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REVIEW ARTICLE

Interventions to improve breastfeeding outcomes: a systematic review and meta-analysis

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ABSTRACT

Aim: To provide comprehensive evidence of the effect of interventions on early initiation, exclusive, continued and any breastfeeding rates when delivered in five settings: (i) Health systems and services (ii) Home and family environment (iii) Community environment (iv) Work environment (v) Policy environment or a combination of any of above.

Methods: Of 23977 titles identified through a systematic literature search in PUBMED, Cochrane and CABI, 195 articles relevant to our objective, were included. We reported the pooled relative risk and corresponding 95% confidence intervals as our outcome estimate. In cases of high heterogeneity, we explored its causes by subgroup analysis and meta-regression and applied random effects model.

Results: Intervention delivery in combination of settings seemed to have higher improvements in breastfeeding rates. Greatest improvements in early initiation of breastfeeding, exclusive breastfeeding and continued breastfeeding rates, were seen when counselling or education were provided concurrently in home and community, health systems and community, health systems and home settings, respectively. Baby friendly hospital support at health system was the most effective intervention to improve rates of any breastfeeding.

Conclusion: To promote breastfeeding, interventions should be delivered in a combination of settings by involving health systems, home and family and the community environment concurrently.

INTRODUCTION

Optimal breastfeeding practices are the cornerstone of child survival, nutrition and early childhood development. The World Health Organization (WHO) and United Nations Children's Fund (UNICEF) recommend initiation of breastfeeding within an hour of birth, exclusive breastfeeding for the first 6 months of life, and continued breastfeeding beyond 6 months and at least up to 2 years of age or more along with the introduction of nutritionally adequate and safe complementary foods (1). These optimal breastfeeding practices are so critical that they could prevent around 12% of deaths in children under five annually, which in 2013 would have amounted to around 800 000 lives saved in low and middle income countries (2). Optimal breastfeeding practices also improve mother and infant bonding, help achieve optimum growth and development, protect against non-communicable diseases and benefit maternal health (3,4). However, global breastfeeding rates are still low and

Abbreviations

BF, Breastfeeding; BFHI, Baby friendly hospital initiative; CI, Confidence interval; HIC, High income country; IMCI, Integrated management of childhood illness; LMIC, Low and middle income; MeSH, Medical subject heading; NICU, Neonatal intensive care unit; OR, Odds ratio; RCTs, Randomized controlled trials; RR, Relative risk; UNICEF, United nations children's fund; WHO, World health organization.

Key notes

- Improvements in breastfeeding rates are critical.
- Counselling by peers or health personnel, baby friendly hospital support and community mobilization approaches are the key interventions to improve breastfeeding rates.
- Interventions should be delivered concurrently in a combination of settings i.e. health system, home and community to have a higher impact on optimal breastfeeding rates.

only subtle improvements have been observed over the past decades. Only 43% of the world's newborns are put to the breast within 1 hour of birth (5,6). UNICEF estimates that globally around 40% of children under 6 months of age are exclusively breastfed (5) and 49% of children are breastfed up to 2 years of age (7). A WHO report from 47 countries among 75 countdown countries, showed that the median coverage of exclusive breastfeeding has only increased from 34% in 2000–2007 to 41% in 2008–2012 (8). Improvements in breastfeeding rates are critical to the attainment of unfinished agenda of Millennium Development Goal 4 and require urgent action (9). The Comprehensive implementation plan for maternal, infant and young child nutrition aims to increase the rate of exclusive breastfeeding in the first 6 months of life from the current 40% to at least 50% by the year 2025 (10).

To improve breastfeeding rates, effective breastfeeding promotion interventions (which encompasses whole range of protection, promotion and support interventions) are needed which can empower and enable mothers to solve breastfeeding difficulties. Interventions such as the Baby Friendly Hospital Initiative, peer counsellor support through home visits, telephonic support, group counselling, community awareness campaigns, health programme approaches such as Integrated Management of Childhood Illness (IMCI) and policies like the WHO Code of Marketing of Breast Milk Substitutes have been found to be effective in improving breastfeeding in different studies (11–205). Some systematic reviews have looked at the effect on breastfeeding rates of specific interventions like antenatal education (206), lactation counselling by counsellors or health professionals (207), telephone support (208), peer support (209–211), and work place support (212). Others have reviewed the effect in specific settings such as the community (213) or primary health care (214). Some recent reviews pooled studies on educational interventions and observed that exclusive breastfeeding rates can be improved significantly with interventions (215,216).

Inspite of proven interventions, global improvements in breastfeeding rates have been limited. There is a lack of information about which interventions delivered in clearly defined settings have the highest beneficial effects on breastfeeding rates. Evidence is also limited on the effect of interventions on all the WHO recommended breastfeeding practices. In this review, we summarize the evidence on how and to what extent interventions delivered in various settings can improve selected breastfeeding outcomes. This will help us identify the most effective interventions in each setting so that these can be prioritized. Within each setting we also examined the effect of different interventions that have the highest impact. Apart from including all studies covered in the most recent meta-analysis on breastfeeding interventions (215), we have included other studies published thereafter and also set our review objectives broader. The objectives of our review was to ascertain the effects of interventions on early initiation, exclusive, continued and any breastfeeding rates when delivered in five types of settings: (i) Health systems and services, (ii) Home and family environment, (iii) Community environment, (iv) Work environment, (v) Policy environment or (vi) Combination of settings.

METHODS

We searched for existing systematic reviews, particularly Cochrane reviews, on the effects of interventions on breastfeeding outcomes. As the scope of our objective was wider than previous reviews, we planned for a new review.

The search strategy (Box 1) was developed and reviewed by all authors. Medical Subject Heading terms and keywords were used in various combinations. We searched

Box 1. Search strategy

1. (Breastfeeding OR Breast Feeding OR (Exclusive AND Breastfeeding [All Fields]) OR (Continued AND Breast feeding [All Fields]) OR Lactation OR Human Milk OR Breast Milk [MeSH Majr])
2. (Counseling OR Peer OR education OR (intervention[All Fields]) OR family practice OR support OR Groups OR health worker OR physician [MeSH terms])
3. (Social media OR social networking OR mass media OR health campaigns OR group OR meeting OR health promotion OR community [MeSH terms])
4. (BFHI [All Fields] OR (Baby Friendly Hospital [All Fields]) OR Rooming in OR Perinatal Care OR health services OR Hospital OR Facility OR health system OR health program[MeSH terms])
5. ((Infant food Marketing [All Fields]) OR (Code of Marketing [All Fields]) OR (Infant milk substitutes [All Fields]) OR (Breast milk substitutes [All Fields]) OR Policy OR Legislations OR law [MeSH terms] OR work OR Workplace)
6. (Addresses[ptyp] OR Autobiography[ptyp] OR Bibliography[ptyp] OR Biography[ptyp] OR pubmed books[filter] OR Case Reports[ptyp] OR Congresses[ptyp] OR Consensus Development Conference[ptyp] OR Directory[ptyp] OR Duplicate Publication[ptyp] OR Editorial[ptyp] OR Festschrift[ptyp] OR Guideline[ptyp] OR *In Vitro*[ptyp] OR Interview[ptyp] OR Lectures [ptyp] OR Legal Cases[ptyp] OR News[ptyp] OR Newspaper Article[ptyp] OR Personal Narratives [ptyp] OR Portraits[ptyp] OR Retracted Publication[ptyp] OR Twin Study[ptyp] OR Video-Audio Media[ptyp])
7. #1 AND (2 OR #3 OR #4 OR #5)
8. #7 NOT #6

published literature from PubMed, the Cochrane Library and CABI databases to identify studies examining the effects of interventions to promote breastfeeding on the following outcomes: early initiation of breast feeding, exclusive breastfeeding in the first 6 months, continued breastfeeding between 12 and 23 months, and any breastfeeding. The search was conducted in October 2014. No language or date restrictions were employed in the electronic searches.

