

Integrated Interventions Delivered in Health Systems, Home, and Community Have the Highest Impact on Breastfeeding Outcomes in Low- and Middle-Income Countries

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Abstract

Background: Improving breastfeeding rates is critical. In low- and middle-income countries (LMICs), only subtle improvements in breastfeeding rates have been observed over the past decade, which highlights the need for accelerating breastfeeding promotion interventions.

Objective: The objective of this article is to update evidence on the effect of interventions on early initiation of and exclusive (<1 and 1–5 mo) and continued (6–23 mo) breastfeeding rates in LMICs when delivered in health systems, in the home or in community environments, or in a combination of settings.

Methods: A systematic literature search was conducted in PubMed, Cochrane, and CABI databases to identify new articles relevant to our current review, which were published after the search date of our earlier meta-analysis (October 2014). Nine new articles were found to be relevant and were included, in addition to the other 52 studies that were identified in our earlier meta-analysis. We reported the pooled ORs and corresponding 95% CIs as our outcome estimates. In cases of high heterogeneity, random-effects models were used and causes were explored by subgroup analysis and meta-regression.

Results: Early initiation of and exclusive (<1 and 1–5 mo) and continued (6–23 mo) breastfeeding rates in LMICs improved significantly as a result of interventions delivered in health systems, in the home or community, or a combination of these. Interventions delivered concurrently in a combination of settings were found to show the largest improvements in desired breastfeeding outcomes. Counseling provided in any setting and baby-friendly support in health systems appear to be the most effective interventions to improve breastfeeding.

Conclusions: Improvements in breastfeeding practices are possible in LMICs with judicious use of tested interventions, particularly when delivered in a combination of settings concurrently. The findings can be considered for inclusion in the Lives Saved Tool model. *J Nutr* 2017;147(Suppl):2179S–87S.

Keywords: interventions, breastfeeding, early initiation of breastfeeding, exclusive breastfeeding, low- and middle-income countries, meta-analysis

Introduction

Optimal breastfeeding is a key intervention that is known to improve survival, reduce infections, and promote health and development in children. The WHO and UNICEF recommend initiation of breastfeeding within 1 h of birth, exclusive breastfeeding (EBF) for the first 6 mo of life, and continued breastfeeding beyond 6 mo and ≤ 2 y of age or beyond (1). Timely initiation of breastfeeding within 1 h of birth has been shown to lower the risk of all-cause and infection-related neonatal

mortality (2). Infants who were not exclusively breastfed in the first 6 mo of life or were not breastfed ≤ 2 y of age had a higher risk of all-cause and infection-related mortality than did those who met these criteria (3). Moreover, breastfeeding in infants improves intelligence quotients and prevents development of chronic conditions such as obesity and diabetes later in life (4–6).

The latest UNICEF estimates (2016) suggest that, globally, 45% of newborns begin breastfeeding within 1 h of birth (7).

Approximately 43% of the world's infants are breastfed exclusively in the first 6 mo of life (7) compared with the global target of 50% set out in the WHO's Comprehensive Implementation Plan (8). Globally, continued breastfeeding at 12–15 and 23–24 mo is reported to be practiced in 74% and 46% of children, respectively (7). However, this is not uniform across all populations or regions. Time trends in low- and middle-income countries (LMICs) show that EBF rates increased modestly from 25% in 1993 to 37% in 2013. But continued breastfeeding rates at age 12–15 mo decreased from 76% in 1993 to 73% in 2013, largely due to a decrease in the practice of breastfeeding in poor populations (9, 10). Hence, accelerated efforts to promote breastfeeding interventions are essential to improve continued breastfeeding rates and to achieve the global breastfeeding target in LMICs by 2025 (8). Previous systematic reviews conducted by Haroon et al. (11) and Sinha et al. (12) summarized the effects of proven interventions to promote breastfeeding. Haroon et al. (11) examined the combined effect of interventions on EBF and predominant, partial, and no breastfeeding at day 1 and at <1 and 1–5 mo in developed and developing countries and found significant improvements in EBF as a result of breastfeeding education and support. However, this review presented no information on interventions to improve early initiation of or continued breastfeeding beyond 6 mo. In our previous review (12), we synthesized evidence on the effects of interventions on early initiation and exclusive, continued, and any breastfeeding rates when delivered in different settings, as follows: health systems and services, home and family environment, community environment, work environment, policy environment, or in a combination of settings. Interventions delivered concurrently in a combination of settings (e.g., both in the health system and in the home or community) were found to have a higher impact on breastfeeding rates. In this review, we included studies from high-income countries and LMICs but did not examine the effect of interventions separately on EBF at <1 or 1–5 mo in LMICs.

