated	1	0.1	1	0.1	16	1.2	11	0.8
Widowed	1	0.1	3	0.2	5	0.4	5	0.4
Mother's education								
No school/incomplete primary	18	1.5	20	1.6	16	1.2	22	1.6
Completed primary school	189	15.8	262	21.2	221	16.3	258	18.7
Completed junior high school	348	29.0	331	26.8	319	23.5	341	24.7
Completed senior high school	481	40.1	465	37.6	570	42.0	541	39.1
Diploma/university	148	12.3	138	11.2	210	15.5	205	14.8
Employment status								
Housewife	849	70.8	901	72.9	963	71.0	1086	78.5
Government/private	138	11.5	137	11.1	164	12.1	118	8.5
Farmer/fisherman	157	13.1	115	9.3	152	11.2	116	8.4
Other	40	3.3	63	5.1	57	4.2	47	3.4
Reproductive history								
Percent currently pregnant	7	0.6	10	0.8	17	1.3	24	1.7
No. of pregnancies (median)	2	0.2	2	0.2	2	0.2	2	0.2
No. of live births (median)	2	0.2	2	0.2	2	0.2	2	0.2
Percent ever delivered twins	22	1.8	20	1.6	23	1.7	34	2.5
Antenatal care								
Attended ANC	1182	98.6	1211	98.0	1341	98.8	1355	98.0
ANC provider								
Doctor/OBGYN	201	16.8	172	13.9	265	19.5	271	19.6
Midwife/nurse	981	81.8	1039	84.1	1076	79.3	1084	78.4
No ANC	10	0.8	17	1.4	11	0.8	21	1.5
Had recommended ANC visits	879	73.3	838	67.8	1001	73.8	924	66.8
Delivery care								
Place of delivery								
Health facility: public sector	266	22.2	240	19.4	251	18.5	202	14.6
Health facility: private sector	888	74.1	965	78.1	1092	80.5	1131	81.8
Home/other	45	3.8	31	2.5	14	1.0	50	3.6
Type of delivery attendants								
Doctor/OBGYN	492	41.0	424	34.3	583	43.0	531	38.4
Midwife/nurse	676	56.4	787	63.7	765	56.4	816	59.0
TBA/family/friends	31	2.6	25	2.0	9	0.7	36	2.6
Post-natal care								
No PNC	70	5.8	89	7.2	134	9.9	144	10.4
Health workers	1125	93.8	1144	92.6	1213	89.4	1234	89.2

TABLE 1 (Continued)

Characteristics	Baseline				Endline			
	Intervention (*N* = 1199)		Comparison (*N* = 1236)		Intervention (*N* = 1357)		Comparison (*N* = 1383)	
	n	%	*n*	%	*n*	%	*n*	%
TBA	3	0.3	2	0.2	6	0.4	3	0.2
Infant characteristics								
Age (months)								
0–5 months	300	25.0	337	27.3	313	23.1	358	25.9
6–11 months	276	23.0	278	22.5	319	23.5	354	25.6
12–17 months	282	23.5	302	24.4	378	27.9	344	24.9
18–23 months	341	28.4	319	25.8	347	25.6	327	23.6
Sex								
Male	616	51.4	642	51.9	670	49.4	726	52.5
Female	583	48.6	594	48.1	687	50.6	657	47.5
Birthweight categories								
Less than 2.5 kg	62	5.4	67	6.0	78	5.8	84	6.2
2.5 kg or above	1096	94.7	1050	94.0	1264	94.2	1277	93.8

Abbreviations: ANC, antenatal care; OBGYN, obstetrician-gynecologist; PNC, post-natal care; TBA, traditional birth attendant.

95% CI: 1.03–1.75; $p = 0.030$), and decreased odds of receiving prelacteal feeds in children aged 0–23 in the intervention group than in the comparison group at the endline. The most common prelacteal food for children in both intervention and comparison groups was formula milk (>90%), as shown in Table S1.

Table 4 shows the prevalence and odds for these breastfeeding indicators by age and treatment groups months. There was no statistically significant difference in any breastfeeding indicators at baseline between the intervention and comparison groups. At endline, we found significantly increased odds for exclusive breastfeeding in the intervention group, but no differences for other breastfeeding indicators (Table 4).

The percentage of children receiving age-appropriate breastfeeding was the lowest in the group of children aged 0–5 months, at both baseline and endline, and the highest in the 6–11 months age group, at both time points (Figure 3). There was no significant difference in the odds of age-appropriate breastfeeding at baseline between the intervention and comparison groups. At endline, we found significantly higher odds for age-appropriate breastfeeding in the intervention group than in the comparison group.

3.2 | Fever and diarrhoea indicators

Table 2 shows the percentage of mothers reporting their child had a fever or diarrhoea 2 weeks before the interview. There was no significant difference in the odds of developing fever or diarrhoea between the intervention and comparison groups at baseline and endline, except for diarrhoea in the 6–11 months age group at baseline.

After adjustment for multiple comparisons, using the Benjamin–Hochberg test, we found that the odds of prelacteal feeding, exclusive breastfeeding in the last 24 h and age-appropriate breastfeeding remained significant at endline. However, after adjustment for multiple comparisons, the odds of diarrhoea during the previous 2 weeks at baseline and early initiation of breastfeeding at endline were no longer significant (Table S2).