Two review authors (BS and RC) screened the titles and abstracts independently to identify potentially relevant citations. They retrieved the full texts of all potentially relevant articles and independently assessed eligibility of the studies using pre-defined inclusion criteria. Data extraction was done for all the articles which were found to be relevant. Any disagreements or discrepancies between reviewers were resolved by discussion and, if necessary, by consulting a third review author (JSM). In addition to the electronic search, we reviewed the reference lists of the articles identified. We used web based citation index for citing manuscripts of these identified articles.

Inclusion criteria

We selected studies that were either randomized controlled trials (RCTs) including cluster randomized trials or quasi-experimental trials as well as observational studies (prospective/retrospective cohort and case–control). All studies on interventions to improve breastfeeding that were delivered to mothers in the antenatal or postnatal period or both, were included. Studies were also included in which the interventions to improve breastfeeding were delivered to families, community, health staff and other stakeholders. For articles in other languages, we attempted to find out whether the abstract was available in English. If none of the key outcomes included in this review was mentioned in the abstract, the study was excluded. We also included articles which examined the effect of interventions on breastfeeding outcomes in preterm infants or babies in the Neonatal Intensive Care Unit (NICU).

Categorization of interventions

We considered interventions in five categories based on the 'Settings' according to the place of intervention delivery, identified in a conceptual model. These were (i) Health systems and services, (ii) Home and family environment, (iii) Community environment, (iv) Work environment (v) Policy environment or (vi) Combination of settings. Studies which examined the effect of the Baby Friendly hospital support, establishment of rooming in practices or organizational support on breastfeeding outcomes were grouped under health systems and services. Home and family support included studies on peer support, one to one counselling or education by home visits or telephone, home support by father or grandparent. Under the category of community environment we included studies which examined the effect of group counselling, group meetings, social mobilization, mass media or social media on breastfeeding outcomes. The work environment category included studies on maternity leave, workplace support and employment status of the mothers. Studies included under the category of policy environment examined the effect of the Breast-milk Substitutes Act (or the Code of Marketing of Breast Milk Substitutes), national maternal and child health programmes on breastfeeding. Studies where interventions were delivered in multiple settings, e.g. health systems and services together with home and family environment, were categorized under combination of settings.

Each of the five categories of interventions was further sub-grouped according to the nature of interventions. The Health systems and services setting was subdivided into baby friendly hospital support, counselling or education, special training to health workers. The subgroup baby friendly hospital support included studies which examined interventions included under the domain of 'Ten steps of Successful breastfeeding' provided at hospitals or health systems according to the UNICEF/WHO BFHI guidelines (Box 2). Home and family environment was subdivided into counselling or education and family or social support. Family or social support is the breastfeeding support that is expected to be provided to a nursing mother by her family members, relatives and society. Community environment was subdivided into Group counselling or Education and Integrated mass media-counselling-community mobilization approach. Work environment was subdivided into maternal leave policy, work place support and employment status. Policy environment included studies on breast milk substitute policies and maternal and child health programmes.

Outcomes and definitions

We specified breastfeeding (BF) outcomes according to the categories of breastfeeding defined by the WHO (1). Outcomes of interest were early initiation of breastfeeding, exclusive breastfeeding, continued breastfeeding and any breast feeding.

Early initiation of breastfeeding was defined as initiation of breastfeeding within 1 hour of birth irrespective of the mode of delivery. Exclusive breastfeeding was defined as feeding breast milk from mother or wet nurse or expressed breast milk and no other liquids or solids except vitamin drops or syrups, mineral supplements or prescribed medicines up to 6 months of age. If the definition of breastfeeding practice assessed in a study for a child <6 months was different from that of exclusive breastfeeding, it was categorized under any breastfeeding. A child aged more than 6 to 23 months if breastfed was considered as receiving continued breastfeeding. If in a study the breastfeeding rate was assessed in between 6 to 12 or 12 to 23 completed months it was analysed as continued breastfeeding at 12 months and 23 months, respectively.

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

Box 2. The Baby-Friendly Hospital Initiative (BFHI): Ten steps to successful breastfeeding

- Have a written breastfeeding policy that is routinely communicated to all health care staff.
- Train all health care staff in skills necessary to implement this policy.
- Inform all pregnant women about the benefits and management of breastfeeding.
- Help mothers initiate breastfeeding within one half-hour of birth.
- Show mothers how to breastfeed and maintain lactation, even if they should be separated from their infants.
- Give newborn infants no food or drink other than breastmilk, unless medically indicated.
- Practice rooming in - that is, allow mothers and infants to remain together 24 hours a day.
- Encourage breastfeeding on demand.
- Give no artificial nipples or pacifiers (soothers) to breastfeeding infants.
- Foster the establishment of breastfeeding support groups and refer mothers to them on discharge from the hospital or clinic

Research gaps

- To what extent interventions can promote optimal breastfeeding in premature babies and NICU infants.
- To what extent can work place interventions improve exclusive and continued breastfeeding rates.
- Role of educating family or society to promote optimal breastfeeding.
- Implementation science research to better understand how to guide effective scaling up of well integrated multisectoral breastfeeding protection, promotion and support programs.

Abstraction, analysis and summary measures

For the studies that met the final inclusion criteria, data abstraction was done by two review authors (BS and RC). The data abstraction form (modified from the Cochrane data abstraction form) described study identifiers and context, study design and limitations, intervention details and outcome effects. If outcomes had been assessed in two or more different study populations or the effects of different interventions had been compared with the control group, these outcome estimates were examined separately. We used relative risk (RR) as our outcome estimate measure and recorded it as provided in the article. If RR was not provided, we calculated it from the actual data provided in the article. To estimate the effect of interventions on breastfeeding outcomes we conducted a meta-analysis using 'metan' command in Stata 11.2 (StataCorp, College Station, TX, USA) and pooled Hazard Ratio, adjusted and unadjusted RR together and reported the pooled relative risk (RR) and corresponding 95% confidence interval (CI). High heterogeneity was defined either by a low p value (<0.05) and a large chi-squared statistic relative to its degree of freedom or an I^2 value >60%. In cases of high heterogeneity, random effects model was used and causes were explored by doing subgroup analysis and meta-regression.

Subgroup analyses were carried out based on intervention delivery settings (Health systems and services, home and family environment, community environment, work environment, policy and combination of settings), study size (<500, 500–1499, ≥1500), country type i.e. high income (HIC) vs. low and middle income (LMIC) (217), Urban or Rural setting, study design (RCT, Observational, Quasi-experimental), control for confounding (yes, no) and quality of study (adequate, inadequate). For control of confounding a judgment of 'yes' was assigned to a study if it had controlled for maternal age, at least one among other socio-demographic factors viz. family type, mother's education, working status of mother and at least one among other risk factors viz. parity, mode or place of delivery. To assess quality of study, we used the Cochrane risk of bias tool (218). If in a study any two or more biases e.g. selection bias, performance bias, detection bias, attrition bias, reporting bias, other bias (confounding) were present, we labelled it as 'inadequate'. We conducted subgroup analysis to examine the effect of the different nature of interventions under each setting on breastfeeding practices.