The current meta-analysis was conducted to update the Lives Saved Tool (LiST) model (13) for breastfeeding promotion interventions in relation to early initiation of breastfeeding, EBF, and continued breastfeeding. We examined the effect of different interventions on early initiation and exclusive (<1 and 1–5 mo)

and continued (6–23 mo) breastfeeding rates in LMICs when delivered in health systems, in the home or community environments, or in a combination of settings.

Methods

In this review, we updated the previous reviews to include studies in LMICs [defined as per World Bank data (14)] published after the last search date (i.e., October 2014). We searched published literature from PubMed (<https://www.ncbi.nlm.nih.gov/pubmed/>), the Cochrane Library (<http://www.cochranelibrary.com/>), and CABI (<http://www.cabi.org/publishing-products/resources-for-database-users/>) databases on 10 July 2016 with the use of the search strategy used by Sinha et al. (12) to identify new studies from November 2014 onward that examined the effects of interventions to promote breastfeeding (**Supplemental Box 1**). We restricted the search to studies from LMICs by using a custom-made LMIC filter (**Supplemental Box 2**). No language restriction was used in the electronic searches.

Three review authors (BS, RC, and RPU) screened the titles and abstracts independently to identify potentially relevant citations. The review authors retrieved the full texts of all potentially relevant articles and independently assessed the eligibility of the studies by using predefined inclusion criteria and performed data extraction. Any disagreements or discrepancies between reviewers was resolved by discussion and, if necessary, by consulting a fourth review author (MJS or ST).

Inclusion criteria. The inclusion criteria were similar to our previous review (12). We included individual randomized controlled trials (RCTs), cluster-randomized trials (cRCTs), quasi-experimental trials, and observational studies (prospective or retrospective cohort and case-control) conducted in LMICs. For articles in other languages, we attempted to find out whether the abstract was available in English. If none of the outcomes included in the review were mentioned in the available English abstract, the article was excluded.

Categorization of interventions. The interventions to promote breastfeeding were classified into 3 major categories according to their setting: health systems, home and community environments, or a combination of these. Studies that examined the effect of the Baby-Friendly Hospital Initiative (BFHI), the establishment of rooming-in practices, organizational support on breastfeeding outcomes, etc., were grouped under health systems and services. Home and community interventions included studies of one-on-one counseling by home visits or telephone, home support by the father or grandparent, group counseling, group meetings, social mobilization, mass media, or social media. If the study involved interventions delivered concurrently in multiple settings (i.e., both health systems and home or community), the study was grouped under “combination of settings” (12).

The first 2 categories of intervention settings were further grouped according to the nature of interventions, and subgroup analyses were performed accordingly to assess their impact on breastfeeding rates. Interventions delivered at health systems were categorized into BFHI and counseling or education for health workers. Interventions in the home or community environment were categorized into counseling or education, family or social support, and integrated mass media, counseling, and community mobilization approach (12).

Outcomes and definitions. We specified breastfeeding outcomes according to the categories of breastfeeding defined by the WHO (1). Outcomes of interest were early initiation of breastfeeding, EBF, and continued breastfeeding.

Early initiation of breastfeeding was defined as the initiation of breastfeeding within 1 h of birth. EBF was defined as breast milk from the mother or wet nurse or feeding only expressed breast milk and no other liquids or solids, except for vitamin drops or syrups, mineral supplements, or prescribed medicines. Outcomes were examined at 2 different time points: <1 and 1–5 mo. The time interval of <1 mo included the time from birth to 30 d of age. The time interval of 1–5 mo included the beginning of the second month to 6 completed months of

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Abbreviations used: BFHI, Baby-Friendly Hospital Initiative; EBF, exclusive breastfeeding; GRADE, Grading of Recommendations Assessment, Development, and Evaluation; LiST, Lives Saved Tool; LMIC, low- and middle-income country; RCT, randomized controlled trial.

life. If an infant was given a prelacteal feeding, then she or he was classified as not exclusively breastfed in the <1-mo time period, but if the infant did not receive any other feedings before 6 mo, she or he would be classified as being exclusively breastfed in the 1- to 5-mo period. A child aged 6–23 mo and who was being breastfed was considered as receiving continued breastfeeding, which was also examined at 2 different time points: 6–11 and 12–23 mo (i.e., up to the day before the child's second birthday).

If a study examined EBF rates at multiple time points (e.g., 3, 4, or 6 mo), we used the longest time point data for pooling. Similarly, we used the longest time point data available for continued breastfeeding.