4 | DISCUSSION

4.1 | Main findings and significance of findings

In general, our study found improved early breastfeeding practices in the intervention group compared to the comparison group for some indicators evaluated. There were increased odds for exclusive breastfeeding in children under 6 months. Across all ages, there was an increased odds for early initiation of breastfeeding and age-appropriate breastfeeding and decreased odds for prelacteal feeding at the endline. We observed no significant differences at baseline or endline in the odds of breastfeeding in the last 24 h or predominant breastfeeding for children aged 0–5 months and ever breastfed, continued breastfeeding after 12 months of age bottle-feeding practices. We also found a nonsignificant difference in the odds of fever and diarrhoea 2 weeks before the interview at the endline between the intervention and

TABLE 2 Prevalence of fever and diarrhoea of children 0–23 months in the intervention versus comparison group.

Indicators	Intervention				Comparison				Adjusted odds ratio[a]				p Value[b]
	n		N	%	n		N	%	OR	95% CI			
Baseline (February 2015)													
Fever—2-week recall in under 2 years old children													
0–5 months	45	/	300	15.0	68	/	337	20.2	0.70	0.46	-	1.06	0.090
6–11 months	82	/	276	29.7	92	/	278	33.1	0.87	0.45	-	1.68	0.674
12–17 months	82	/	282	29.1	107	/	302	35.4	0.78	0.48	-	1.28	0.327
18–23 months	114	/	341	33.4	104	/	319	32.6	1.07	0.76	-	1.50	0.710
Diarrhoeal—2-week recall in under 2 years old children													
0–5 months	14	/	300	4.7	21	/	337	6.2	1.36	0.54	-	3.46	0.478
6–11 months	45	/	276	16.3	21	/	278	7.6	0.40	0.18	-	0.92	0.034
12–17 months	45	/	282	16.0	55	/	302	18.2	1.14	0.53	-	2.45	0.704
18–23 months	48	/	341	14.1	43	/	319	13.5	0.94	0.57	-	1.56	0.799
Endline (February 2017)													
Fever—2-week recall in under 2 years old children													
0–5 months	43	/	313	13.7	57	/	358	15.9	0.86	0.53	-	1.38	0.529
6–11 months	82	/	319	25.7	111	/	354	31.4	0.74	0.52	-	1.06	0.104
12–17 months	110	/	378	29.1	108	/	344	31.4	0.88	0.63	-	1.23	0.456
18–23 months	91	/	347	26.2	77	/	327	23.6	1.14	0.80	-	1.62	0.467
Diarrhoeal—2-week recall in under 2 years oldchildren													
0–5 months	20	/	313	6.4	30	/	358	8.4	0.76	0.42	-	1.39	0.378
6–11 months	28	/	319	8.8	34	/	354	9.6	0.92	0.53	-	1.57	0.752
12–17 months	47	/	378	12.4	38	/	344	11.1	1.17	0.68	-	2.02	0.561
18–23 months	35	/	347	10.1	42	/	327	12.8	0.80	0.48	-	1.34	0.399

Abbreviations: CI, confidence interval; OR, odds ratio.

[a]The odds ratio for intervention versus comparison groups was adjusted for household wealth index and cluster randomization using random-effect logistic regression models.

[b]*p* Value for χ^2 to test for significant differences between intervention and comparison groups considering the complex sample design and adjusted for household wealth index using random-effect logistic or linear regression models. $p < 0.05$ indicates statistical significance.

comparison groups. The BADUTA interventions provided evidence of improvement of early initiation and exclusive breastfeeding practices and gives policymakers and programme managers a potential package of interventions to consider when addressing these problems.

4.2 | Limitations of the study

The first limitation is the BADUTA study cannot identify the impact of the individual behaviour change intervention components or if they acted synergistically; we designed the study to evaluate the combined nutritional and behavioural change interventions on the outcome. The second limitation is we remain uncertain of the impact of the package of interventions if they had been fully implemented as planned. The third limitation is the small number of clusters to implement the interventions prevented applying simple randomization to allocate the treatments. Therefore, we used the restricted randomization method (Hayes & Moulton, 2017) by identifying combinations of clusters with balanced characteristics related to the study outcomes. We randomly selected one of these balanced combinations to allocate study treatments. The fourth limitation is the lack of economic analysis to assess the programme's cost–benefit to improve breastfeeding practices. A further limitation is potential contamination from the nationally broadcast T.V. commercials that might have increased awareness among mothers and other family members and the community in both treatment arms.

4.3 | The role of package of behaviour change interventions

Breastfeeding is associated with various health benefits for both infants and mothers. The significant differences in the odds for appropriate

TABLE 3 Prevalence of early breastfeeding practices for children 0–23 months in the intervention versus comparison groups in the baseline and endline surveys.