RESULTS

We screened the 23977 titles of articles identified through literature searches. Of these, after reviewing the abstracts of the 1042 articles that appeared relevant, we assessed 301 full text articles for eligibility and included 195 in our final database (Fig. 1) (11–205). Of these, a total of 73 studies examined the effect of health systems and services on different breastfeeding outcomes, 57 studies on home and family environment, six studies on community environment, four studies on work environment and two studies on policy. Interventions were delivered at more than one setting in 53 studies. These were considered under combination of settings. We could not calculate RR for 10 studies which are not mentioned in the tables (see Appendix). We encountered studies where the effect of interventions on outcome measures was examined in two different populations or the effects of different nature of interventions had been compared with the control group; this resulted in the number of estimates being higher than the total number of studies.

Often, one study examined the effect of interventions on more than one breastfeeding outcome and some studies examined the effect of interventions in different settings for one breastfeeding outcome. These outcomes were analysed separately. We estimated the effect of these interventions on four major breastfeeding outcomes i.e. early initiation of breast feeding (49 estimates), exclusive breastfeeding (130 estimates), continued breastfeeding up to 23 months (19 estimates) and any breastfeeding (118 estimates).

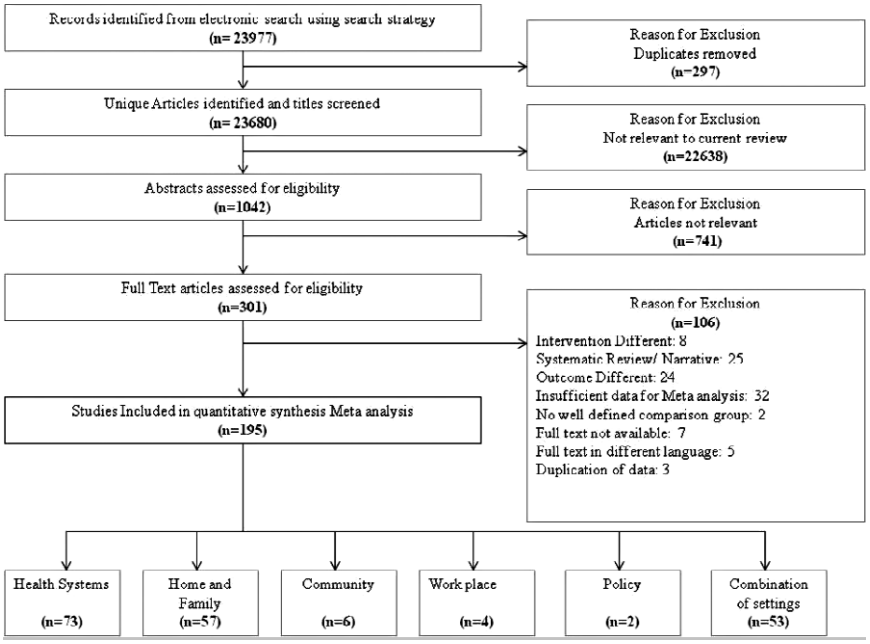

Figure 1 PRISMA flowchart.

Initiation of breastfeeding within 1 hour

Initiation of breastfeeding within 1 hour increased significantly by 25% (RR 1.25, 95% CI 1.19–1.32) as an effect of all interventions (Table 1, Fig. 2). In the subgroup analysis, all strata showed positive associations. Pooled effect of studies in rural areas showed higher effect of interventions on early breastfeeding initiation compared to urban areas. Similar findings were observed for low and middle income countries (LMIC) compared to high income countries (HIC). Meta-regression also showed that the effects in country type subgroups were significantly different from the overall effect.

According to intervention delivery setting

Interventions delivered in the health system setting improved early initiation of breastfeeding rates by 11% whereas interventions delivered in the community environment showed a significant 86% increase (RR 1.86, 95% CI 1.33–2.59). Interventions delivered in the home and family were not statistically significant. However interventions delivered concurrently in a combination of settings improved breastfeeding rates significantly by 57% (RR 1.57, 95% CI 1.24–1.97). Interventions targeting both home and family settings along with the community environment (RR 1.85; 95% CI 1.08–3.17), showed the highest effect.

According to nature of interventions

Group counselling in the community (RR 1.65, 95%CI 1.38–1.97) (Table 5), Baby Friendly Hospital support (RR 1.20, 95%CI 1.11–1.28), and counselling or education by health staff delivered in multiple settings had the largest effects on breastfeeding initiation in the first hour.

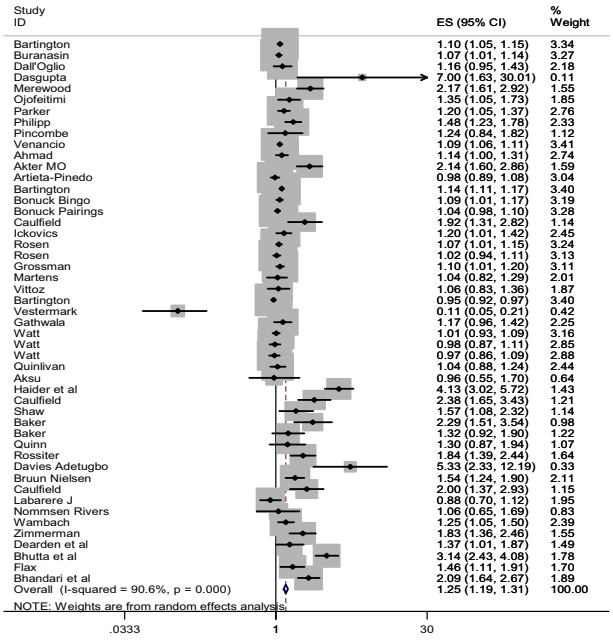

Figure 2 Effect of all interventions on Early Initiation of breastfeeding.

Exclusive breastfeeding

Pooled results from 130 estimates showed that exclusive breastfeeding rates increased by 44% (RR 1.44, 95% CI 1.38–1.51) as an effect of all interventions (Table 2, Fig. 3). On subgroup analysis, it was seen that the effect of interventions was greater for exclusive breastfeeding during the 4–6 month period (RR 1.59, 95% CI 1.44–