Abstraction, analysis, and summary measures. For the studies that met the inclusion criteria, data abstraction was performed by using a modified version of the Cochrane data abstraction form, which includes study identifiers and context, study design and limitations, intervention specifics, and outcome effects. We used ORs as our outcome estimate for this meta-analysis as per the requirements of the LiST model (13). If an article reported only RRs (adjusted or unadjusted), we converted these to ORs (unadjusted) by using raw data from the article (15).

To estimate the effect of an intervention on any outcome, we conducted meta-analysis with the use of STATA 11.2 (StataCorp). Adjusted and unadjusted ORs were pooled by using the generic inverse variance method, and the pooled ORs and corresponding 95% CIs were reported. Heterogeneity was assessed by using either *P* values <0.05 for the Cochrane *Q* test or an *I*² value >60% (15). If heterogeneity was found, the random-effects model was used. The causes of heterogeneity were explored by subgroup analysis; meta-regression was performed if there were an adequate number of studies (≥10) (15).

The variables included for the subgroup analysis were decided a priori and are based on our previous review (12), which was coordinated by the WHO. They were as follows: study size (<500, 500–1499, or

≥1500 participants), setting (urban or rural), study design (RCT, observational, or quasi-experimental), control for confounding (yes or no), and quality of study (high or low). For control of confounding, a judgment of “yes” was assigned to a study if it had controlled for maternal age, had ≥1 among other sociodemographic factors (family type, mother's education, or working status of mother), and ≥1 among other risk factors (parity, mode, or place of delivery) (12). To assess quality of study, we used the Cochrane Risk-of-Bias tool (16). If ≥2 biases [e.g., selection bias, performance bias, detection bias, attrition bias, reporting bias, or other bias (confounding)] were present in a study, we labeled it as “low” quality; otherwise, it was labeled as “high” quality (12). Finally, quality assessment of the pooled estimates was conducted by using GRADE Pro software version 3.6.1 (McMaster University and Evidence Prime Inc.) for the effect of overall interventions on each of the breastfeeding outcomes. GRADE (Grading of Recommendations Assessment, Development, and Evaluation) quality assessment was performed for the pooled evidence from the RCTs (17).

Results

The literature search was conducted on 10 July 2016. The search revealed 540 new articles on interventions to promote breastfeeding outcomes in LMICs that had been published since October 2014. After reviewing the abstracts of the 125 articles that appeared to be relevant on title screening, we assessed 33 full-text articles for eligibility and included 8 new articles in our final database (18–25). One additional unpublished (but accepted for publication) study was included after receiving permission from the study authors (26). Overall, we included 61 studies in our final database for the current review, of which