Indicators	Intervention				Comparison				Adjusted odds ratio[a]				p Value[b]
	n	/	N	%	n	/	N	%	OR	95% CI	-		
Baseline (February 2015)													
Ever breastfed													
0–5 months	284	/	300	94.7	315	/	337	93.5	1.27	0.63	-	2.57	0.500
6–11 months	261	/	276	94.6	252	/	278	90.7	1.69	0.73	-	3.93	0.220
12–17 months	265	/	282	94.0	287	/	302	95.0	0.86	0.39	-	1.88	0.705
18–23 months	316	/	341	92.7	297	/	319	93.1	0.88	0.48	-	1.61	0.677
Breastfeeding within 1 h of birth													
0–5 months	183	/	300	61.0	166	/	337	49.3	1.64	0.96	-	2.81	0.070
6–11 months	167	/	276	60.5	148	/	278	53.2	1.40	0.91	-	2.16	0.124
12–17 months	167	/	282	59.2	169	/	302	56.0	1.15	0.67	-	1.98	0.601
18–23 months	208	/	341	61.0	182	/	319	57.1	1.19	0.77	-	1.84	0.443
Prelacteal feeds (ever breastfed children aged 0–23 months)													
Prelacteal feeds	630	/	1199	52.5	787	/	1236	63.7	0.63	0.37	-	1.04	0.072
Endline (February 2017)													
Ever breastfed													
0–5 months	303	/	313	96.8	345	/	358	96.4	1.10	0.48	-	2.56	0.818
6–11 months	315	/	319	98.8	342	/	354	96.6	3.44	0.86	-	13.74	0.081
12–17 months	368	/	378	97.4	328	/	344	95.4	1.77	0.54	-	5.87	0.349
18–23 months	337	/	347	97.1	311	/	327	95.1	1.56	0.52	-	4.67	0.423
Breastfeeding within 1 h of birth													
0–5 months	203	/	313	64.9	210	/	358	58.7	1.30	0.89	-	1.88	0.172
6–11 months	211	/	319	66.1	213	/	354	60.2	1.28	0.81	-	2.00	0.292
12–17 months	262	/	378	69.3	209	/	344	60.8	1.53	1.10	-	2.12	0.011
18–23 months	232	/	347	66.9	204	/	327	62.4	1.24	0.88	-	1.74	0.219
Prelacteal feeds (ever breastfed children aged 0–23 months)													
Prelacteal feeds	458	/	1357	33.8	674	/	1383	48.7	0.52	0.41	-	0.65	<0.001

Abbreviations: CI, confidence interval; OR, odds ratio.

[a]The odds ratio for intervention versus comparison groups was adjusted for household wealth index and cluster randomization using random-effect logistic regression models.

[b]p Value for χ^2 to test for significant differences between intervention and comparison groups considering the complex sample design and adjusted for household wealth index using random-effect logistic or linear regression models. $p < 0.05$ indicates statistical significance.

breastfeeding practices between baseline and endline assessment of the BADUTA study suggest an important role of behaviour change interventions to improve breastfeeding practices of mothers. These interventions can potentially be replicated in other areas of Indonesia to ensure infants receive maximum nutritional advantages of breastfeeding.

In the BADUTA study, information, education, and community materials were developed and distributed, such as the T.V. commercials and short text messages on maternal and child health topics sent to mothers' mobile phones (SMS Bunda) regularly. We designed these interventions to improve awareness of mothers, family members and the community regarding basic maternal and child health, including the importance of breastfeeding. Mothers in the intervention districts were visited at home by trained village facilitators to provide further support and help the mothers watch the commercials again using handheld tablets.

Previous studies highlight the advantages of implementing different behaviour change strategies that target different population groups to improve breastfeeding practices (Kim et al., 2018; Nabulsi et al., 2019; Rollins et al., 2016). However, there are reports that an

TABLE 4 Prevalence of breastfeeding indicators for children 0–23 months in the intervention versus comparison groups

Indicators	Intervention			Comparison			Adjusted odds ratio[a]				p Value[b]
	n	N	%	n	N	%	OR	95% CI			
Baseline (February 2015)											
BF status (children aged <6 months)											
BF in last 24 h	256 /	300	85.3	280 /	337	83.1	1.19	0.66	-	2.14	0.554
Exclusively BF	134 /	300	44.7	153 /	337	45.4	0.97	0.70	-	1.36	0.877
Predominant BF	9 /	300	3.0	8 /	337	2.4	1.30	0.38	-	4.47	0.681
Continued BF (children at 1 and 2 years of age)											
Cont. BF 12–15 months	110 /	173	63.6	135 /	190	71.1	1.41	0.56	-	3.53	0.429
Cont. BF 20–23 months	108 /	198	54.6	90 /	192	46.9	1.41	0.87	-	2.26	0.160
Bottle feeding (children aged 0–23 months)											
0–5 months	144 /	300	48.0	152 /	337	45.1	1.14	0.68	-	1.92	0.621
6–11 months	134 /	276	48.6	125 /	278	45.0	1.12	0.53	-	2.37	0.766
12–17 months	155 /	282	55.0	158 /	302	52.3	1.08	0.51	-	2.29	0.847
18–23 months	196 /	341	57.5	183 /	319	57.4	1.01	0.58	-	1.78	0.962
Endline (February 2017)											
BF status (children aged <6 months) at endline February 2017											
BF in last 24 h	283 /	313	90.4	313 /	358	87.4	1.49	0.64	-	3.45	0.358
Exclusively BF	205 /	313	65.5	183 /	358	51.1	1.85	1.35	-	2.53	0.000
Predominant BF	7 /	313	2.2	9 /	358	2.5	1.00	0.22	-	4.54	0.996
Continued BF (children at 1 and 2 years of age) at endline February 2017											
Cont. BF 12–15 months	185 /	240	77.1	159 /	222	71.6	1.40	0.91	-	2.16	0.128
Cont. BF 20–23 months	103 /	183	56.3	99 /	169	58.6	0.95	0.61	-	1.48	0.819
Bottle feeding (children aged 0–23 months) at endline February 2017											
0–5 months	96 /	313	30.7	104 /	358	29.1	0.70	0.44	-	1.12	0.135
6–11 months	126 /	319	39.5	152 /	354	42.9	0.81	0.41	-	1.60	0.537
12–17 months	162 /	378	42.9	171 /	344	49.7	0.69	0.45	-	1.06	0.092
18–23 months	168 /	347	48.4	169 /	327	51.7	0.82	0.48	-	1.40	0.459