Table 1 Effect of interventions on early initiation of breastfeeding

Subgroup analysis	No. of estimates	Pooled odds ratio and 95% confidence interval	I^2 (%)	Meta-regression p value
All interventions	49	1.25 (1.19–1.32)	90.6	
Intervention delivery setting				
Health systems and services	29	1.11 (1.06; 1.16)	88.2	0.534
Home and family environment	5	1.74 (0.97; 3.12)*	93.8	
Community environment	5	1.86 (1.33; 2.59)	69.3	
Work environment	–	–	–	
Combination of settings	10	1.57 (1.24; 1.97)	86.8	
Health system + Home	6	1.36 (1.07; 1.73)	79.1	
Home + Community	3	1.85 (1.08; 3.17)	91.1	
Health system + Community	1	2.09 (1.64; 2.67)	–	
Study size				
<500 participants	26	1.30 (1.18; 1.44)	86.2	0.871
500–1499 participants	11	1.48 (1.24; 1.75)	92.1	
≥1500 participants	12	1.10 (1.03; 1.18)	93.8	
Country type				
High income	31	1.13 (1.07; 1.19)	88.0	0.046
Lower mid income	18	1.66 (1.44; 1.91)	92.8	
Urban/Rural‡				
Urban	27	1.24 (1.13; 1.36)	87.9	0.773
Rural	8	1.72 (1.26; 2.36)	94.1	
Combined	1	1.35 (1.05; 1.73)	–	
Study design				
RCT	12	1.48 (1.23; 1.79)	94.0	0.835
Observational	15	1.20 (1.11; 1.30)	91.3	
Quasi experimental	22	1.19 (1.10; 1.29)	85.7	
Control for confounding				
Yes	73	1.25 (1.18; 1.32)	92.8	0.930
No	57	1.26 (1.12; 1.42)	84.6	
Quality of study†				
Adequate	27	1.19 (1.13; 1.26)	91.4	0.283
Inadequate	22	1.36 (1.19; 1.55)	89.2	
86.1% of the heterogeneity was explained by these 7 factors.				

*Not significant.
†Measured according to The Cochrane Collaboration's Tool for assessing Risk of bias.
‡Data for all studies were not available.

1.75) compared to <4 months (RR 1.39, 95% CI 1.31–1.48). The effect of interventions on exclusive breastfeeding rates was higher in LMIC and rural areas when compared with HIC and urban areas, respectively. Pooled result from RCTs showed 61% improvement (RR 1.61, 95% CI 1.46–1.78) in exclusive breastfeeding rates; studies that had controlled for confounding showed a lower improvement (RR 1.36, 95% CI 1.28–1.46). On meta-regression, the subgroup's country type, study design and control for confounding showed significant differences from the overall effect.

According to intervention delivery setting

Pooled results showed that interventions delivered in either health system and services or home and family settings increased exclusive breastfeeding by more than 45%. Interventions delivered only in the community environment had a comparatively lower impact (RR 1.20, 95% CI 1.03–1.39). Interventions delivered in the work environment were associated with an increased probability of exclusive breastfeeding in the intervention group but the results were not statistically significant (RR 1.28, 95%CI 0.98–1.69). Exclusive breastfeeding rates were seen to improve significantly by 79% (RR 1.79, 95% CI 1.45–2.21) when interventions were delivered concurrently in any combination of settings. The highest effect i.e. 152% increase in exclusive breastfeeding was observed when interventions were delivered together in the health systems and community environment.

According to nature of interventions

Pooled results showed that education or counselling had the highest impact on promoting exclusive breastfeeding whether delivered in health system setting (RR 1.66, 95%CI 1.43–1.92) or home and family environment (RR 1.58, 95% CI 1.39–1.80) or in multiple settings (Table 5). Interventions such as baby friendly hospital support (RR 1.49, 95%CI 1.33–1.68) or special training of health staff in the hospitals

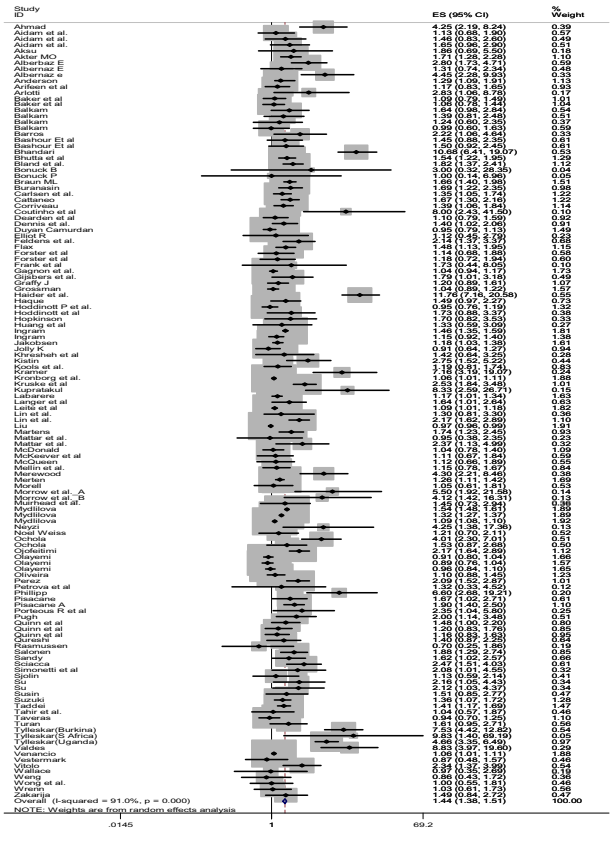

Figure 3 Effect of all interventions on Exclusive breast feeding.

(RR 1.36, 95% CI 1.14–1.63) and integrated mass media, counselling and community mobilization approach in the community (RR 1.17, 95% CI 1.01–1.14) also had a significant impact.

Family or social support had no significant effect on promoting exclusive breastfeeding (RR 0.95, 95% CI 0.87–1.02).

Continued breastfeeding up to 23 months

Continued breastfeeding rates showed a significant improvement of 61% as a result of all interventions (Table 3, Fig. 4). All subgroup analyses showed positive associations and meta-regression showed no significant differences between subgroups compared to the overall estimate. During subgroup analysis it was observed that the effect of interventions on continued breastfeeding rates was more at 12 months and was lower at 12–23 months. Interestingly, studies in HIC and urban areas showed a higher effect on continued breastfeeding compared to LMIC and rural areas. RCTs which controlled for confounding and adequate quality studies showed a more modest effect than the overall effect.

According to intervention delivery setting

Interventions delivered either in the health system settings or in home settings had a significant impact on continued breastfeeding. The study available on workplace interventions showed that paid maternal leave from work may result in significantly better continued breastfeeding practices at 10 months (RR 3.33, 95%CI 1.43–10.0). A study on policy environment showed that use of breast milk substitutes significantly hampered continued breastfeeding (OR 0.16, 95% CI 0.04–0.55). Interventions delivered concurrently in any combination of settings had a higher impact on the continued breastfeeding rates (RR 1.97, 95% CI 1.74–2.24).

According to nature of interventions

Counselling or education when given concurrently in any combination of settings significantly promoted continued breastfeeding rates (RR 1.97, 95% CI 1.74–2.24) and approached statistical significance when delivered in health systems alone (RR 1.15, 95% CI 0.99–1.35) (Table 5). The baby friendly hospital support had no significant effect on continued breastfeeding rates (RR 1.26, 95% CI 0.96; 1.64).

Any breastfeeding

Any breastfeeding rates were seen to improve by 30% as an effect of all interventions. Subgroup analysis showed greater improvements at <4 months (RR 1.38, 95% CI 1.28–1.50) as compared to 4–6 months (RR 1.23, 95% CI 1.13–1.35) (Table 4, Fig. 5). Similar improvements in any breastfeeding rates were noted in urban-rural or LMIC-HIC settings. Pooled results from RCTs, adequate quality studies and studies which controlled for confounding showed a more modest effect of the interventions on any breastfeeding rates. Meta-regression showed the effect of interventions in all subgroups to be significantly different from the overall effect.