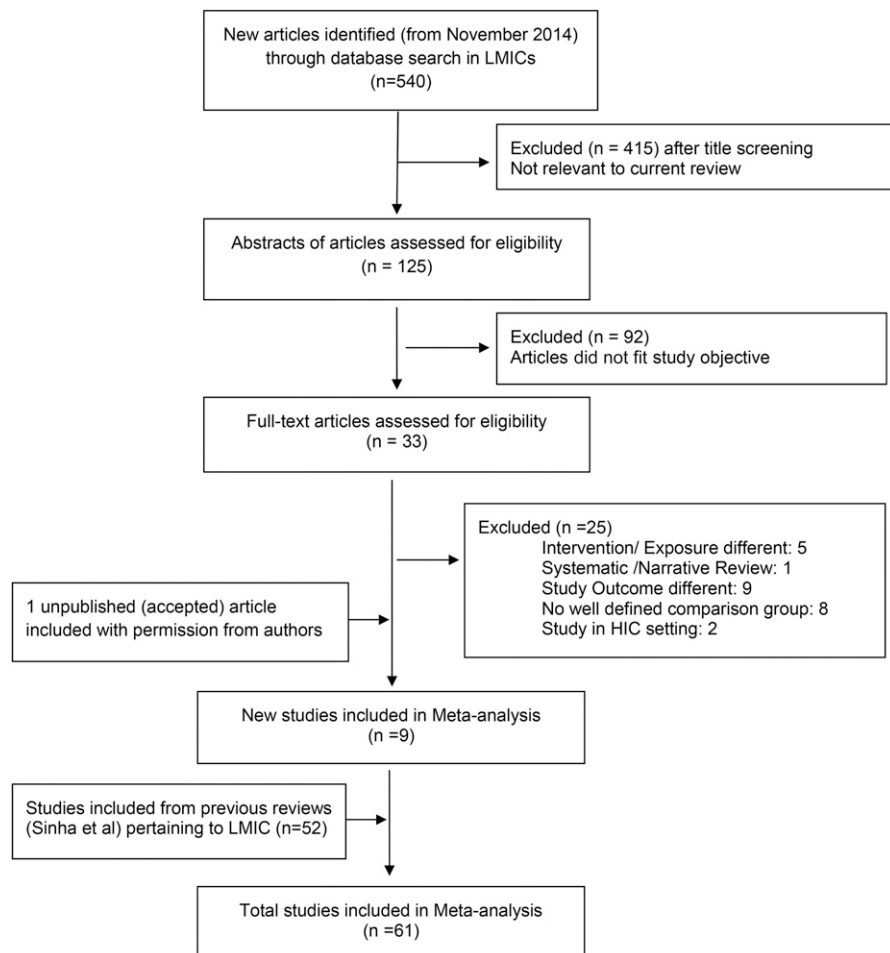


FIGURE 1 PRISMA flowchart. HIC, high-income country; LMIC, low- and middle-income country; PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-Analyses.

the other 52 studies (27–78) were identified in our earlier meta-analysis (12) (Figure 1).

Often, one study examined the effect of interventions on >1 breastfeeding outcome, and in many studies the effect of interventions on an outcome was examined in 2 different populations or the effects of different natures of interventions were compared with the control group, resulting in the number of estimates being higher than the total number of studies. We found 28 estimates from 23 studies for early initiation of breastfeeding, 21 estimates from 18 studies for EBF (<1 mo), 62 estimates from 45 studies for EBF (1–5 mo), and 7 estimates from 7 studies for continued breastfeeding.

Early initiation of breastfeeding. Interventions led to significant improvements in early initiation of breastfeeding (OR: 3.31; 95% CI: 2.44, 4.50) (Table 1 and Supplemental Figure 1). Interventions delivered concurrently in health systems and in a home or community environment showed the highest effect (OR: 4.96; 95% CI: 2.88, 8.54) when compared with interventions delivered individually in either of the 2 settings. In the subgroup analysis, we found a more modest effect of interventions in studies with >1500 study participants, in RCTs that controlled for confounding, and in high-quality studies compared with trials with fewer participants, with observational or quasi-experimental designs, and that were not controlled for confounding and in low-quality studies, respectively. Meta-regression analysis showed that, of all of the subgroups, the variation in the impact of interventions by intervention delivery setting was statistically significant ($P < 0.05$).

According to the nature of interventions, counseling or education in the home or community settings had a high impact on early initiation of breastfeeding (OR: 3.16; 95% CI: 1.80, 5.52). Integrated mass media, counseling, and community mobilization approaches were found to be even more effective (OR: 7.37; 95% CI: 2.81, 22.6); however, this was based on the findings of a single study (26). Counseling in health system settings and baby-friendly support were also effective but had a lower impact (Table 2).

EBF at <1 mo. The odds of EBF in the <1-mo time period was found to increase by 2-fold (OR: 2.16; 95% CI: 1.68, 2.79) as an effect of breastfeeding promotion interventions (Supplemental Figure 2, Table 3). By delivery setting, we found a similar 2-fold improvement in EBF rates at <1 mo when interventions were delivered either at a health system or at the home or community level. The impact when interventions were delivered in a combination of settings was of slightly higher magnitude (OR: 2.33; 95% CI: 0.85, 6.45) but no longer significant. In subgroup analysis, the effect of interventions was higher in urban settings (OR: 3.48; 95% CI: 2.00, 6.06) than in rural settings (OR: 2.10; 95% CI: 1.75, 2.52). Meta-regression showed that the impact of interventions on EBF at <1 mo varied significantly ($P < 0.01$) by intervention delivery setting and the urban or rural subgroups.

Subgroup analysis according to the nature of intervention showed counseling or education in home or community settings (OR: 2.45; 95% CI: 1.68, 3.57) to have the highest impact on EBF at <1 mo, followed closely by the same intervention in health system settings (OR: 2.22; 95% CI: 1.67, 2.95) (Table 2).