Abbreviations: BF, breastfeeding; CI, confidence interval; OR, odds ratio.

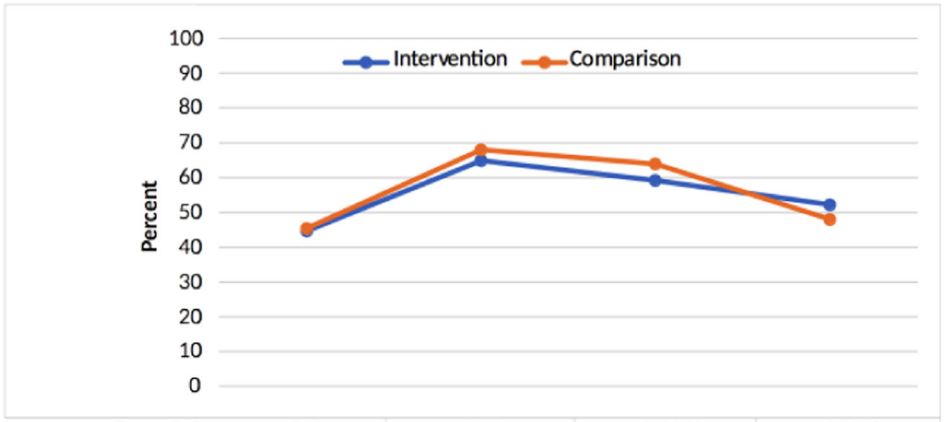
[a]The odds ratio for intervention versus comparison groups was adjusted for household wealth index and cluster randomization using random effect logistic regression models.

[b]*p* Value for χ^2 to test for significant differences between intervention and comparison groups considering the complex sample design and adjusted for household wealth index using random-effect logistic or linear regression models. $p < 0.05$ indicates statistical significance.

integrated approach directed at the individual, household and community levels would produce better IYCF outcomes (Kim et al., 2018; Sinha et al., 2015). Our previous analysis of mothers' breastfeeding self-efficacy using the BADUTA data supports this concept. Mothers exposed to three or more interventions had higher breastfeeding self-efficacy than those exposed to only one intervention (Titaley et al., 2021). Moreover, previous reports show that a continuing approach, from preconception, antenatal, extended to the post-natal period, has a greater effect than antenatal or post-natal interventions alone (Hannula et al., 2008; Kim et al., 2018). Further examination is needed to examine the impact of each component of intervention in the BADUTA study and identify the optimal combination of interventions to support appropriate breastfeeding practices.

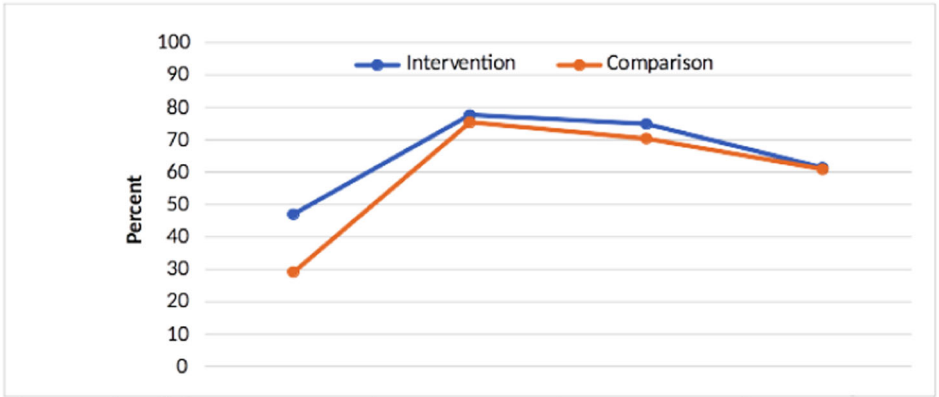
The improved breastfeeding practices found in our analysis agree with previous studies reporting a positive association between behaviour change interventions, increased early initiation of breastfeeding (Engebretsen et al., 2014; Lassi et al., 2020; Rollins et al., 2016; Sinha et al., 2015), exclusive breastfeeding (Kassianos et al., 2019; Lassi et al., 2020; Nabulsi et al., 2019; Rollins et al., 2016), age-appropriate breastfeeding (Lassi et al., 2020), and reduced prelacteal feeding practices (Engebretsen et al., 2014). Our analysis cannot confirm if an individual intervention is better than a complex