According to intervention delivery setting

Highest improvements in any breastfeeding rates were seen when interventions were delivered in Health system settings (RR 1.40, 95% CI 1.30–1.52). Interventions delivered at the work environment or combination of settings showed a significant 30% increase in breastfeeding rates.

Among combinations of settings, interventions delivered concurrently at both health systems and home (21 estimates from 21 studies) significantly improved any breastfeeding rates by 23% (RR−1.23, 95%CI 1.08–1.40). The impact of interventions delivered at home along with community settings or health systems with community setting was not statistically significant.

According to nature of interventions

Baby Friendly Hospital Support interventions in health systems had the highest impact on promoting any breastfeeding (RR 1.66, 95% CI 1.34–2.07) (Table 5). Counselling or education given either in health systems (RR 1.47, 95% CI 1.29; 1.68) or in the home environment (RR 1.17, 95% CI 1.08–1.27) or in health systems together with home (RR 1.23, 95% CI 1.08; 1.40) had a significant effect on promoting any breastfeeding but this effect was most prominent when delivered in the health systems. Special

Table 2 Effect of interventions on exclusive breastfeeding

Subgroup analysis	No. of estimates	Pooled odds ratio and 95% confidence interval	I^2 (%)	Meta-regression p value
All interventions	130	1.44 (1.38–1.51)	91.0	
Intervention delivery setting				
Health systems and services	51	1.46 (1.37; 1.56)	94.7	0.482
Home and family environment	43	1.48 (1.32; 1.66)	22.0	
Community environment	6	1.20 (1.03; 1.39)	0.0	
Work environment	4	1.28 (0.98; 1.69)*	0.0	
Combination of settings	26	1.79 (1.45; 2.21)	78.9	
Health system + Home	16	1.63 (1.27; 2.10)	54.9	
Home + Community	3	1.42 (1.21; 1.66)	23.0	
Health system + Community	7	2.52 (1.39; 4.59)	92.6	
Age at outcome measurement				
<4 months	57	1.39 (1.31; 1.48)	93.7	0.806
4–6 months	73	1.59 (1.44; 1.75)	85.9	
Study size				
<500 participants	69	1.66 (1.50; 1.84)	68.2	0.548
500–1499 participants	39	1.51 (1.34; 1.70)	89.4	
≥1500 participants	22	1.30 (1.21; 1.40)	97.1	
Country type				
High income	73	1.35 (1.26; 1.43)	87.3	0.028
Lower mid income	57	1.69 (1.54; 1.86)	92.1	
Urban/Rural‡				
Urban	78	1.47 (1.36; 1.59)	80.0	0.948
Rural	20	2.04 (1.52; 2.76)	94.5	
Combined	8	1.51 (1.21; 1.88)	71.2	
Study design				
RCT	71	1.61 (1.46; 1.78)	83.3	0.009
Observational	20	1.34 (1.24; 1.46)	97.4	
Quasi experimental	39	1.46 (1.31; 1.63)	81.7	
Control for confounding				
Yes	73	1.36 (1.28; 1.46)	84.8	<0.001
No	57	1.61(1.48; 1.75)	92.7	
Quality of study†				
Adequate	45	1.43 (1.30; 1.59)	77.7	0.312
Inadequate	85	1.46 (1.38; 1.54)	93.1	
78.1% of the heterogeneity was explained by these 8 factors.				

*Not significant.
†Measured according to The Cochrane Collaboration's Tool for assessing Risk of bias.
‡Data for all studies were not available.

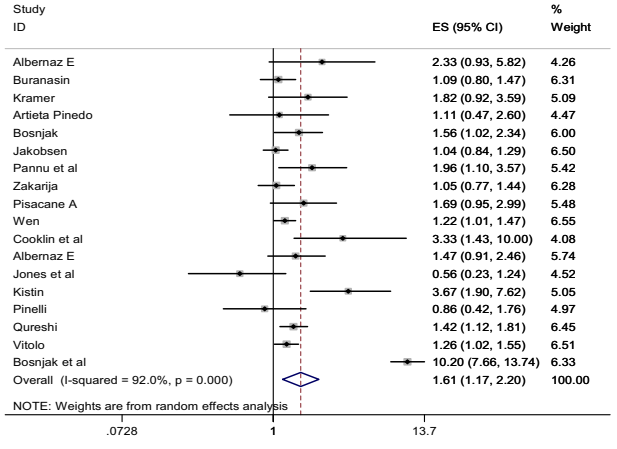

Figure 4 Effect of all interventions on continued breastfeeding.

training of health staff at the hospitals (RR 1.33, 95% CI 1.07–1.67) also increased any breastfeeding. Pooled results of two estimates suggested that non-working mothers were 1.49 times (95% CI 1.12–1.98) more likely to breastfeed compared to working mothers.

Family or social support did not have a significant impact on promoting any breastfeeding (RR 1.02, 95% CI 0.86–1.22).

DISCUSSION

The findings of the review indicate that for all three WHO/UNICEF recommended breastfeeding outcomes (1), interventions (particularly counselling or education) delivered concurrently in a combination of settings had a higher impact than when delivered independently in a single setting.

Table 3 Effect of interventions on continued breastfeeding

Subgroup analysis	No. of estimates	Pooled odds ratio and 95% confidence interval	I^2 (%)	Meta-regression p value
All interventions	18[§]	1.61 (1.17; 2.20)	92.0	
Intervention delivery setting				
Health systems and services	8	1.18 (1.03; 1.35)	32.8	0.219
Home and family environment	2	1.26 (1.05; 1.50)	10.8	
Community environment	–	–	–	
Work Environment	1	3.33 (1.43–10.0)	–	
Combination of settings	7	1.97 (1.74; 2.24)	96.4	
Health system + Home	6	1.34 (1.01; 1.81)	65.2	
Home + Community	–	–	–	
Health system + Community	1	10.2 (7.66; 13.74)	–	
Age at outcome measurement				
≤12 months	14	1.67 (1.51; 1.84)	93.2	0.327
12–23 months	4	1.19 (1.03; 1.37)	49.8	
Study size				
<500 participants	6	1.55 (1.29; 1.86)	56.6	0.312
500–1499 participants	7	1.16 (1.05; 1.29)	26.7	
≥1500 participants	5	2.37 (0.83; 6.80)*	96.7	
Country type				
High income	12	1.76 (1.04; 3.01)	94.0	0.368
Lower mid income	6	1.22 (1.09; 1.37)	25.7	
Urban/Rural[‡]				
Urban	8	1.53 (1.03; 2.27)	72.0	0.330
Rural	3	1.47 (1.19; 1.81)	0.0	
Combined	3	2.56 (0.57; 11.4)*	98.3	
Study design				
RCT	8	1.22 (1.10; 1.35)	33.5	0.140
Observational	6	2.32 (0.87; 6.14)*	96.0	
Quasi experimental	4	1.72 (1.04; 2.83)	74.8	
Control for confounding				
Yes	7	1.22 (1.08; 1.40)	84.8	0.115
No	11	1.67(1.03; 2.73)	94.6	
Quality of study[†]				
Adequate	7	1.18 (1.37; 1.61)	30.7	0.312
Inadequate	11	1.85 (1.10; 3.10)	94.3	
80.9% of the heterogeneity was explained by these 8 factors.				