EBF at 1–5 mo. Pooled estimates showed that the odds of EBF at 1–5 mo increased 3-fold (OR: 3.08; 95% CI: 2.57, 3.68) with breastfeeding promotion interventions (Supplemental Figure 3, Table 4). The impact was highest when interventions were delivered in a combination of settings (OR: 6.80; 95% CI: 3.75,

TABLE 1 Effect of interventions on early initiation of breastfeeding in low- and middle-income countries

Subgroup analysis	Estimates, <i>n</i>	Pooled OR (95% CI)	I^2 , %	P^2
All interventions	28	3.31 (2.44, 4.50)	96.3	
Intervention delivery setting				0.05
Health systems and services	9	1.82 (1.32, 2.50)	82.8	
Home or community environment	10	3.38 (1.97, 5.80)	95.0	
Combination of settings	9	4.96 (2.88, 8.54)	95.9	
Study size				0.73
<500 participants	9	3.25 (2.70, 3.91)	36.6	
500–1499 participants	13	3.84 (2.22, 6.65)	97.2	
≥1500 participants	6	2.17 (1.48, 3.17)	94.7	
Setting ³				0.97
Urban	7	2.31 (1.12, 4.74)	94.0	
Rural	13	4.51 (2.70, 7.52)	97.5	
Combined	1	2.18 (1.44, 3.30)	—	
Study design				0.08
Randomized controlled trial	10	3.70 (1.95, 7.00)	97.6	
Observational	4	1.99 (1.61, 2.46)	0.0	
Quasi-experimental	14	3.46 (2.18, 5.49)	96.2	
Control for confounding				0.34
Yes	11	2.55 (1.80, 3.61)	95.6	
No	17	3.93 (2.62, 5.91)	93.1	
Quality of study ⁴				0.18
High	11	2.80 (1.83, 4.27)	97.0	
Low	17	3.68 (2.60, 5.22)	90.6	

¹ I^2 signifies heterogeneity between studies.

² Derived by using meta-regression.

³ Data for all studies were not available.

⁴ Measured according to the Cochrane Collaboration's tool for assessing risk of bias (16).

12.33) than when delivered in individual settings. Among the subgroups, the impact of interventions was seen to be smaller in studies in >1500 participants, in those with an RCT design, in those that controlled for confounding, and in high-quality studies when compared with their respective complementary groups. However, of all subgroups, meta-regression analysis showed a significant difference in the effect sizes when studies that controlled for confounding were compared with studies that did not adjust for confounding ($P < 0.05$).

Subgroup analysis on the nature of interventions showed that counseling or education interventions were the most efficacious in improving EBF at 1–5 mo when delivered either in health systems or in home or community settings, followed by baby-friendly support interventions and integrated mass media, counseling, and community mobilization approaches (Table 2).

Continued breastfeeding. Only 7 studies were available that examined the effects of the intervention on continued breastfeeding. Our meta-analysis showed that the odds of continued breastfeeding was ~1.6 times higher (OR: 1.62; 95% CI: 1.16, 2.27) after breastfeeding promotion interventions (Supplemental Figure 4, Table 5), with the impact being highest when the interventions were delivered in a combination of settings (OR: 1.82; 95% CI: 1.36, 2.45). Within subgroups, the number of studies was very few and the results were mostly nonsignificant. According to the nature of interventions, baby-friendly support was found to be a significant health system intervention (Table 2). The number of studies was limited to examine the effect of other types of interventions on continued breastfeeding.

TABLE 2 Effect of nature of interventions on breastfeeding outcomes according to intervention setting in low- and middle-income countries¹

Nature of interventions	Breastfeeding outcomes							
	Early initiation of breastfeeding		EBF at <1 mo		EBF at 1–5 mo		Continued breastfeeding	
	Estimates, <i>n</i>	OR (95% CI)	Estimates, <i>n</i>	OR (95% CI)	Estimates, <i>n</i>	OR (95% CI)	Estimates, <i>n</i>	OR (95% CI)
Health systems and services	7	1.20 (1.11, 1.28)	1	0.84 (0.35, 2.03)	8	2.89 (1.73, 4.80)	3	1.69 (1.28, 2.24)
Baby-friendly support	2	1.12 (1.05, 1.19)	6	2.22 (1.67, 2.95)	8	3.33 (1.80, 6.17)	1	0.93 (0.72, 1.21)
Counseling or education	9	3.16 (1.80, 5.52)	7	2.45 (1.68, 3.57)	23	3.02 (2.19, 4.18)	—	—
Home or community environment	—	—	—	—	6	1.43 (1.08, 1.90)	—	—
Counseling or education	1	7.37 (2.81, 22.6)	2	1.69 (0.88, 3.24)	5	2.07 (1.25, 3.43)	—	—
Family or social support	—	—	—	—	—	—	—	—
Integrated mass media, counseling, and community mobilization approaches	—	—	—	—	—	—	—	—

¹ EBF, exclusive breastfeeding.