(a) **Baseline**



Age group (months)	0-5	6-11	12-17	18-23
Intervention				
n/N	134/300	179/276	167/282	178/341
%	44.7	64.9	59.2	52.2
Comparison				
n/N	153/337	189/278	193/302	153/319
%	45.4	68	63.9	48
OR	0.97	0.89	0.83	1.15
95% CI	0.70-1.36	0.49-1.61	0.47-1.49	0.7-1.9
p	0.877	0.689	0.542	0.581

(b) **Endline**



Age group (months)	0-5	6-11	12-17	18-23
Intervention				
n/N	147/313	248/319	283/378	213/347
%	47	77.7	74.9	61.4
Comparison				
n/N	104/358	267/354	242/344	199/327
%	29.1	75.4	70.4	60.9
OR	2.17	1.18	1.34	1.06
95% CI	1.57-2.99	0.68-2.06	0.90-2.00	0.71-1.56
p	<0.001	0.559	0.149	0.781

FIGURE 3 Prevalence of age-appropriate breastfeeding for children aged 0–23 months in the intervention versus comparison groups at the baseline and endline.

multicomponent intervention for improving breastfeeding practices. However, the incomplete implementation of the BADUTA study interventions limits our ability to compare with other studies with either individual or multicomponent interventions.

Several behaviour-change strategies were applied in the BADUTA study to change the community's behaviour, including breastfeeding practices, in mothers with children aged 0–23 months, which is the optimal period of children's growth and development. There were two fully implemented breastfeeding interventions (100%) in the last two-quarters: breastfeeding counselling training for village midwives and the delivery of at least three Emo-Demo sessions for breastfeeding in Posyandu (integrated health post). Additionally, two interventions, that is, mothers attending at least one Emo-Demo session of exclusive breastfeeding and mothers watching an exclusive breastfeeding commercial together with a village facilitator, had been rolled out with at least 60% coverage in the last two-quarters and then increased to more than 70% in the final quarter. Although the implementation of these interventions was incomplete throughout the 2 years of evaluation, there was sufficient delivery to improve breastfeeding practices of mothers in the intervention group.

We hypothesized several pathways leading to positive breastfeeding practices in mothers exposed to the behaviour change interventions. At the individual level, we designed the interventions to increase maternal knowledge and awareness of positive breastfeeding practices through individual counselling sessions with trained village midwives and by attending Emo-Demo sessions at Posyandu to promote positive maternal feeding behaviours. Pre-experimental research with a one-group pre–post-test design among mothers in Malang reported the Emo-Demo method's effectiveness in increasing mothers' knowledge and attitude towards exclusive (Supriyadi et al., 2021). Furthermore, since the last two-quarters before the BADUTA study concluded, the education session through Emo-Demo had been fully implemented (100%) by Posyandu in intervention districts. More than three-quarters of mothers of children under 2 years of age attended the Emo-Demo sessions (Figure 1), indicating considerable mothers' exposure to the breastfeeding educational programmes offered in these group meetings in the community.

At the health system level, in the 2 years of implementation of the BADUTA study, all village midwives working in the interventions districts had been trained in breastfeeding counselling. Thereby, women living in intervention districts received breastfeeding counselling and assistance from trained personnel during antenatal, postnatal, and mothers' breastfeeding periods. Reviews of different studies on breastfeeding counselling show that counselling is highly effective at maintaining exclusive breastfeeding (McFadden et al., 2017, 2019). From the providers' side, the training of village midwives could enhance midwives' confidence, knowledge, and skills to counsel and support women on optimum breastfeeding practices. A study from Burkina Faso reported the positive effect of training facility- and community-based health workers on exclusive breastfeeding practices (Cresswell et al., 2019).

Overall, our findings highlight the advantages of counselling and education activities when carried out simultaneously, either in the health system, community or at the individual level, as reported by various studies (Melo et al., 2021; Pérez-Escamilla et al., 2016; Sinha et al., 2015). Our analysis supports previous literature showing that needs-based, one-to-one, informal sessions delivered by trained personnel, including peer-counsellor, promoted breastfeeding practices (Thurston et al., 2013). The benefits of face-to-face counselling appear to be more effective than other types of counselling (McFadden et al., 2017, 2019).

The role of the health system and care providers are critical to support mothers during pre- and post-natal periods. In addition to training midwives on breastfeeding, the implementation of Baby Friendly Hospital Initiatives (BFHIs) in health facilities offering maternity services also can help in promoting positive breastfeeding practices. Studies show that BFHI promoting early breastfeeding initiation can reduce prelacteal feeding and minimize the provision of breast milk substitutes to infants (Rollins et al., 2016; Thurston et al., 2013). A systematic review on the impact of BFHI on breastfeeding also found that compliance with the BFHI Ten Steps has a positive outcome on short-, medium- and longer term breastfeeding outcomes (Pérez-Escamilla et al., 2016). Furthermore, a dose–response relationship was reported between the number of BFHI steps and the likelihood of improved breastfeeding outcomes (Pérez-Escamilla et al., 2016).