*Not significant.
[†]Measured according to The Cochrane Collaboration's Tool for assessing Risk of bias.
[‡]Data for all studies were not available.
[§]1 study on policy not pooled as they reported OR (not shown in table).

For early initiation, counselling or educational interventions delivered at home and community were found to be the most powerful intervention (85% increase) and should receive the highest priority. Counselling when provided as a single intervention in the community environment was also effective but had a lower impact on breastfeeding initiation. Similar to the findings of Ingram et al. (209), counselling by health staff only at home had a non-significant effect on breastfeeding initiation. This suggests that in addition to educating the mother, increasing awareness in the whole community may be essential.

For promotion of exclusive breastfeeding, counselling or education in the health system and community is likely to be the most powerful (increase by 152%) among the examined interventions. The individual interventions i.e. counselling at health systems or community when examined separately had a significant but lower impact on exclusive breastfeeding rates, but the combination had a synergistic effect. This finding was similar to the review by Haroon S et al. (215) where combined facility and community based interventions resulted in greater improvements in breastfeeding rates. Similarly, interventions when delivered in both health systems and home settings had a greater impact on the exclusive breastfeeding rates compared to the effect achieved when delivered in individual settings alone. Although surprising, we observed that family or social support had no significant effect on promoting exclusive breastfeeding. From this finding, it seems that educating family or society regarding breastfeeding and providing support to the mother may be useful to create a better breastfeeding milieu.

Table 4 Effect of interventions on any breastfeeding

Subgroup analysis	No. of estimates	Pooled odds ratio and 95% confidence interval	I^2 (%)	Meta-regression p value
All interventions	118[§]	1.30 (1.23; 1.37)	92.1	
Intervention delivery setting				
Health systems and services	47	1.40 (1.30; 1.52)	94.7	0.361
Home and family environment	36	1.16 (1.07; 1.25)	63.5	
Community environment	–	–	–	
Work environment	4	1.31 (1.10; 1.56)	81.1	
Combination of settings	30	1.30 (1.06; 1.61)	93.6	
Health system + Home	21	1.23 (1.08;l 1.40)	56.5	
Home + Community	3	1.00 (0.89; 1.12)	32.7	
Health system + Community	6	1.74 (0.84; 3.39)	98.3	
Age at outcome measurement				
<4 months	57	1.38 (1.28; 1.50)	94.5	0.218
4–6 months	61	1.23 (1.13; 1.35)	87.2	
Study size				
<500 participants	65	1.34 (1.25; 1.44)	72.4	0.933
500–1499 participants	29	1.14 (1.06; 1.23)	63.2	
≥1500 participants	24	1.36 (1.20; 1.53)	98.0	
Country type				
High income	97	1.31 (1.23; 1.40)	94.0	0.418
Lower mid income	21	1.27 (1.13; 1.42)	87.2	
Urban/Rural[‡]				
Urban	83	1.30 (1.22; 1.39)	88.1	0.249
Rural	10	1.29 (1.08; 1.55)	66.0	
Combined	7	1.67 (0.93; 2.99)*	98.6	
Study design				
RCT	48	1.07 (1.04; 1.10)	34.6	0.105
Observational	32	1.59 (1.35; 1.88)	97.3	
Quasi experimental	38	1.34 (1.23; 1.45)	83.8	
Control for confounding				
Yes	74	1.18 (1.12; 1.24)	86.9	0.115
No	44	1.48 (1.28; 1.72)	93.9	
Quality of study[†]				
Adequate	61	1.21 (1.13; 1.30)	86.4	0.517
Inadequate	51	1.39 (1.26; 1.53)	94.0	
90.4% of the heterogeneity was explained by these 8 factors.				

*Not significant.
[†]Measured according to The Cochrane Collaboration's Tool for assessing Risk of bias.
[‡]Data for all studies were not available.
[§]Includes 1 more study on policy (not shown in table).

For improvement in rates of continued breastfeeding, educational interventions delivered at health systems along with home seemed to be the most effective (34% increase), and should be prioritized. The effect of counselling or education when given independently in these two settings was significant but lower compared to the combined effect in improving continued breastfeeding rates. Interventions delivered at home and family settings as well as in the community also showed a large impact on continued breastfeeding rates. It should also be noted that although the available evidence is limited, workplace interventions and policies to restrict use of breast milk substitutes may significantly increase continued breastfeeding (51,175).

We also examined the effect of interventions on any breastfeeding, although this practice falls short of recommended breastfeeding practices by WHO/UNICEF in the first 6 months of life. Baby friendly hospital support interventions delivered in health system settings were the most effective (66% increase) in improving any breastfeeding rates. The reason for a higher improvement in any breastfeeding rates in the health system settings alone compared to health system settings and home combined, may be due to the fact that many of the included studies in the former group have assessed any breastfeeding rates very early i.e. at hospital discharge. Our subgroup analysis also shows that effect of interventions on any breastfeeding is greater at earlier ages.

All breastfeeding outcomes were seen to improve significantly as a result of the interventions but the level of effect was modified by subgroup factors. Larger studies showed a lower effect of interventions on breastfeeding initiation and exclusive breastfeeding rates. Studies done in LMIC or rural

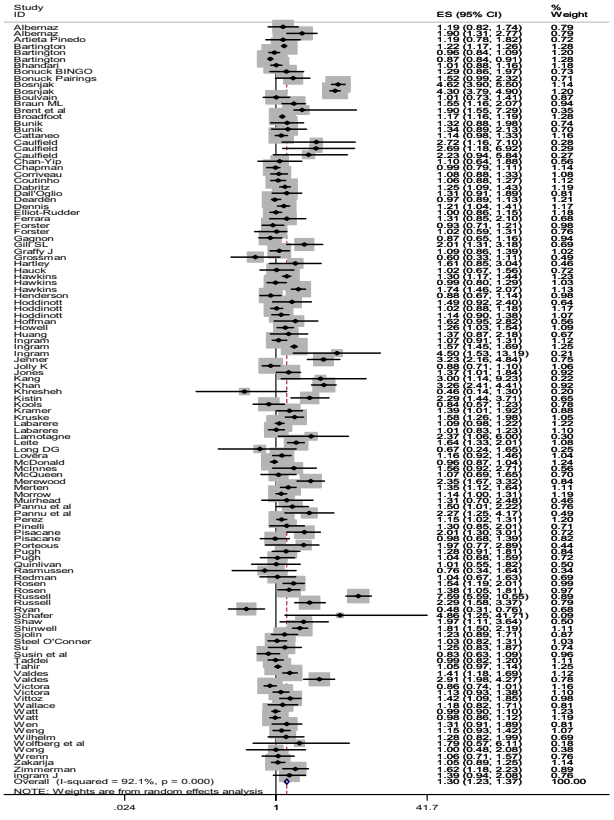

Figure 5 Effect of all interventions on any breastfeeding

areas showed a higher effect of interventions on early initiation and exclusive breastfeeding rates than in HIC or urban areas. This could be because there are more gaps in mothers' knowledge about breastfeeding in the less developed regions because of poorly developed health systems and low education levels as compared to developed countries and therefore these mothers are likely to benefit more from any educational intervention. Breastfeeding is also a socially acceptable norm in less developed regions which may make these mothers more amenable to breastfeed their child post counselling. In developed regions the increases in breastfeeding rates were less, perhaps due to the easy availability of formula and other factors that hinder breastfeeding such as work constraints. Educational interventions seemed to have a lower effect on continued breastfeeding rates in LMIC or rural areas as the average duration of breastfeeding is usually longer in these settings than in urban areas.