TABLE 3 Effect of interventions on exclusive breastfeeding at <1 mo in low- and middle-income countries

Subgroup analysis	Estimates, <i>n</i>	Pooled OR (95% CI)	<i>I</i> ² , %	<i>P</i> ²
All interventions	21	2.16 (1.68, 2.79)	60.8	
Intervention delivery setting				0.01
Health systems and services	7	2.03 (1.33, 3.10)	55.3	
Home or community environment	9	2.17 (1.84, 2.56)	46.2	
Combination of settings	5	2.33 (0.85, 6.45) ³	81.5	
Study size				0.14
<500 participants	15	2.72 (1.96, 3.76)	55.8	
500–1499 participants	3	1.16 (0.55, 2.48) ³	67.4	
≥1500 participants	3	2.07 (1.71, 2.51)	56.0	
Setting ⁴				0.01
Urban	9	3.48 (2.00, 6.06)	69.8	
Rural	4	2.10 (1.75, 2.52)	0.0	
Combined	—	—	—	
Study design				0.89
Randomized controlled trial	13	2.09 (1.54, 2.84)	62.9	
Observational	1	0.84 (0.35, 2.03) ³	—	
Quasi-experimental	7	2.94 (1.97, 4.41)	56.0	
Control for confounding				0.13
Yes	14	2.36 (1.80, 3.09)	54.6	
No	7	1.71 (0.92, 3.15) ³	68.4	
Quality of study ⁵				0.12
High	8	2.37 (1.67, 3.35)	61.5	
Low	13	2.03 (1.37, 3.02)	61.8	

¹ *I*² signifies heterogeneity between studies.

² Derived by using meta-regression.

³ NS (*P* > 0.05).

⁴ Data for all studies were not available.

⁵ Measured according to the Cochrane Collaboration's tool for assessing risk of bias (16).

Assessment by GRADE showed that the quality of the pooled evidence (only from RCTs) to examine the effect of breastfeeding promotion interventions was high for early initiation of breastfeeding, moderate for EBF at <1 and 1–5 mo, and low for continued breastfeeding (Table 6).

Discussion

The key findings of this review are as follows: 1) breastfeeding outcomes in LMICs can be improved significantly as a result of interventions delivered either in health systems, in the home or community, or both; 2) the impact of breastfeeding-promoting interventions on early initiation, EBF (1–5 mo), and continued breastfeeding (6–23 mo) is highest when they are delivered in a combination of settings; and 3) counseling or education provided in health systems or the home or community and baby-friendly support in health systems seem to be the most effective interventions to promote the desired breastfeeding outcomes.

As an extension of the previous review by Sinha et al. (12), in this review we estimated the effect of interventions on EBF at <1 or 1–5 mo in LMICs and assessed the quality of evidence as per GRADE (17). Compared with the review by Haroon et al. (11), we additionally looked at the effect of interventions on early initiation of breastfeeding and continued breastfeeding in LMICs. We observed maximum improvements in the breastfeeding rates in LMICs when multiple interventions are delivered concurrently in a combination of settings, and this is strongly supported by previous reviews (11, 12) and some recent studies conducted in

TABLE 4 Effect of interventions on exclusive breastfeeding at 1–5 mo in low- and middle-income countries

Subgroup analysis	Estimates, <i>n</i>	Pooled OR (95% CI)	<i>I</i> ² , %	<i>P</i> ²
All interventions	62	3.08 (2.57, 3.68)	95.1	
Intervention delivery setting				0.15
Health systems and services	16	3.07 (2.09, 4.52)	96.8	
Home or community environment	34	2.48 (1.99, 3.09)	94.0	
Combination of settings	12	6.80 (3.75, 12.33)	80.8	
Study size				0.67
<500 participants	22	3.96 (2.78, 5.64)	75.5	
500–1499 participants	23	3.36 (2.32, 5.05)	94.9	
≥1500 participants	17	2.29 (1.78, 2.93)	97.0	
Setting ³				0.75
Urban	25	3.14 (2.12, 4.65)	93.4	
Rural	16	5.28 (3.20, 8.72)	92.6	
Combined	4	2.37 (1.44, 3.91)	86.3	
Study design				0.35
Randomized controlled trial	35	3.86 (2.78, 5.36)	93.1	
Observational	15	1.98 (1.64, 2.38)	91.4	
Quasi-experimental	12	3.03 (1.81, 5.07)	95.8	
Control for confounding				0.02
Yes	39	2.45 (2.04, 2.96)	94.2	
No	23	4.29 (3.02, 6.09)	90.0	
Quality of study ⁴				0.38
High	20	2.73 (2.13, 3.49)	96.6	
Low	42	3.26 (2.52, 4.23)	90.2	

¹ *I*² signifies heterogeneity between studies.