Our findings demonstrate some positive effects of a package of interventions on breastfeeding practices; however, further evaluation is required to examine the effectiveness of each intervention component and which combination of intervention components has the greatest impact on recommended breastfeeding practices. The differences in the timing of rolling out each intervention throughout the BADUTA study might have resulted in the relatively modest results found in our trial despite implementing a package of interventions compared to studies implementing only a single intervention (Lassi et al., 2020). However, it is also plausible that multiple components of intervention working at different levels that worked synergistically to promote optimal breastfeeding practices will produce a larger effect than individual intervention alone, as reported in other studies (Melo et al., 2021; Pérez-Escamilla et al., 2012).

5 | CONCLUSIONS

In summary, our findings show that the integrated package of behaviour interventions in the BADUTA study improved exclusive breastfeeding, age-appropriate breastfeeding and reduced prelacteal feeding practices in children under 2 years old. Further research is, however, needed to evaluate the effectiveness of each component of the BADUTA intervention package and different combinations of interventions to identify which is the most impactful along with the cost-effectiveness of the interventions. Such future research would assist in designing and developing the most effective and efficient measures to help reach the current nutrition targets for children in Indonesia.

AUTHOR CONTRIBUTIONS

Michael J. Dibley led the funding application with contributions from Ashraful Alam, Mu Li, Iwan Ariawan, Umi Fahmida, Christiana Rialine Titaley and Elaine Ferguson. Iwan Ariawan, Umi Fahmida and Michael J. Dibley led the study implementation. Christiana Rialine Titaley and Min Kyaw Htet supervised the field evaluation team. Ashraful Alam oversaw the field implementation of the intervention. Iwan Ariawan, Michael J. Dibley and Christiana Rialine Titaley developed the statistical plan and interpreted the analyses with input from all authors. Christiana Rialine Titaley and Anifatun Mu'asyaroh conducted the statistical analysis supervised by Michael J. Dibley and Iwan Ariawan. Ashraful Alam, Rita Damayanti, Tran Thanh Do, Elaine Ferguson, Min Kyaw Htet, Mu Li and Aang Sutrisna Umi Fahmida provided data analysis advice. Christiana Rialine Titaley and Michael J. Dibley wrote the original draft of the manuscript. Iwan Ariawan and Bunga Astria Paramashanti contributed to major modifications of the draft manuscript. All authors read and approved the manuscript.

ACKNOWLEDGMENTS

The authors extend thanks to the women and children who participated in evaluating phase one (2014–2017) of the BADUTA programme. We also thank the following organizations that contributed to the success of the BADUTA program: Directorate of Community Nutrition, Ministry of Health, Indonesia, East Java Provincial Health Office, District Health Offices of Sidoarjo and Malang, Yayasan Sayangi Tunas Cilik, Save the Children, Paramitra Foundation and PT Holland for Water (Nazava). We also thank GAIN staff, both past and present, for their support of Phase 1 of the BADUTA program evaluation, including Lynnette Neufeld and Alison Tumilowicz, for their contributions to the design of the evaluation. We also thank those who contributed to the program evaluation, including the enumerators, fieldwork teams, the staff and students from local health and nutrition academies (Poltelkes Kemenkes Malang and Akademi Gizi Surabaya) for their enthusiastic support of the field activities. The study was funded by a grant from the Kingdom of the Netherlands to GAIN (activity number: 400000062), who contracted a consortium led by the University of Sydney to conduct an independent impact evaluation.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

ETHICS STATEMENT

The Faculty of Public Health, Universitas Indonesia (323/H2.F10/PPM.00.02/2016) and the Human Research Ethics Committee of the University of Sydney, Australia (Protocol number: 2015/115), both provided ethical approval for the project. We also obtained a research clearance from the Ministry of Internal Affairs at the central level and the Office of National Unity and Community Protection at the provincial and district levels. We recorded written informed consent from all respondents before the interview. All individuals included in this study are 18 years or older.

ORCID

Christiana Rialine Titaley http://orcid.org/0000-0002-3023-003X
Michael J. Dibley http://orcid.org/0000-0002-1554-5180
Ashraful Alam http://orcid.org/0000-0001-7034-1095
Elaine Ferguson http://orcid.org/0000-0003-4673-5128
Min Kyaw Htet http://orcid.org/0000-0001-6417-2942
Umi Fahmida https://orcid.org/0000-0003-1403-6242

REFERENCES

Bickel, G., Nord, M., Price, C., Hamilton, W., & Cook, J. (2000). *Guide to measuring household food security, revised 2000*. US Department of Agriculture, Food and Nutrition Service.

Braveman, P., & Gottlieb, L. (2014). The social determinants of health: It's time to consider the causes of the causes. *Public Health Reports*, *129*(Suppl 2), 19–31.