Study design was also an important effect modifier. RCTs showed a higher effect of interventions on early initiation and exclusive breastfeeding rates but a lower effect on continued and any breastfeeding rates. Studies of adequate quality or studies which controlled for potential confounders uniformly showed, when pooled, a more modest effect of interventions on all breastfeeding outcomes.

Previous systematic reviews showed that interventions can improve breastfeeding rates (215,216). Some reviews examined the individual effects of specific breastfeeding promotion interventions, others examined the effect of interventions in a particular setting (213,214). Some reviewed the effect of interventions on specific breastfeeding outcomes like exclusive breastfeeding (216) and early initiation (219). In the most recent review, Haroon S et al. (215) included 110 studies to examine the combined effect of interventions on exclusive breastfeeding, predominant breastfeeding, partial breastfeeding and no breastfeeding. An increase of 90% was noted in exclusive breastfeeding as a result of breastfeeding promotion interventions in a 1–5 month period. The proportion not breastfeeding at all was significantly reduced but the effect of interventions on predominant and partial breastfeeding was not significant. However, comprehensive evidence on how and where the proven interventions should be delivered to improve breastfeeding practices was lacking. We did a unique setting-wise analysis which showed how and to what extent interventions delivered in different settings affected breastfeeding rates. Thus, based on the evidence, we identified the most effective interventions in each setting that can be prioritized for scaling up to improve the WHO/UNICEF recommended breastfeeding indicators.

Limitations

Our review had some important limitations. There were only a few studies in the categories of work environment or policy environment for which a quantitative measure was available and therefore the pooled estimate for these groups may not represent the true effect. For some categories e.g. interventions in community environment to promote continued or any breastfeeding, we did not find any studies. There were insufficient studies examining the effect of mass media or social media so these were obviously grouped with community environment which may have masked their effect as an independent intervention that could possibly have a large impact. Though we included breastfeeding intervention studies among premature babies and in NICU, we have not done any subgroup analysis for these groups. We have converted studies which provided only OR to RR (from the data provided in study) and have pooled hazard ratios, unadjusted and adjusted RRs together to get the pooled estimate. As it was not possible to get adjusted estimates for all studies, we judged that this was the best approach to still get a single pooled estimate closest to true effect, instead of excluding the study.

Apart from methodological heterogeneity due to difference in study designs, heterogeneity was also observed due to the variations in the nature of interventions and their duration, different health personnel delivering the interventions, periodicity of the interventions, differences in study population (income, place of residence i.e. rural or urban, socioeconomic status and education), outcome definitions (full breastfeeding interpreted as exclusive breastfeeding but possibly including predominant breastfeeding in some cases) and different time intervals for follow-up. There was also variability in the recall period of infant feeding practices by mothers. Exclusive breastfeeding data were sometimes collected from birth whereas in most

Table 5 Effect of nature of interventions on breastfeeding outcomes according to settings

	Early Initiation of BF		Exclusive BF		Continued BF		Any BF	
Nature of Interventions	No. of estimates	RR (95% CI)	No. of estimates	RR (95% CI)	No. of estimates	RR (95% CI)	No. of estimates	RR (95% CI)
1. Health systems and services								
Baby friendly support	10	1.20 (1.11; 1.28)	15	1.49 (1.33; 1.68)	3	1.26 (0.96; 1.64)	13	1.66 (1.34; 2.07)
Counseling or education	10	1.12 (1.05; 1.19)	28	1.66 (1.43; 1.92)	5	1.15 (0.99; 1.35)	24	1.47 (1.29; 1.68)
Special training of health staff	3	1.09 (1.01; 1.18)	5	1.36 (1.14; 1.63)	–		5	1.33 (1.07; 1.67)
2. Home and family environment								
Counseling or Education	5	1.74 (0.97; 3.12)	38	1.58 (1.39; 1.80)	1	1.22 (1.01; 1.47)	33	1.17 (1.08; 1.27)
Family or Social Support	–	–	5	0.95 (0.87; 1.02)	1	1.69 (0.95; 2.99)	3	1.02 (0.86; 1.22)
3. Community environment								
Group counseling or education	4	1.65 (1.38; 1.97)	1	1.61 (0.95; 2.71)	–		–	
Integrated mass media, counseling and community mobilization approach	1	5.33 (2.33;12.19)	5	1.17 (1.01; 1.36)	–		–	
4. Work environment								
Maternal leave policy	–		2	1.52 (1.03; 2.23)	–		1	0.99 (0.80; 1.29)
Workplace support	–		2	1.08 (0.74; 1.60)	–		1	1.25 (1.09; 1.43)
Employment status	–		–		1	3.33 (1.43; 10.0)	2	1.49 (1.12; 1.98)
5. Policy environment								
WIC federal program (US)	–		–	–	–	–	1	0.48(0.31; 0.76)
Breast milk substitutes	–		–	–	–	–	–	

*Studies for which RR could not be calculated are not mentioned.

studies it was defined ascertaining feeding practices in the last 24 hours. In case of significant heterogeneity we have done post-hoc subgroup analysis and meta-regression and have used the random effects model. But even within the subgroups there was significant heterogeneity which suggests some unidentified factors. Although the meta-regression seemed to explain around 80% of the heterogeneity for all the breastfeeding outcomes, we need to acknowledge the limitation of post-hoc subgroup analysis.

CONCLUSION

The systematic review findings support the validity of complex adaptive systems driven models such as the 'Breastfeeding Gear Model' (220) that calls for the engagement of multiple sectors and actors as part of a well synchronized engine to protect, promote and support optimal breastfeeding practices globally. From the findings, it can be inferred that to promote breastfeeding optimally in an expectant or nursing mother, support should be provided throughout the continuum in multiple settings i.e. by increasing community awareness regarding breastfeeding, followed by hospital or health system support through the BFHI approach and home and family support through counselling. Counselling by peers or health personnel, baby friendly hospital support and community mobilization approach are the key interventions to promote optimal breastfeeding practices. We thus recommend a multidimensional approach to strengthen breastfeeding interventions.

This review has identified a set of interventions that can improve breastfeeding practices. A strong political will is required for investing in their full implementation and scaling-up. Advocacy and championship by health ministries at national and sub-national level are required together with ongoing monitoring and evaluation in order to meet the global target of the Comprehensive implementation plan for maternal, infant and young child nutrition, to increase exclusive breastfeeding in the first 6 months of life by at least 50% by the year 2025.

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CONFLICT OF INTEREST

None of the authors has any conflict of interest.

DISCLAIMER

The authors alone are responsible for the views expressed in this article and they do not necessarily represent the views, decisions or policies of the institutions with which they are affiliated.