² Derived by using meta-regression.

³ Data for all studies were not available.

⁴ Measured according to the Cochrane Collaboration's tool for assessing risk of bias (16).

Bangladesh, Vietnam, and Ethiopia (79, 80). This finding suggests that for the promotion of breastfeeding in LMICs, it may be best to use an integrated intervention delivery approach throughout the continuum of care. However, the low quality of evidence on the impact of interventions on continued breastfeeding as per the GRADE assessment (17) suggests the need for more research in this area. The pooled estimate of the effect of interventions delivered in a combination of settings on EBF at <1 mo was higher than that in individual settings but, because of the small number of studies, inadequate power, and high between-study heterogeneity (81%), the results were inconclusive. Among the individual nature of interventions, the BFHI emerged as an intervention with immense potential to promote breastfeeding in developing countries, as did counseling through peer support, and these findings are in concordance with previously published literature (81, 82).

The estimates of intervention effects on breastfeeding outcomes differed between some of the subgroups. The studies with relatively larger sample sizes, those that controlled for confounding, and those of high quality (as per the Cochrane Risk-of-Bias tool), when pooled together, tended to show a lower level of effect. Meta-regression analysis showed that, in both rural and urban settings, interventions led to similar improvements in all breastfeeding outcomes, which suggests that integrated interventions are equally effective for both urban and rural settings. However, the impact of interventions on EBF at <1 mo was significantly higher in urban settings. This may be explained by the better uptake of interventions in urban areas due to higher hospital delivery rates (83) and in-hospital breastfeeding education, more exposure to mass media, better educational status, and well-established health systems.

Our review had some important strengths. This review was a unique effort to assess the effect of interventions on breastfeeding outcomes in LMICs according to different delivery settings. On the basis of the available evidence, we identified the effective interventions in each setting in LMICs that can be prioritized for scaling up to promote the desired breastfeeding outcomes. In addition, a GRADE assessment was done to understand the quality of the evidence.

We should nonetheless acknowledge some limitations. There were relatively few studies that examined the effect of interventions on continued breastfeeding in LMICs. Studies that examined the effect of interventions delivered in a combination of settings on the outcome of EBF at <1 mo were also few. For some subgroups (e.g., interventions in home or community environments to promote continued breastfeeding), we did not find any studies. There were insufficient studies that examined the effect of mass media or social media in LMICs. This is clearly an area that needs further research.

To obtain the pooled estimate, we combined unadjusted and adjusted ORs. Because it was not possible to get adjusted estimates for all studies, we judged that this was the most feasible approach to get a single pooled estimate closest to the true effect, instead of excluding studies. The included studies had methodologic heterogeneity due to different study designs and variations in the nature and duration of interventions, types of health

TABLE 5 Effect of interventions on continued breastfeeding in low- and middle-income countries

Subgroup analysis	Estimates, <i>n</i>	Pooled OR (95% CI)	<i>I</i> ² , %
All interventions	7	1.62 (1.16, 2.27)	72.1
Intervention delivery setting			
Health systems and services	4	1.42 (0.88, 2.28) ²	78.3
Home or community environment	—	—	—
Combination of settings	3	1.82 (1.36, 2.45)	30.0
Age at outcome measurement			
6–11 mo	3	1.96 (1.50, 2.57) ²	36.7
12–23 mo	4	1.30 (0.89, 1.92) ²	62.6
Study size			
<500 participants	2	2.13 (1.41, 3.24)	42.4
500–1499 participants	2	1.17 (0.71, 1.92) ²	75.6
≥1500 participants	3	1.69 (1.28, 2.24)	54.0
Setting ³			
Urban	2	1.20 (0.97, 1.49) ²	91.8
Rural	3	2.18 (1.47, 3.22)	0.0
Combined	—	—	—
Study design			
Randomized controlled trial	4	1.51 (0.99, 2.29) ²	80.2
Observational	2	1.31 (0.87, 1.97) ²	34.9
Quasi-experimental	1	3.49 (1.50, 8.10)	—
Control for confounding			
Yes	2	1.39 (0.62, 3.11) ²	91.8
No	5	1.63 (1.28, 2.07)	33.5
Quality of study ⁴			
High	2	1.39 (0.62, 3.11) ²	91.8
Low	5	1.63 (1.28, 2.07)	33.5

¹ *I*² signifies heterogeneity between studies. Meta-regression was not conducted because <10 studies were available.

² NS (*P* > 0.05).

³ Data for all studies were not available.

⁴ Measured according to the Cochrane Collaboration's tool for assessing risk of bias (16).

