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

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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

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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; Victoria 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 & Victoria, 2013). However, suboptimal breastfeeding practices are frequently reported globally (Victoria 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.

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 TAahun, 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 diarrhea 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.

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 diarrhea 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.

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, 2009); (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,
we examined frequency distributions and performed a χ² 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...
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.

| Characteristics                        | Baseline Intervention (N = 1199) | Baseline Comparison (N = 1236) | Endline Intervention (N = 1357) | Endline Comparison (N = 1383) |
|----------------------------------------|----------------------------------|---------------------------------|----------------------------------|-------------------------------|
|                                        | n  | %   | 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 | 20–24 | 25–29 | 30–34 | 35–39 | 40–44 | 45–49 |
|-------------|-------|-------|-------|-------|-------|-------|-------|
| Intervention | 56    | 4.7   | 67    | 5.4   | 56    | 4.1   | 57    | 4.1   |
| Comparison   | 287   | 23.9  | 316   | 25.6  | 282   | 20.8  | 318   | 23.0  |
| Intervention | 310   | 25.9  | 300   | 24.3  | 349   | 25.7  | 345   | 25.0  |
| Comparison   | 301   | 25.1  | 302   | 24.4  | 365   | 26.9  | 360   | 26.0  |
| Intervention | 163   | 13.6  | 164   | 13.3  | 211   | 15.6  | 212   | 15.3  |
| Comparison   | 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)
| Characteristics                        | Baseline Intervention (N = 1199) | Comparison (N = 1236) | Endline 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            |
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

| Characteristic       | Baseline (N = 1199) | Comparison (N = 1236) | Endline (N = 1357) | Comparison (N = 1383) |
|----------------------|---------------------|------------------------|--------------------|------------------------|
| TBA                  | 3 (0.3)             | 2 (0.2)                | 6 (0.4)            | 3 (0.2)                |

**Infant characteristics**

| Age (months) | Baseline Intervention | Baseline Comparison | Endline Intervention | Endline Comparison |
|--------------|-----------------------|---------------------|----------------------|--------------------|
| 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**

| | Baseline Intervention | Baseline Comparison | Endline Intervention | Endline Comparison |
|------------------|-----------------------|---------------------|--------------------|--------------------|
| 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**

|                 | Baseline Intervention | Baseline Comparison | Endline Intervention | Endline Comparison |
|-----------------|-----------------------|---------------------|--------------------|--------------------|
| 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.
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.

### 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
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 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** | **p Value** |
|          | 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 / 378 | 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.

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

*p Value for χ² 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.
An 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), 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

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

| Indicators | Intervention | | Comparison | | Adjusted odds ratio | | p Value |
|------------|--------------|----------------|------------|----------------|----------------|-----------------|
| Baseline (February 2015) | | | | | | |
| BF status (children aged <6 months) | | | | | | |
| BF in last 24 h | 256 / 300 85.3 | 280 / 337 83.1 | | | | |
| Exclusively BF | 134 / 300 44.7 | 153 / 337 45.4 | | | | |
| Predominant BF | 9 / 300 3.0 | 8 / 337 2.4 | | | | |
| Continued BF (children at 1 and 2 years of age) | | | | | | |
| Cont. BF 12–15 months | 110 / 173 63.6 | 135 / 190 71.1 | | | | |
| Cont. BF 20–23 months | 108 / 198 54.6 | 90 / 192 46.9 | | | | |
| Bottle feeding (children aged 0–23 months) | | | | | | |
| 0–5 months | 144 / 300 48.0 | 152 / 337 45.1 | | | | |
| 6–11 months | 134 / 276 48.6 | 125 / 278 45.0 | | | | |
| 12–17 months | 155 / 282 55.0 | 158 / 302 52.3 | | | | |
| 18–23 months | 196 / 341 57.5 | 183 / 319 57.4 | | | | |
| 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 | | | | |
| Exclusively BF | 205 / 313 65.5 | 183 / 358 51.1 | | | | |
| Predominant BF | 7 / 313 2.2 | 9 / 358 2.5 | | | | |
| 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 | | | | |
| Cont. BF 20–23 months | 103 / 183 56.3 | 99 / 169 58.6 | | | | |
| Bottle feeding (children aged 0–23 months) at endline February 2017 | | | | | | |
| 0–5 months | 96 / 313 30.7 | 104 / 358 29.1 | | | | |
| 6–11 months | 126 / 319 39.5 | 152 / 354 42.9 | | | | |
| 12–17 months | 162 / 378 42.9 | 171 / 344 49.7 | | | | |
| 18–23 months | 168 / 347 48.4 | 169 / 327 51.7 | | | | |

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

*aThe 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 χ² 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.
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 Titalye and Elaine Ferguson. Iwan Ariawan, UmI Fahmida and Michael J. Dibley led the study implementation. Christiana Rialine Titalye 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 Titalye developed the statistical plan and interpreted the analyses with input from all authors. Christiana Rialine Titalye and Anifatun Mu’sayaroh 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 Titalye and Michael J. Dibley wrote the original draft of the manuscript. Iwan Ariawan and Bunga Astra Paramashanti contributed to major modifications of the draft manuscript. All authors read and approved the manuscript.

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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.

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**SUPPORTING INFORMATION**

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

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