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Appendix 1 Summary of studies included in early initiation of breastfeeding

	Estimates	Studies	Ref. No.	Design		Country		Quality	
Health systems and services (1)									
Overall	29	23	12, 15, 23, 28, 33, 44, 47, 56, 57, 72, 78, 92, 123, 131, 141, 145, 148, 149, 161, 189, 190, 193, 198	RCT Obs Quas	4 10 15	HIC LMIC	22 7	AQ IQ	17 12
Home and family environment (2)									
Overall	5	5	14, 47, 79, 156, 171	RCT Obs Quasi	3 1 1	HIC LMIC	4 1	AQ IQ	2 3
Community environment (3)									
Overall	5	4	25, 58, 157, 162	RCT Obs Quasi	0 0 5	HIC LMIC	 5	AQ IQ	0 5
Work environment (4)									
No studies									
Policy environment (5)									
No studies									
Combination of Setting (6)									
Setting 1+2	6	6	40, 47, 110, 139, 197, 205	RCT Obs Quasi	2 2 2	HIC LMIC	5 1	AQ IQ	5 1
Setting 2+3	3	3	31, 60, 67	RCT Obs Quasi	2 1	HIC LMIC	0 3	AQ IQ	2 1
Setting 1+3	1	1	30	RCT Obs Quasi	1 0 0	HIC LMIC	 1	AQ IQ	1 0

RR, relative risk; 95% CI, 95% confidence interval; RCT, randomized controlled trial; Obs., observational study; Quas, quasiexperimental design; HIC, high income country; LIC, low income country; AQ, adequate quality; IQ, inadequate quality.

Appendix 2 Summary of studies included for exclusive breastfeeding

	Estimates	Studies	Reference Nos.	Design		Country		Quality	
Health systems and services (1)									
Overall	51	46	16, 12, 15, 27, 33,34, 44, 46, 52, 63, 64, 78, 80, 89, 91, 93, 96, 106, 108, 110, 113, 117, 118, 119, 123, 124, 129, 131, 132, 136, 138, 140, 141, 143, 146, 148, 152, 177, 179, 180, 187, 189, 190, 196, 200, 204	RCT Obs Quas	18 16 17	HIC LMIC	30 21	AQ IQ	19 32
Home and family environment (2)									
Overall	43	36	14, 19, 21, 22, 29, 32, 45, 61, 65, 68, 71, 73, 75, 79, 86, 105, 107, 115, 125, 133, 134, 135, 140, 142, 151, 158, 159, 165, 166, 167, 173, 174, 178, 181, 185, 203	RCT Obs Quas	31 0 12	HIC LMIC	24 19	AQ IQ	16 26
Community environment (3)									
Overall	6	3	25, 157, 184	RCT Obs Quas	0 0 6	HIC LMIC	1 5	AQ IQ	0 6
Work environment (4)									
Overall	4	1	26	RCT Obs Quas	0 0 4	HIC LMIC	4 0	AQ IQ	0 4
Policy environment (5)									
No studies									

Appendix 2 (Continued)

	Estimates	Studies	Reference Nos.	Design		Country		Quality	
Combination of setting (6)									
Setting 1+2	16	14	13, 17, 18, 53, 69, 86, 98,102, 103, 127, 128, 131, 147, 153	RCT	13	HIC	10	AQ	5
				Obs	0	LMIC	6	IQ	11
				Quas	3				0
Setting 2+3	3	3	31, 60, 67	RCT	2	HIC	0	AQ	2
				Obs	0	LMIC	3	IQ	1
				Quas	1				
Setting 1+3	7	7	30, 94, 109, 154, 170, 183, 192	RCT	4	HIC	4	AQ	2
				Obs	0	LMIC	3	IQ	5
				Quas	3				

RR, relative risk; 95% CI, 95% confidence interval; RCT, randomized controlled trial; Obs., observational study; Quas, quasiexperimental design; HIC, high income country; LIC, low income country; AQ, adequate quality; IQ, inadequate quality.

Appendix 3 Summary of studies included in continued breastfeeding

	Estimates	Studies	Ref. No.	Design		Country		Quality	
Health systems and services (1)									
Overall	8	8	16, 23, 35, 44, 96, 106, 144, 204	RCT	2	HIC	5	AQ	4
				Obs	4	LMIC	3	IQ	4
				Quasi	2				
Home and family environment (2)									
Overall	2	2	151, 199	RCT	2	HIC	2	AQ	2
				Obs	0	LMIC	0	IQ	0
				Quasi	0				
Community environment (3)									
No studies									
Work environment (4)									
Overall	1	1	51	RCT	0	HIC	1	AQ	0
				Obs	1	LMIC	0	IQ	1
				Quasi	0				
Policy environment (5)									
Overall	1	1	175	Obs	1	LMIC	1	IQ	1
Combination of setting (6)									
Setting 1+2	6	6	17, 99, 103, 150, 158, 192	RCT	4	HIC	3	AQ	5
				Obs	0	LMIC	3	IQ	1
				Quasi	2				
Setting 2+3	No studies								
Setting 1+3	1	1	35	RCT	0	HIC	1	AQ	0
				Obs	1	LMIC	0	IQ	1
				Quasi	0				

RR, relative risk; 95% CI, 95% confidence interval; RCT, randomized controlled trial; Obs., observational study; Quas, quasiexperimental design; HIC, high income country; LIC, low income country; AQ, adequate quality; IQ, inadequate quality.

Appendix 4 Summary of studies included in any breastfeeding

	Estimates	Studies	Ref. No.	Design		Country		Quality	
Health systems and services (1)									
Overall	47	39	23, 28, 33, 35, 37, 38, 39, 46, 47, 52, 56, 64, 85, 91, 93, 101, 106, 108, 110, 112, 131, 132, 144, 146, 151, 161, 163, 172, 177, 180, 186, 187, 191, 196, 198, 200, 201, 204	RCT Obs Quas	11 20 16	HIC LMIC	36 11	AQ IQ	30 17
Home and family environment (2)									
Overall	36	34	41, 43, 47, 49, 54, 61, 68, 71, 74, 83, 87, 86, 95, 97, 100, 105, 115, 121, 125, 134, 135, 151, 156, 159, 165, 168, 171, 174, 176, 178, 181, 199, 202, 203	RCT Obs Quas	22 5 9	HIC LMIC	30 6	AQ IQ	19 17
Community environment (3)									
Overall	No studies								
Work environment (4)									
Overall	4	2	55, 84	RCT Obs Quas	0 4 0	HIC LMIC	4 0	AQ IQ	0 4
Policy environment (5)									
Overall	1	1	164	Obs	1	HIC LMIC	1 0	AQ IQ	0 1
Combination of setting (6)									
Setting 1+2	21	21	17, 18, 36, 46, 66, 78, 81, 90, 98, 99, 102, 103, 111, 120, 128, 150, 153, 154, 155, 160, 205	RCT Obs Quas	13 1 7	HIC LMIC	19 2	AQ IQ	8 13
Setting 2+3	3	3	48, 60, 126	RCT Obs Quas	0 1 2	HIC LMIC	1 2	AQ IQ	0 3
Setting 1+3	6	5	30, 35, 75, 88, 94	RCT Obs Quas	2 1 3	HIC LMIC	5 1	AQ IQ	4 2

RR, relative risk; 95% CI, 95% confidence interval; RCT, randomized controlled trial; Obs., observational study; Quas, quasiexperimental design; HIC, high income country; LIC, Low income country; AQ, adequate quality; IQ, inadequate quality.

Appendix 5 Studies for which RR could not be calculated

Author Name	Year	Ref. No.
Agrasada	2005	11
Anderson	1984	20
Baghurst	2007	24
Bonuck	2005	34
Chapman	2011	50
Lavender	2005	114
Lucchini	2013	122
Merewood	2006	130
Ryan	2006	164
Tarrant	2011	182