Cresswell, J. A., Ganaba, R., Sarrassat, S., Somé, H., Diallo, A. H., Cousens, S., & Filippi, V. (2019). The effect of the Alive & Thrive initiative on exclusive breastfeeding in rural Burkina Faso: A repeated cross-sectional cluster randomised controlled trial. *Lancet Glob Health*, *7*(3), e357–e365.

BPS-Statistics of Malang District. (2018). *Malang District in figures 2018*.

BPS-Statistics of Sidoarjo District. (2018). *Sidoarjo District in figures 2018*.

Dennis, C. L. (2003). The breastfeeding self-efficacy scale: Psychometric assessment of the short form. *Journal of Obstetric, Gynecologic, and Neonatal Nursing*, *32*(6), 734–744.

Dibley, M. J., Alam, A., Fahmida, U., Ariawan, I., Titaley, C. R., Htet, M. K., Damayanti, R., Li, M., Sutrisna, A., & Ferguson, E. (2020). Evaluation of a package of behaviour change interventions (Baduta Program) to improve maternal and child nutrition in East Java, Indonesia: Protocol for an impact study. *JMIR Research Protocols*, *9*(9), e18521.

Dickinson, L. M., Beaty, B., Fox, C., Pace, W., Dickinson, W. P., Emsermann, C., & Kempe, A. (2015). Pragmatic cluster randomized trials using covariate constrained randomization: A method for Practice-based Research Networks (PBRNs). *Journal of the American Board of Family Medicine*, *28*(5), 663–672.

Engebretsen, I. M., Nankabirwa, V., Doherty, T., Diallo, A. H., Nankunda, J., Fadnes, L. T., Ekström, E.-C., Ramokolo, V., Meda, N., Sommerfelt, H., Jackson, D., Tylleskär, T., & Tumwine, J. K., PROMISE-EBF study group. (2014). Early infant feeding practices in three African countries: The PROMISE-EBF trial promoting exclusive breastfeeding by peer counsellors. *International Breastfeeding Journal*, *9*(1), 19.

Filmer, D., & Pritchett, L. H. (2001). Estimating wealth effects without expenditure data—Or tears: An application to educational enrollments in states of India. *Demography*, *38*(1), 115–132.

Hannula, L., Kaunonen, M., & Tarkka, M. T. (2008). A systematic review of professional support interventions for breastfeeding. *Journal of Clinical Nursing*, *17*(9), 1132–1143.

Hayes, R. J., & Moulton, L. H. (2017). *Cluster randomised trials*. Chapman & Hall/CRC.

Horta, B. L., & Victora, C. G. (2013). *Short-term effects of breastfeeding: Systematic review on the benefits of breastfeeding on diarrhoea and pneumonia mortality*. World Health Organization

Kassianos, A. P., Ward, E., Rojas-Garcia, A., Kurti, A., Mitchell, F. C., Nostikasari, D., Payton, J., Pascal-Saadi, J., Spears, C. A., & Notley, C. (2019). A systematic review and meta-analysis of interventions incorporating behaviour change techniques to promote breastfeeding among postpartum women. *Health Psychology Review*, *13*(3), 344–372.

Kim, S. K., Park, S., Oh, J., Kim, J., & Ahn, S. (2018). Interventions promoting exclusive breastfeeding up to six months after birth: A systematic review and meta-analysis of randomized controlled trials. *International Journal of Nursing Studies*, *80*, 94–105.

Lassi, Z. S., Rind, F., Irfan, O., Hadi, R., Das, J. K., & Bhutta, Z. A. (2020). Impact of Infant and Young Child Feeding (IYCF) nutrition interventions on breastfeeding practices, growth and mortality in low- and middle-income countries: Systematic review. *Nutrients*, *12*(3), 722.

McFadden, A., Gavine, A., Renfrew, M. J., Wade, A., Buchanan, P., Taylor, J. L., Veitch, E., Rennie, A. M., Crowther, S. A., Neiman, S., & MacGillivray, S. S. (2017). Support for healthy breastfeeding mothers with healthy term babies. *Cochrane Database of Systematic Reviews*, *2*(2), CD001141.

McFadden, A., Siebelt, L., Marshall, J. L., Gavine, A., Girard, L.-C., Symon, A., & MacGillivray, S. (2019). Counselling interventions to enable women to initiate and continue breastfeeding: A systematic review and meta-analysis. *International Breastfeeding Journal*, *14*, 42–42.

Melo, D. S., Oliveira, M. H., & Pereira, D. D. S. (2021). Brazil's progress in protecting, promoting and supporting breastfeeding from the perspective of the global breastfeeding collective. *Revista Paulista de Pediatria*, *39*, e2019296.

Moulton, L. H. (2004). Covariate-based constrained randomization of group-randomized trials. *Clinical Trials (London, England)*, *1*(3), 297–305.

Nabulsi, M., Tamim, H., Shamsedine, L., Charafeddine, L., Yehya, N., Kabakian-Khasholian, T., Masri, S., Nasser, F., Ayash, S., & Ghanem, D. (2019). A multi-component intervention to support breastfeeding in Lebanon: A randomized clinical trial. *PLoS One*, *14*(6), e0218467.