TABLE 6 Quality assessment of effect of all interventions compared with control to promote breastfeeding outcomes in LMICs for RCTs¹

Outcome	Studies, <i>n</i>	Risk of bias					Pooled OR (95% CI)	GRADE
		Not serious ²	Serious ³	Indirectness	Imprecision	Other considerations		
Early initiation of breastfeeding	10	Not serious ²	Serious ³	Not serious	Not serious	Strong association ⁴	3.70 (1.95, 7.00)	⊕ ⊕ ⊕ ⊕ High
EBF								
<1 mo	13	Serious ⁵	Serious ⁶	Not serious	Not serious	Strong association ⁷	2.09 (1.54, 2.84)	⊕ ⊕ ⊕ ⊖ Moderate
1–5 mo	35	Serious ⁸	Serious ⁹	Not serious	Not serious	Strong association ¹⁰	3.86 (2.78, 5.36)	⊕ ⊕ ⊕ ⊖ Moderate
Continued breastfeeding	4	Serious ¹¹	Serious ¹²	Not serious	Not serious	None	1.51 (0.99, 2.29)	⊕ ⊕ ⊖ ⊖ Low

¹ EBF, exclusive breastfeeding; GRADE, Grading of Recommendations Assessment, Development, and Evaluation; LMIC, low- and middle-income country; RCT, randomized controlled trial. ⊕ ⊖ symbols represent certainty of evidence.

² Only 1 of 10 studies were judged as low quality as per the Cochrane Risk-of-Bias tool.

³ Heterogeneity was present, $I^2 = 97.6\%$ ($P < 0.05$); nonoverlap of CIs.

⁴ OR: 3.70; >3-fold increase.

⁵ Six of 13 studies were judged as low quality as per the Cochrane Risk-of-Bias tool.

⁶ Heterogeneity was present, $I^2 = 62.9\%$ ($P < 0.05$); nonoverlap of CIs.

⁷ OR: 2.09; >2-fold improvement.

⁸ Twenty-two of 35 studies were judged as low quality as per the Cochrane Risk-of-Bias tool.

⁹ Heterogeneity was present, $I^2 = 93\%$ ($P < 0.05$); nonoverlap of CIs.

¹⁰ OR: 3.86; >3-fold improvement.

¹¹ Two of 4 studies were judged as low quality as per the Cochrane Risk-of-Bias tool.

¹² Heterogeneity was present, $I^2 = 80.2\%$ ($P < 0.05$); nonoverlap of CIs.

personnel delivering the interventions, periodicity of the interventions, study populations (income, socioeconomic status, and education), and time intervals for follow-up. There was also variability in the recall period of infant feeding practices by mothers. EBF data were mostly ascertained by 24-h recall, which is a challenge and may not always reflect the correct breastfeeding status of the child. However, in some studies, information was collected from birth. To address significant heterogeneity, we used the random-effects model and conducted subgroup analysis (decided a priori) and meta-regression to explore its causes. But within some subgroups there was significant heterogeneity, which suggests some other unidentified factors.

Our review of the evidence indicates that interventions in health systems, in the home or community, or in a combination of settings have a major impact on early initiation of, exclusive (<1 and 1–5 mo), and continued (6–23 mo) breastfeeding. They should be considered for inclusion in models that estimate the benefits of interventions on infant survival, such as the LiST.

In conclusion, our review shows substantial evidence that breastfeeding practices are amenable to improvement in LMICs with judicious use of tested interventions. From the findings, it can be inferred that for better results in promoting breastfeeding in LMICs, support should be provided to mothers by delivering interventions concurrently in a combination of settings—for example, by increasing community awareness on breastfeeding, providing support to mothers in the health system through the baby-friendly approach or counseling, and by providing home and family support for breastfeeding through counseling. Support should be multipronged and provided throughout the continuum from the community to the facility. The review thus supports the validity of the Breastfeeding Gear Model (84), which emphasizes the need for coordination between multiple sectors and working in synchrony to protect, promote, and support breastfeeding. Further research is required on the effect of interventions on continued breastfeeding and the effect of mass media on breastfeeding outcomes. Innovative methods to ascertain breastfeeding

outcomes compared with the 24-h recall method would also be valuable.

Although improvement in breastfeeding outcomes is not distinctly stated in the Sustainable Development Goals, improvements in breastfeeding will nevertheless benefit child survival, health, development, food security, education, and equity in LMICs (10). Therefore, it is clearly important, particularly in LMICs, to cultivate positive societal attitudes toward breastfeeding and create strong political will to invest in scaling up interventions for breastfeeding improvement throughout the community.

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