National Institute of Health Research and Development MoH, Republic of Indonesia. (2018). *Basic health research 2018: National report 2018*.

Pérez-Escamilla, R., Curry, L., Minhas, D., Taylor, L., & Bradley, E. (2012). Scaling up of breastfeeding promotion programs in low- and middle-income countries: The "breastfeeding gear" model. *Advances in Nutrition*, *3*(6), 790–800.

Pérez-Escamilla, R., Martinez, J. L., & Segura-Pérez, S. (2016). Impact of the baby-friendly hospital initiative on breastfeeding and child health outcomes: A systematic review. *Maternal & Child Nutrition*, *12*(3), 402–417.

Rollins, N. C., Bhandari, N., Hajeebhoy, N., Horton, S., Lutter, C. K., Martines, J. C., Piwoz, E. G., Richter, L. M., & Victora, C. G. (2016). Why invest, and what it will take to improve breastfeeding practices? *Lancet*, *387*(10017), 491–504.

Ruel, M. T., Menon, P., Habicht, J. P., Loechl, C., Bergeron, G., Pelto, G., Arimond, M., Maluccio, J., Michaud, L., & Hankebo, B. (2008). Age-based preventive targeting of food assistance and behaviour change and communication for reduction of childhood undernutrition in Haiti: A cluster randomised trial. *Lancet*, *371*(9612), 588–595.

Sinha, B., Chowdhury, R., Sankar, M. J., Martines, J., Taneja, S., Mazumder, S., Rollins, N., Bahl, R., & Bhandari, N. (2015). Interventions to improve breastfeeding outcomes: A systematic review and meta-analysis. *Acta Paediatrica*, *104*(S467), 114–134.

Statistics Indonesia, National Family Planning Coordinating Board, Ministry of Health Republic of Indonesia. (2008). *ORC Macro: Indonesia Demographic and Health Survey 2007*. BPS and ORC Macro.

Statistics Indonesia, National Family Planning Coordinating Board, Ministry of Health Republic of Indonesia. (2013). *Macro O: Indonesia demographic and health survey 2012*. BPS and ORC Macro.

Statistics Indonesia, National Family Planning Coordinating Board, Ministry of Health Republic of Indonesia. (2017). *Macro O: Indonesia demographic and health survey 2017*. BPS and ORC Macro.

Supriyadi, S. K., Rosyada, F., & Dea Aflah, S. (2021). The effectiveness of Emo-Demo in increasing the knowledge and attitudes in mother who do not provide exclusive breastfeeding in the working area of Cisadae Public Health Center in Malang. *KnE Life Sciences*, *6*(2), 93–101.

Thissen, D., Steinberg, L., & Kuang, D. (2002). Quick and easy implementation of the Benjamini-Hochberg procedure for controlling the false positive rate in multiple comparisons. *Journal of Educational and Behavioral Statistics*, *27*(1), 77–83.

Thurston, A., Bolin, J. H., & Chezem, J. C. (2013). Infant formula samples: Perinatal sources and breast-feeding outcomes at 1 month postpartum. *The Journal of Perinatal & Neonatal Nursing*, *27*(4), 353–358.

Titaley, C. R., Dibley, M. J., Ariawan, I., Mu'asyaroh, A., Alam, A., Damayanti, R., Do, T. T., Ferguson, E., Htet, K., Li, M., Sutrisna, A., & Fahmida, U. M. (2021). Determinants of low breastfeeding self-efficacy amongst mothers of children aged less than six months: Results from the BADUTA study in East Java, Indonesia. *International Breastfeeding Journal*, *16*(1), 12.

USAID, Davies U, WHO, UNICEF. (2008). *IFPRI: Indicators for assessing infant and young child feeding practices. Part 1. Definitions*.

Usfar, A. A., Fahmida, U., & Februhartanty, J. (2007). Household food security status measured by the US-Household Food Security/Hunger Survey Module (US-FSSM) is in line with coping strategy indicators found in urban and rural Indonesia. *Asia Pacific Journal of Clinical Nutrition*. *16*(2), 368–374.

Victora, C. G., Bahl, R., Barros, A. J., França, G. V., Horton, S., Krasevec, J., Murch, S., Sankar, M. J., Walker, N., & Rollins, N. C. (2016). Breastfeeding in the 21st century: Epidemiology, mechanisms, and lifelong effect. *Lancet*, *387*(10017), 475–490.

World Health Organization. (2003). *Unicef: Global strategy for Infant and young child feeding*.

World Health Organization. (2021). *Unicef: Indicators for assessing infant and young child feeding practices: Definitions and measurement methods*. https://creativecommons.org/licenses/by-nc-sa/3.0/igo

SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

How to cite this article: Titaley, C. R., Dibley, M. J., Ariawan, I., Mu'asyaroh, A., Paramashanti, B. A., Alam, A., Damayanti, R., Do, T. T., Ferguson, E., Htet, M. K., Li, M., Sutrisna, A., & Fahmida, U. (2022). The impact of a package of behavior change interventions on breastfeeding practices in East Java Province, Indonesia. *Maternal & Child Nutrition*, 18, e13362. https://doi.org/10.1111/mcn.13362